

SAFETY DATA SHEET

(according to Regulation (EC) No 1907/2006 (REACH), ANNEX II)

CAPROLACTAM

Revision date: 01.05.2020 Version 4.2

SECTION 1: IDENTIFICATION OF THE SUBSTANCE AND OF THE COMPANY

1.1 Product identifier

Trade name:	ε-Caprolactam
Other names:	2H-Azepin-2-one, hexahydro-
Name IUPAC/ international chemical name	Azepan-2-one
INDEX No. and name as listed in Annex VI of CLP:	613-069-00-2, ε-Caprolactam
CAS No.:	105-60-2
EINECS No.:	203-313-2
REACH registration No.:	01-2119457029-36-0012
Molecular formula:	C ₆ H ₁₁ NO

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

Relevant identified uses:	<p>Manufacture/import of caprolactam (see ES 1) Distribution of caprolactam (see ES 2) Industrial formulation of solid preparations (see ES 3) Formulation of liquid preparations (industrial/professional) (see ES 4) Use as intermediate (see ES 5) Use as monomer for polyamide, polymers, thermoplastics (see ES 6) Use as monomer for resins (see ES 7) Use as monomer for thermo hardened resins (see ES 8) Use as plasticizer for polyamide (see ES 9) Use in leather tanning, finishing, impregnation, coatings and paints (see ES 10) Use as laboratory chemical (see ES 11) Use in coatings/paints (consumer) (see ES 12)</p>
Uses advised against:	None

1.3 Details of the supplier of the safety data sheet

Only Representative:	<p>OSTCHEM GERMANY GmbH Erdmannstr. 10 222765 Hamburg, Germany Phone: +49 40 5300 300 Fax: +49 40 5300 30 33 www.ostchem.com E-mail: Irene.Nasdala@ebicon.de</p>
Manufacturer:	<p>PrJSC "AZOT" 72, Heroiv Kholodnoho Yaru Str., Cherkasy, Ukraine Tel.: +38 0472 39-63-03 +38 0472 39-23-33 URL website: http://www.azot.ck.ua Email: let@azot.ck.ua sale@azot.ck.ua</p>
E-mail address of the person responsible for this Safety Data Sheet	<p>PrJSC "AZOT" REACH Department onr@azot.ck.ua</p>
National contact:	Not available

1.4 Emergency telephone number

Emergency phone number:	<p>Tel: + 49 405 300 300 Opening hours: 9-18 (CET) Languages of the phone service: German, English, Russian Tel: + 38 (0472) 39 61 17 Opening hours: 0-24 Languages of the phone service: Russian, Ukrainian</p>
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SECTION 2: HAZARDS IDENTIFICATION

2.1 Classification of the substance

2.1.1 Classification in accordance with Regulation 1272/2008 (CLP)


Hazard statement(s):	<p>H302 H332 H315 H319 H335</p>	<p>Harmful if swallowed. Harmful if inhaled. Causes skin irritation. Causes serious eye irritation. May cause respiratory irritation</p>
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2.2 Label elements		
2.2.1 Labelling in accordance with Regulation (EC) No 1272/2008 [CLP]		
Hazard pictogram(s):		
Signal word:	Warning	
Hazard statement(s):	H302 Harmful if swallowed H332 Harmful if inhaled H315 Causes skin irritation H319 Causes serious eye irritation H335 May cause respiratory irritation	Oral: Acute Tox. 4 Inhal: Acute Tox. 4 Skin Irrit. 2 Eye Irrit. 2 STOT Single Exp. 3
Precautionary Statements (Prevention):	P271 Use only outdoors or in a well-ventilated area. P280 Wear protective gloves, eye and face protection. P261 Avoid breathing dust, fume, gas, mist, vapours, spray.	
Precautionary Statements (Response):	P301+P312 If swallowed: Call a POISON CENTER or doctor if you feel unwell. P305 + P351 + P338 IF IN EYES: Rinse cautiously with water for several minutes. Remove contact lenses, if present and easy to do. Continue rinsing. P304 + P340 IF INHALED: Remove person to fresh air and keep comfortable for breathing. P302 + P352 IF ON SKIN: Wash with plenty of soap and water.	
Precautionary Statements (Storage):	P403 + P233 Store in a well-ventilated place. Keep container tightly closed.	
Other hazards (GHS):	No specific dangers known, if the regulations/notes for storage and handling are considered. Assessment PBT / vPvB: According to Annex XIII of Regulation (EC) No.1907/2006 concerning the Registration, Evaluation, Authorisation and Restriction of Chemicals (REACH): - Not fulfilling PBT (persistent/bioaccumulative/toxic) criteria; - Not fulfilling vPvB (very persistent/very bioaccumulative) criteria.	
SECTION 3: COMPOSITION/INFORMATION ON INGREDIENTS		
3.1 Substances		
Name	INDEX No. as listed in Annex VI of CLP	Weight % content (or range)
ε-Caprolactam	613-069-00-2	>99.0 % (w/w)
SECTION 4: FIRST-AID MEASURES		
4.1 Description of first aid measures		
General notes:	Immediately remove contaminated clothing. Avoid contact with the skin, eyes and clothing.	
Following eye contact:	Immediately wash affected eyes for at least 15 minutes under running water with eyelids held open, consult an eye specialist.	
Following skin contact:	Wash thoroughly with soap and water. Burns caused by molten material require hospital treatment.	
Following ingestion:	Rinse mouth immediately and then drink plenty of water, seek medical attention.	
Following inhalation:	Keep victim calm, remove to fresh air, seek medical attention.	
Self-protection for the first aider:	None	
4.2 Most important symptoms and effects, both acute and delayed		
Acute effects/Delayed effects	Symptoms: The most important known symptoms and effects are described in the labeling (see section 2) and/or in section 11.	
4.3 Indication of any immediate medical attention and special treatment needed		
Treatment: Treat according to symptoms (decontamination, vital functions), no known specific antidote.		
SECTION 5: FIRE-FIGHTING MEASURES		
5.1 Extinguishing media		
Suitable extinguishing media:	Foam, carbon dioxide, water spray, water	
Not suitable extinguishing media:	None	
5.2 Special hazards arising from the substance or mixture		
Hydrogen cyanide, nitrogen and carbon oxides. The substances/groups of substances mentioned can be released in case of fire.		
5.3 Advice for firefighters		
Use isolating breathing apparatus. Collect contaminated extinguishing water separately, do not allow reaching sewage or effluent systems.		

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SECTION 6: ACCIDENTAL RELEASE MEASURES

6.1 Personal precautions, protective equipment and emergency procedures

6.1.1 For non-emergency personnel

Protective equipment: Use breathing apparatus if exposed to vapours/dust/aerosol. Wear personal protective equipment. Unprotected persons must be kept away. Approach the release from upwind.

Emergency procedures: Ensure adequate ventilation. Avoid contact with skin and eyes. Avoid generating dusty conditions. Do not touch or walk through spilt material. No flares, smoking or flames in hazard area. Wear appropriate respirator when ventilation is inadequate. No action shall be taken involving any personal risk or without suitable training. Evacuate surrounding areas.

6.1.2 For emergency responders:

Use breathing apparatus/wear personal protective equipment. See also the information in "For non-emergency personnel". Information regarding personal protective measures see, chapter 8.

6.2 Environmental precautions

Do not empty into drains. Retain and dispose of contaminated wash water.

6.3 Methods and material for containment and cleaning up

6.3.1 For containment:

Move containers from spill area. Prevent entry into sewers, water courses, basements or confined areas.

6.3.2 For cleaning up:

Allow to solidify and sweep/shovel up. Collect into clean, dry, properly labeled container, supplied with the cover. It is necessary to prevent dust emission. Use spark-proof tools and explosion-proof equipment.

6.3.3 Other information

For residues: Rinse away with water.

6.4 Reference to other sections

See section 8 for personal protective equipment and section 13 for waste disposal.

SECTION 7: HANDLING AND STORAGE

7.1 Precautions for safe handling

Protective measures: Keep in the original container or an approved alternative made from a compatible material, kept tightly closed when not in use.

Measures to prevent fire: Vapours may form explosive mixture with air. Take precautionary measures against static discharges. Dust can form an explosive mixture with air.

Measures to prevent aerosol and dust generation: Ensure thorough ventilation of stores and work areas.

Measures to protect the environment: Do not allow material to be released to the environment.

Advice on general occupational hygiene: Do not eat, drink or smoke in work areas. Remove contaminated clothing and protective equipment before entering eating areas. Wash hands, forearms and face thoroughly after handling chemical products, before eating, smoking and using the lavatory and at the end of the working period. Appropriate techniques should be used to remove potentially contaminated clothing. Wash contaminated clothing before reusing.

7.2 Conditions for safe storage, including any incompatibilities

Technical measures/ Storage conditions:	Segregate from acids and bases. Segregate from oxidants. <i>Further information on storage conditions:</i> Keep crystallized caprolactam in dry storage room, equipped with proper ventilation system. <i>Storage stability:</i> Storage temperature: at ambient temperature (crystallized). The stated storage temperature should be noted.
Packing materials:	Stainless steel 1.4301 (V2), aluminum, Stainless steel 1.4401 and other suitable materials.
Requirements for storage rooms and vessels: Storage class:	13
Further information on storage conditions:	None
Incompatible products:	Strong oxidizing agents, alkali and mineral acids.
7.3 Specific end use(s):	None

SECTION 8: EXPOSURE CONTROLS / PERSONAL PROTECTION

The information in this section contains generic advice and guidance. The list of Identified Uses in Section 1 should be consulted for any available use-specific information provided in the Exposure Scenario(s).

8.1 Control parameters

8.1.1 National occupational exposure limit values: Not available

8.1.2 National biological limit values: Not available

8.1.3 PNEC (Predicted No Effect Concentration)

<u>Environmental protection target</u>	<u>PNEC</u>
Aqua – freshwater	2 mg/L
Aqua - marine water	0.2 mg/L
Aqua – intermittent releases	1 mg/L

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Sediment	18.7 mg/kg sediment dw																												
Soil	2.55 mg/kg soil dw																												
Sewage treatment plant	1737 mg/L																												
Food chain: oral (secondary poisoning)	Due to its low logPow of 0.12, secondary poisoning is of no concern for this substance.																												
Air	Not listed in Annex I of Regulation (EC) 2037/2000 on substances that deplete the ozone layer.																												
8.1.4 DNEL:	<p style="text-align: center;">ACUTE (Local effects)</p> <table border="1"> <thead> <tr> <th rowspan="2">Route</th> <th colspan="2">Derived No Effect Level (DNEL)</th> </tr> <tr> <th>Workers</th> <th>General population</th> </tr> </thead> <tbody> <tr> <td>Oral</td> <td>Not quantifiable*</td> <td>Not quantifiable*</td> </tr> <tr> <td>Dermal</td> <td>Not quantifiable*</td> <td>Not quantifiable*</td> </tr> <tr> <td>Inhalation</td> <td>10 mg/m³</td> <td>5 mg/m³</td> </tr> </tbody> </table> <p style="text-align: center;">LONG TERM (Local effects)</p> <table border="1"> <thead> <tr> <th rowspan="2">Route</th> <th colspan="2">Derived No Effect Level (DNEL)</th> </tr> <tr> <th>Workers</th> <th>General population</th> </tr> </thead> <tbody> <tr> <td>Oral</td> <td>Not quantifiable*</td> <td>Not quantifiable*</td> </tr> <tr> <td>Dermal</td> <td>Not quantifiable*</td> <td>Not quantifiable*</td> </tr> <tr> <td>Inhalation</td> <td>5 mg/m³</td> <td>2.5 mg/m³</td> </tr> </tbody> </table> <p>* <ul style="list-style-type: none"> • Dermal exposure: Skin and eye irritation is the leading acute effect and no signs of systemic toxicity were observed at the acute limit dose of 2000 mg/kg bw. Therefore the derivation of DNELs for dermal exposure is misleading. In this context, protection from irritation is protecting from any kind of potential systemic toxicity on the dermal route of exposure. • Oral exposure: In an industrial setting, ingestion is not an anticipated route of exposure. The general population may, in the worst case, be exposed to traces of caprolactam only. • Systemic effects – inhalation exposure: Both OEL-values (MAK and TLV) were based on transient signs of respiratory tract irritation observed in humans. Following single or repeated inhalation exposure(s) to irritating concentrations of caprolactam, neither from human experience nor in animal studies, signs of systemic toxicity were reported. Inhalative uptake of even higher concentrations is limited by the irritant potential of caprolactam to the eyes and the respiratory tract. </p>	Route	Derived No Effect Level (DNEL)		Workers	General population	Oral	Not quantifiable*	Not quantifiable*	Dermal	Not quantifiable*	Not quantifiable*	Inhalation	10 mg/m ³	5 mg/m ³	Route	Derived No Effect Level (DNEL)		Workers	General population	Oral	Not quantifiable*	Not quantifiable*	Dermal	Not quantifiable*	Not quantifiable*	Inhalation	5 mg/m ³	2.5 mg/m ³
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Dermal	Not quantifiable*	Not quantifiable*																											
Inhalation	5 mg/m ³	2.5 mg/m ³																											
8.1.5 Monitoring procedures:	Not available																												

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8.2 Exposure controls	
8.2.1 Appropriate engineering controls:	
Substance/mixture related measures to prevent exposure during identified uses: None required.	
Technical measures to prevent exposure: Use of adequate ventilation and the high integrity of closed systems is good industrial practice.	
8.2.2 Personal protection equipment	
8.2.2.1 Eye and face protection:	Use suitable protective equipment
8.2.2.2 Skin protection: Hand protection: Other skin protection:	Use suitable protective equipment Working clothes
8.2.2.3 Respiratory protection:	Use suitable protective equipment
8.2.2.4 Thermal hazards:	None.
8.2.3 Environmental exposure controls:	Dispose of rinse water in accordance with local and national regulations.
SECTION 9: PHYSICAL AND CHEMICAL PROPERTIES	
9.1 Information on basic physical and chemical properties	
Appearance:	Organic solid, white
Odour:	Slight
Odour threshold:	Not available
pH	7 - 8,5 (333 g/l, 20 °C) (solid)
Melting point/Freezing point:	69,3°C (solid)
Initial boiling point and boiling range:	270.8°C at 1013.25 hPa (solid)
Flash-point:	Not relevant. The substance is a solid at 20° C and 1013 hPa.
Evaporation rate:	Not available
Flammability (solid, gas):	Non-flammable
Auto-ignition temperature	395°C at 1013 mbar (solid)
Upper/lower flammability or explosive limits	Not applicable
Oxidising properties	None
Vapour pressure:	0.0013 hPa at 20°C. (solid)
Vapour density:	Not available
Relative density:	1,105 g/cm ³ at 20°C (solid)
Solubility in water:	866,89 g/l at 22°C (solid)
Partition coefficient n-octanol/water:	0,12 at 25°C (solid)
Viscosity:	Study technically not feasible. Substance is a solid at 20°C and 1013 hPa.
Explosive properties	Non explosive. There are no chemical groups associated with explosive properties present in the molecule.
Decomposition temperature:	Not available
SECTION 10: STABILITY AND REACTIVITY	
10.1 Reactivity	
Stable under recommended storage and handling conditions (see section 7, handling and storage).	
10.2 Chemical stability	
Stable under recommended storage and handling conditions (see section 7, handling and storage).	
10.3 Possibility of hazardous reactions	
Reacts with oxidizing agents. Polymerization coupled with heat formation.	
10.4 Conditions to avoid	
Temperature: > 100 °C Avoid all sources of ignition: heat, sparks, open flame. Avoid formation of polymers in valves and pipes.	
10.5 Incompatible materials	
Oxidizing agents, alkali and mineral acids.	
10.6 Hazardous decomposition products	
Nitrogen and carbon oxides, hexane Under normal conditions of storage and use, hazardous decomposition products should not be produced.	

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SECTION 11: TOXICOLOGICAL INFORMATION**11.1 Information on toxicological effects**

11.1.1 Acute toxicity

<u>Route of exposure</u>	<u>Species</u>	<u>Method</u>	<u>Effective dose</u>	<u>Exposure time</u>	<u>Results</u>
oral	rat (Wistar) male/female	oral: gavage EU Method B.1 (Acute Toxicity (Oral)) (Cited as Directive 84/449/EEC, B.1)	–	–	LD ₅₀ : 1475 mg/kg bw (male) 1876 mg/kg bw (female)
dermal	rat (Wistar) male/female	Coverage: occlusive 84/449/EWG (Official Journal of EU, Nr. L251 from 19.09.1984, p 103)	–	–	LD ₅₀ : >2000 mg/kg bw
inhalation	rat (Wistar) male/female	inhalation: aerosol (nose/head only) equivalent or similar to OECD Guideline 403 (Acute Inhalation Toxicity)	–	4 h	LC ₅₀ : 8.16 mg/l
11.1.2 Skin corrosion/irritation:		Irritating			
11.1.3 Serious eye damage/irritation:		Irritating			
11.1.4 Respiratory or skin sensitisation:		Not sensitizing			
11.1.5 Germ cell mutagenicity:		Negative			
11.1.6 Genetic toxicity:		No indication for a genotoxic potential was found in vitro and in vivo			
11.1.7 Reproductive toxicity:		No indications of reproductive toxicity were identified in a 3-gen study in rats and no developmental toxicity was identified in developmental toxicity studies in rats and rabbits. Therefore no classification for toxicity to reproduction is warranted			
11.1.8 Carcinogenicity:		No indication for a carcinogenic potential was identified in carcinogenicity studies in rodents			
11.1.9 STOT-single exposure:		3 (Hazard statement: H335: May cause respiratory irritation.)			
11.1.10 STOT-repeated exposure:		Not available			
11.1.11 Aspiration hazard		Negative			

SECTION 12: ECOLOGICAL INFORMATION**12.1 Toxicity**

Fish (freshwater, short-term):	LC50 (96h) >100 mg/l With high probability epsilon-Caprolactam is acutely not harmful to fish.
Fish (long-term):	Not applicable
Freshwater invertebrates (short-term):	EC50 (48h) >1000 mg/l With high probability epsilon-Caprolactam is acutely not harmful to aquatic invertebrates.
Freshwater invertebrates (long-term):	21d-NOEC of 100 mg/l With high probability, epsilon-Caprolactam doesn't reveal negative long-term effects to aquatic invertebrates.
Freshwater algae:	EC50 (72h) >1000 mg/l EC10/LC10 or NOEC - 1000 mg/l With high probability, epsilon-Caprolactam is acutely not harmful to aquatic organisms.
Terrestrial plants:	Not applicable, the substance is not supposed to be directly applied to soil
Soil macro-organisms:	Not applicable, the substance is not supposed to be directly applied to soil
Birds:	Not available

12.2 Persistence and degradability**Abiotic degradation:**

Phototransformation/photolysis Phototransformation in air: Phototransformation in water/soil:	Half-life in air: 1 d No information required under REACH legislation.
Biodegradation:	Readily biodegradable according to OECD criteria.
Hydrolysis:	Not considered to hydrolyze rapidly when released to water.

12.3 Bioaccumulative potential

There is no evidence that epsilon-Caprolactam bioaccumulates in organisms.

12.4 Mobility in soil

Known or predicted distribution to environmental compartments:	According to Mackay Level I modeling, epsilon-Caprolactam will distribute almost completely into water (100 %). Only very small amounts will partition to sediment (0.01 %) and soil (0.01 %).
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Adsorption coefficient:	Koc at 20°C: 57.35
Surface tension:	Based on chemical structure, no surface activity is to be expected.
12.5 Results of PBT and vPvB assessment	
The substance is neither a PBT nor a vPvB substance.	
12.6 Other adverse effects: None	
12.7 Additional information:	
Chemical oxygen demand (COD): 1,960 mg/g Biochemical oxygen demand (BOD): 1,110 mg/g Other ecotoxicological advice: Do not release untreated into natural waters.	
SECTION 13: DISPOSAL CONSIDERATIONS	
13.1 Waste treatment methods:	
13.1.1 Product / Packaging disposal:	Must not be disposed of together with household garbage.
Waste codes / waste designations according to LoW (Commission Decision 2001/118/EC):	07 01 99 Wastes not otherwise specified
13.1.2 Waste treatment-relevant information:	–
13.1.3 Sewage disposal-relevant information:	Do not allow product to reach sewage system.
13.1.4 Other disposal recommendations:	Disposal must be made according to official regulations.
SECTION 14: TRANSPORT INFORMATION	
Land transport	
ADR RID	Not classified as a dangerous good under transport regulations Not classified as a dangerous good under transport regulations
Inland waterway transport	ADNR
	Not classified as a dangerous good under transport regulations
Sea transport	IMDG
	Not classified as a dangerous good under transport regulations
Air transport	IATA/ICAO
	Not classified as a dangerous good under transport regulations
14.1 UN Number:	Not regulated
14.2 UN proper shipping name:	Not regulated
14.3 Transport hazard classes:	Not regulated
14.4 Packaging group:	Not regulated
14.5 Environmental hazards:	No
14.6 Special precautions for user:	None
14.7 Transport in bulk according to Annex II of MARPOL 73/78 and the IBC Code	Not regulated
SECTION 15: REGULATORY INFORMATION	
15.1 Safety, health and environmental regulation/legislation specific for the substance	
EU Regulations	
Authorisations and/or restrictions on use:	
Authorisation: EU Regulation (EC) No. 1907/2006 (REACH) Annex XIV - List of substances subject to authorisation Substances of very high concern	None of the components are listed
Restrictions on use: Annex XVII - Restrictions on the manufacture, placing on the market and use of certain dangerous substances, mixtures and articles	Not applicable
National regulations (country):	Not available
15.2 Chemical safety assessment:	In accordance with REACH Article 14, a Chemical Safety Assessment has been carried out for this substance.

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SECTION 16: OTHER INFORMATION

The information provided in this safety data sheet is correct to the best of our knowledge, information, and belief at the date of its publication. The information given is designed only as guidance for safe handling, use, processing, storage, transportation, disposal, and release and is not to be considered a warranty or quality specification. The information relates only to the specific material designated and may not be valid for such material used in combination with any other materials or in any proceed, unless specified in the text.

16.1 Indication of changes:	v. 3.0: Changes were made to comply with the Guidance on the compilation of safety data sheets (version 1.1) v. 3.1: Changes were made to comply with Article 61 (CLP) v. 4.0: Changes were made taking into account 5 th and 8 th ATP to CLP
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v. 3.0: Page header; 1.1; 1.2; 1.3; 1.4; 2.1; 3.1; 4.1; 5.1; 6.1; 6.3; 7.1; 7.2; 7.3; 8.1; 8.2; 9.1; 11.1; 12.2; 12.4; 13.1; 15.1
 v. 3.1: Page header; 2.1.2; 2.2.2; 16.2
 v. 4.0: Page header; 1.3; 2.2.1
 v. 4.1: Page header; 1.3
 v. 4.2: Page header; 1.3

16.2 Abbreviations and acronyms:

- ADN - European Agreement concerning the International Carriage of Dangerous Goods on Inland Waterway
- ADNR - ADN Rhine
- ADR - Agreement on Dangerous Goods by Road
- CAS - Chemical Abstracts Service
- CLP - Classification, Labelling and Packaging of chemicals
- EC - European Commission
- EEC - European Economic Community
- EINECS - European Inventory of Existing Commercial Chemical Substances
- ES - Exposure Scenario
- GHS - Globally Harmonized System of Classification and Labelling of Chemicals
- IBC Code - International Code for the Construction and Equipment of Ships Carrying Dangerous Chemicals in Bulk
- IUPAC - International Union of Pure and Applied Chemistry
- LC50 - Lethal Concentration
- LD50 - Lethal Dose
- LoW - List of Wastes
- MARPOL - International Convention for the Prevention of Pollution From Ships
- NOEC - No Observed Effect Concentration
- OECD - Organization for Economic Co-operation and Development
- PBT - Persistent, bioaccumulative, toxic chemical
- PJSC - Public Joint-Stock Company
- REACH - Registration, Evaluation, Authorisation and Restriction of Chemicals
- STOT - Specific Target Organ Toxicity
- UN - United Nations
- vPvB - very persistent, very bioaccumulative

16.3 Key literature references and sources for data: CSR (Chemical Safety Report), Guidance on safe use etc.

16.4 Training advice: In accordance with the local regulations

16.5 Further information: None

16.6 Full text of classifications [CLP/GHS]:
 Acute Tox. 4, H302 Acute Toxicity: Oral - Category 4
 Acute Tox. 4, H332 Acute Toxicity: Inhalation - Category 4
 Eye Irrit. 2, H319 Serious Eye Damage/Eye Irritation - Category 2
 Skin Irrit. 2, H315 Skin Corrosion/Irritation - Category 2
 STOT Se 3, H335 Specific Target Organ Toxicity (Single Exposure) [Respiratory Tract Irritation] - Category 3

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ANNEXES

1. Exposure Scenario 1: Manufacture/import of Caprolactam

Number of the ES	1	
Title of exposure scenario	Manufacture/import of Caprolactam	
List of all use descriptors related to the life cycle stage	SU3; PROC 1, 2, 8b and 9; ERC 1	
Name of contributing environmental scenario and corresponding ERC	Manufacture of substances (ERC1).	
Name(s) of contributing worker scenarios and corresponding PROCs	PROC 1: Use in closed process, no likelihood of exposure PROC 2: Use in closed, continuous process with occasional controlled exposure PROC 8b: Transfer of substance or preparation (charging/discharging) from/to vessels/large containers at dedicated facilities PROC 9: Transfer of substance or preparation into small containers (dedicated filling line, including weighing)	
Contributing exposure scenario controlling worker exposure for PROC 1, 2, 8b and 9		
Control of workers exposure for PROC 1		
Title information related to contributing scenario		
Workers related free short title	Use in closed process, no likelihood of exposure	
Use descriptor covered	PROC 1	
Processes, tasks, activities covered	Manufacture in closed system, 90 -150°C	
Exposure Assessment Method	Tool used: ECETOC TRA Worker (v2.0)	
Product characteristic		
Physical state	liquid	Operation conditions: temperature 90 - 150°C
Concentration of substance	100	%
Fugacity	Low - Moderate	
Vapour pressure of the substance	1 - 30 (corresponds to 90-150°C)	hPa
Amounts used		
Not relevant in ECETOC TRA		
Frequency and duration of use/exposure		
Duration of exposure	> 4	hours/day
Frequency of exposure	≤ 240	days/year
Other given operational conditions affecting workers exposure		
Location	Indoors	
Domain	Industrial	
Technical conditions and measures at process level (source) to prevent release		
Not applicable – closed system		
Technical conditions and measures to control dispersion from source towards the worker		
Local exhaust ventilation required	No	
Organisational measures to prevent/limit releases, dispersion and exposure		
Not relevant		
Conditions and measures related to personal protection, hygiene and health evaluation		
Not relevant		
Control of workers exposure for PROC 2		
Title information related to contributing scenario		
Workers related free short title	Use in closed, continuous process with occasional controlled exposure	
Use descriptor covered	PROC 2	
Processes, tasks, activities covered	Continuous process but where the design philosophy is not specifically aimed at minimizing emissions. Occasional exposure will arise e.g. through maintenance, sampling and equipment breakages	

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Exposure Assessment Method		Tool used: ECETOC TRA Worker (v2.0)	
Product characteristic			
Physical state	liquid	Operation conditions: temperature ca. 90°C	
Concentration of substance	100	%	
Fugacity	low		
Vapour pressure of the substance	1.0 (corresponds to ca. 90°C)	hPa	
Amounts used			
Not relevant in ECETOC TRA			
Frequency and duration of use/exposure			
Duration of exposure	> 4 h	hours per day	
Frequency of exposure	≤ 240	days/year	
Other given operational conditions affecting workers exposure			
Location	Indoors		
Domain	Industrial		
Technical conditions and measures at process level (source) to prevent release			
Not relevant			
Technical conditions and measures to control dispersion from source towards the worker			
Appropriate local exhaust ventilation	No		
Organisational measures to prevent/limit releases, dispersion and exposure			
Avoiding frequent and direct contact with substance. Minimisation of manual phases. Regular cleaning of equipment and work area. Supervision in place to check that the RMMs in place are being used correctly and OCs followed.			
Conditions and measures related to personal protection, hygiene and health evaluation			
Use of suitable respiratory protection	no		
Use of suitable chemical resistant gloves	Cross reference to Qualitative Exposure Assessment		
Use of suitable eye protection			
Best practice advise			
Probing/sampling with considerable vapor release should not exceed 1h/day. Otherwise appropriate risk reduction measures (e.g. outside, LEV or breathing protection) are recommended.			
Control of workers exposure for PROC 8b: A (with 100 % preparation and 15 min-1 h exposure)			
Title information related to contributing scenario			
Workers related free short title	Transfer of substance or preparation (charging/discharging) from/to vessels/large containers at dedicated facilities		
Use descriptor covered	PROC 8b		
Processes, tasks, activities covered	Sampling		
Exposure Assessment Method	Tool used: ECETOC TRA Worker (v2.0)		
Product characteristic			
Physical state	Liquid	Operation conditions: temperature ca. 90°C	
Concentration of substance	100	%	
Fugacity	Low		
Vapour pressure of the substance	1 (corresponds to ca. 90°C)	hPa	
Amounts used			
Not relevant in ECETOC TRA			
Frequency and duration of use/exposure			
Duration of exposure	15 min-1 h	per day	
Frequency of exposure	≤ 240	days/year	
Other given operational conditions affecting workers exposure			
Location	Indoors		
Domain	Industrial		
Technical conditions and measures at process level (source) to prevent release			
Not relevant			

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Technical conditions and measures to control dispersion from source towards the worker		
Appropriate local exhaust ventilation	No	
Organisational measures to prevent/limit releases, dispersion and exposure		
Avoiding frequent and direct contact with substance. Minimisation of manual phases. Regular cleaning of equipment and work area. Supervision in place to check that the RMMs in place are being used correctly and OCs followed.		
Conditions and measures related to personal protection, hygiene and health evaluation		
Use of suitable respiratory protection	No	
Use of suitable chemical resistant gloves	Cross reference to Qualitative Exposure Assessment	
Use of suitable eye protection		
Control of workers exposure for PROC 8b: B (with 1-5 % preparation and 1-4 h exposure)		
Title information related to contributing scenario		
Workers related free short title	Transfer of substance or preparation (charging/discharging) from/to vessels/large containers at dedicated facilities	
Use descriptor covered	PROC 8b	
Processes, tasks, activities covered	Maintenance, clean down	
Exposure Assessment Method	Tool used: ECETOC TRA Worker (v2.0)	
Product characteristic		
Physical state	Liquid	Operation conditions: temperature ca. 90°C
Concentration of substance	TRA 1-5	%
Fugacity	Low	
Vapour pressure of the substance	1 (corresponds to ca. 90°C)	hPa
Amounts used		
Not relevant in ECETOC TRA		
Frequency and duration of use/exposure		
Duration of exposure	1-4 hours	per day
Frequency of exposure	≤ 240	days/year
Other given operational conditions affecting workers exposure		
Location	Indoors	
Domain	Industrial	
Technical conditions and measures at process level (source) to prevent release		
Not relevant		
Technical conditions and measures to control dispersion from source towards the worker		
Appropriate local exhaust ventilation	No	
Organisational measures to prevent/limit releases, dispersion and exposure		
Avoiding frequent and direct contact with substance. Minimisation of manual phases. Regular cleaning of equipment and work area. Supervision in place to check that the RMMs in place are being used correctly and OCs followed.		
Conditions and measures related to personal protection, hygiene and health evaluation		
Use of suitable respiratory protection	No	
Use of suitable chemical resistant gloves	Cross reference to Qualitative Exposure Assessment	
Use of suitable eye protection		
Control of workers exposure for PROC 9		
Title information related to contributing scenario		
Workers related free short title	Transfer of substance or preparation into small containers (dedicated filling line, including weighing)	
Use descriptor covered	PROC 9	
Processes, tasks, activities covered	Maintenance, clean down	
Exposure Assessment Method	Tool used: ECETOC TRA Worker (v2.0)	
Product characteristic		
Physical state	Liquid	Operation conditions: temperature ca. 90°C
Concentration of substance	TRA 1-5	%

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Fugacity	Low	
Vapour pressure of the substance	1 (corresponds to ca. 90°C)	hPa
Amounts used		
Not relevant in ECETOC TRA		
Frequency and duration of use/exposure		
Duration of exposure	1-4 hours	per day
Frequency of exposure	≤ 240	days/year
Other given operational conditions affecting workers exposure		
Location	Indoors	
Domain	Industrial	
Technical conditions and measures at process level (source) to prevent release		
Not relevant		
Technical conditions and measures to control dispersion from source towards the worker		
Appropriate local exhaust ventilation	No	
Organisational measures to prevent/limit releases, dispersion and exposure		
Avoiding frequent and direct contact with substance. Minimisation of manual phases. Regular cleaning of equipment and work area. Supervision in place to check that the RMMs in place are being used correctly and OCs followed.		
Conditions and measures related to personal protection, hygiene and health evaluation		
Use of suitable respiratory protection	No	
Use of suitable chemical resistant gloves	Cross reference to Qualitative Exposure Assessment	
Use of suitable eye protection		

Exposure Estimation**Estimated exposure for workers**

Route of exposure	Concentrations		Justification
	Value	Unit	
Long-term exposure, local, inhalative – PROC1	0.047	mg/m ³	
Long-term exposure, local, inhalative – PROC2	4.72	mg/m ³	
Long-term exposure, local, inhalative – PROC8b: A (100%) and B (1-5%)	A	B	mg/m ³
	4.72	2.83	
Long-term exposure, local, inhalative – PROC9	2.83	mg/m ³	

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2. Exposure Scenario 2: Distribution of Caprolactam

Number of the ES	2	
Title of exposure scenario	Distribution of Caprolactam	
List of all use descriptors related to the life cycle stage	SU3; PROC 2, 8b and 9; ERC 2	
Name of contributing environmental scenario and corresponding ERC	Formulation of preparations (ERC2)	
Name(s) of contributing worker scenarios and corresponding PROCs	PROC 2: Use in closed, continuous process with occasional controlled exposure PROC 8b: Transfer of substance or preparation (charging/discharging) from/to vessels/large containers at dedicated facilities PROC 9: Transfer of substance or preparation into small containers (dedicated filling line, including weighing)	
Contributing exposure scenario controlling worker exposure for PROC 2, 8b and 9		
Control of workers exposure for PROC 2		
Title information related to contributing scenario		
Workers related free short title	Use in closed, continuous process with occasional controlled exposure	
Use descriptor covered	PROC 2	
Processes, tasks, activities covered	Storage (closed bulk or container) and loading (closed system) with occasional probing	
Exposure Assessment Method	Tool used: ECETOC TRA Worker (v2.0)	
Product characteristic		
Physical state	Liquid	Operation conditions: temperature ca. 90°C
Concentration of substance	100	%
Fugacity	Low	
Vapour pressure of the substance	1.0 (corresponds to ca. 90°C)	hPa
Amounts used		
Not relevant in ECETOC TRA		
Frequency and duration of use/exposure		
Duration of exposure	> 4	hours/day
Frequency of exposure	≤ 240	days/year
Other given operational conditions affecting workers exposure		
Location	Indoors	
Domain	Industrial	
Technical conditions and measures at process level (source) to prevent release		
Not relevant		
Technical conditions and measures to control dispersion from source towards the worker		
Local exhaust ventilation required	No	
Organisational measures to prevent/limit releases, dispersion and exposure		
Avoiding frequent and direct contact with substance. Minimisation of manual phases. Regular cleaning of equipment and work area. Supervision in place to check that the RMMs in place are being used correctly and OCs followed.		
Conditions and measures related to personal protection, hygiene and health evaluation		
Use of suitable respiratory protection	No	
Use of suitable chemical resistant gloves	Cross reference to Qualitative Exposure Assessment	
Use of suitable eye protection		
Best practice advise		
Probing/sampling with considerable vapor release should not exceed 1h/day. Otherwise appropriate risk reduction measures (e.g. outside, LEV or breathing protection) are recommended.		
Control of workers exposure for PROC 8b (liquid)		
Title information related to contributing scenario		
Workers related free short title	Transfer of substance or preparation (charging/discharging) from/to vessels/large containers at dedicated facilities	
Use descriptor covered	PROC 8b	
Processes, tasks, activities covered	Transfer, filling dedicated (sampling and connection/disconnection of pipes before and after filling)	
Exposure Assessment Method	Tool used: ECETOC TRA Worker (v2.0)	
Product characteristic		
Physical state	Liquid	Operation conditions: temperature ca.90°C
Concentration of substance	100	%
Fugacity	Low	
Vapour pressure of the substance	1 (corresponds to ca. 90 °C)	hPa
Amounts used		

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Not relevant in ECETOC TRA		
Frequency and duration of use/exposure		
Duration of exposure	15 min-1 h	per day
Frequency of exposure	≤ 240	days/year
Other given operational conditions affecting workers exposure		
Location	Outdoors	
Domain	Industrial	
Technical conditions and measures at process level (source) to prevent release		
Not relevant		
Technical conditions and measures to control dispersion from source towards the worker		
Appropriate local exhaust ventilation	No	
Organisational measures to prevent /limit releases, dispersion and exposure		
Avoiding frequent and direct contact with substance. Minimisation of manual phases. Regular cleaning of equipment and work area. Supervision in place to check that the RMMs in place are being used correctly and OCs followed.		
Conditions and measures related to personal protection, hygiene and health evaluation		
Use of suitable respiratory protection	No	
Use of suitable chemical resistant gloves in combination with basic employee training	Cross reference to Qualitative Exposure Assessment	
Use of suitable eye protection		
Control of workers exposure for PROC 8b (solid)		
Title information related to contributing scenario		
Workers related free short title	Transfer of substance or preparation (charging/discharging) from/to vessels/large containers at dedicated facilities	
Use descriptor covered	PROC 8b	
Processes, tasks, activities covered	Dosing of solid Caprolactam to formulation step at ambient temperature.	
Exposure Assessment Method	Tool used: ECETOC TRA Worker (v2.0)	
Product characteristic		
Physical state	Solid	Operation conditions: ambient temperature
Concentration of substance	100	%
Dustiness	Low	
Vapour pressure of the substance	0.0013 (corresponds to ambient temperature)	hPa
Amounts used		
Not relevant		
Frequency and duration of use/exposure		
Duration of exposure	>4h	per day
Frequency of exposure	≤ 240	days/year
Other given operational conditions affecting workers exposure		
Location	Indoors	
Domain	Industrial	
Technical conditions and measures at process level (source) to prevent release		
Not relevant		
Technical conditions and measures to control dispersion from source towards the worker		
Appropriate local exhaust ventilation	No	
Organisational measures to prevent /limit releases, dispersion and exposure		
Avoiding frequent and direct contact with substance. Minimisation of manual phases. Regular cleaning of equipment and work area. Supervision in place to check that the RMMs in place are being used correctly and OCs followed.		
Conditions and measures related to personal protection, hygiene and health evaluation		
Use of suitable respiratory protection	No	
Use of suitable chemical resistant gloves in combination with basic employee training	Cross reference to Qualitative Exposure Assessment	
Use of suitable eye protection		
Control of workers exposure for PROC 9		
Title information related to contributing scenario		
Workers related free short title	Transfer of substance or preparation into small containers (dedicated filling line, including weighing)	
Use descriptor covered	PROC 9	
Processes, tasks, activities covered	Transfer, filling of flakes into small containers	
Exposure Assessment Method	Tool used: ECETOC TRA Worker (v2.0)	
Product characteristic		

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Physical state	Solid	Operation conditions: at ambient temperature
Concentration of substance	100	%
Dustiness	Low	
Vapour pressure of the substance	0.00013 (corresponds to ambient temperature)	hPa
Amounts used		
Not relevant in ECETOC TRA		
Frequency and duration of use/exposure		
Duration of exposure	> 4 hours	per day
Frequency of exposure	≤ 240	days/year
Other given operational conditions affecting workers exposure		
Location	Indoor	
Domain	Industrial	
Technical conditions and measures at process level (source) to prevent release		
Not relevant		
Technical conditions and measures to control dispersion from source towards the worker		
Appropriate local exhaust ventilation	No	
Organisational measures to prevent /limit releases, dispersion and exposure		
Avoiding frequent and direct contact with substance. Minimisation of manual phases. Regular cleaning of equipment and work area. Supervision in place to check that the RMMs in place are being used correctly and OCs followed.		
Conditions and measures related to personal protection, hygiene and health evaluation		
Use of suitable respiratory protection	No	
Use of suitable chemical resistant gloves in combination with basic employee training	Cross reference to Qualitative Exposure Assessment	
Use of suitable eye protection		

Exposure Estimation**Estimated exposure for workers**

Route of exposure	Concentrations		Justification
	Value	Unit	
Long-term exposure, local, inhalative – PROC2 (liquid)	4.72	mg/m ³	
Long-term exposure, local, inhalative – PROC8b (liquid)	3.3	mg/m ³	
Long-term exposure, local, inhalative – PROC8b (solid)	0.5	mg/m ³	
Long-term exposure, local, inhalative – PROC 9 (solid)	0.1	mg/m ³	

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3. Exposure Scenario 3: Industrial formulation of solid preparations

Number of the ES	3	
Title of exposure scenario	Industrial formulation- solid preparations	
List of all use descriptors related to the life cycle stage	SU3; PROC 3, 4, 5, 8b and 9; ERC 2 and 3	
Name of contributing environmental scenario and corresponding ERC	Formulation of preparation (ERC 2) Formulation in materials (ERC 3)	
Name(s) of contributing worker scenarios and corresponding PROCs	PROC 3: Use in closed batch process (synthesis or formulation) PROC 4: Use in batch and other process (synthesis) where opportunity for exposure arises PROC 5: Mixing or blending in batch processes for formulation of preparations and articles (multistage and/or significant contact) PROC 8b: Transfer of substance or preparation (charging/discharging) from/to vessels/large containers at dedicated facilities PROC 9: Transfer of substance or preparation into small containers (dedicated filling line, including weighing)	
Contributing exposure scenario controlling worker exposure for PROC 3, 4, 5, 8b and 9		
Control of workers exposure for PROC 3		
Title information related to contributing scenario		
Workers related free short title	Use in closed batch process (formulation)	
Use descriptor covered	PROC 3	
Processes, tasks, activities covered	Preparation of blends (mixing of solids, plasticizers), Caprolactam included in polymer matrix	
Exposure Assessment Method	Tool used: ECETOC TRA Worker (v2.0)	
Product characteristic		
Physical state	Solid	Operation conditions: ambient temperature
Concentration of substance	TRA 5-25	%
Dustiness	Low	
Vapour pressure of the substance	0.0013 (corresponds to ambient temperature)	hPa
Amounts used		
Not relevant in ECETOC TRA		
Frequency and duration of use/exposure		
Duration of exposure	> 4	hours/day
Frequency of exposure	≤ 240	days/year
Other given operational conditions affecting workers exposure		
Location	Indoors	
Domain	Industrial	
Technical conditions and measures at process level (source) to prevent release		
Not relevant		
Technical conditions and measures to control dispersion from source towards the worker		
Local exhaust ventilation required	No	
Organisational measures to prevent /limit releases, dispersion and exposure		
Avoiding frequent and direct contact with substance. Minimisation of manual phases. Regular cleaning of equipment and work area. Supervision in place to check that the RMMs in place are being used correctly and OCs followed.		
Conditions and measures related to personal protection, hygiene and health evaluation		
Use of suitable respiratory protection	No	
Use of suitable chemical resistant gloves	Cross reference to Qualitative Exposure Assessment	
Use of suitable eye protection		
Control of workers exposure for PROC 4		
Title information related to contributing scenario		
Workers related free short title	Use in batch and other process (synthesis) where opportunity for exposure arises	
Use descriptor covered	PROC 4	
Processes, tasks, activities covered	Preparation of blends (mixing of solids/plasticizers), Caprolactam included in polymer matrix	
Exposure Assessment Method	Tool used: ECETOC TRA Worker (v2.0)	
Product characteristic		
Physical state	Solid	Operation conditions: ambient temperature
Concentration of substance	TRA 5-25	%
Dustiness	Low	
Vapour pressure of the substance	0.0013 (corresponds to ambient	hPa

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	temperature)	
Amounts used		
Not relevant in ECETOC TRA		
Frequency and duration of use/exposure		
Duration of exposure	> 4	hours per day
Frequency of exposure	≤ 240	days/year
Other given operational conditions affecting workers exposure		
Location	Indoors	
Domain	Industrial	
Technical conditions and measures at process level (source) to prevent release		
Not relevant		
Technical conditions and measures to control dispersion from source towards the worker		
Appropriate local exhaust ventilation	No	
Organisational measures to prevent /limit releases, dispersion and exposure		
Avoiding frequent and direct contact with substance. Minimisation of manual phases. Regular cleaning of equipment and work area. Supervision in place to check that the RMMs in place are being used correctly and OCs followed.		
Conditions and measures related to personal protection, hygiene and health evaluation		
Use of suitable respiratory protection	No	
Use of suitable chemical resistant gloves in combination with basic employee training	Cross reference to Qualitative Exposure Assessment	
Use of suitable eye protection		
Control of workers exposure for PROC 5		
Title information related to contributing scenario		
Workers related free short title	Mixing or blending in batch processes for formulation of preparations and articles (multistage and/or significant contact)	
Use descriptor covered	PROC 5	
Processes, tasks, activities covered	Preparation of blends (mixing of solids/plasticizers), Caprolactam included in polymer matrix	
Exposure Assessment Method	Tool used: ECETOC TRA Worker (v2.0)	
Product characteristic		
Physical state	Solid	Operation conditions: ambient temperature
Concentration of substance	TRA 5-25	%
Dustiness	Low	
Vapour pressure of the substance	0.0013 (corresponds to ambient temperature)	hPa
Amounts used		
Not relevant in ECETOC TRA		
Frequency and duration of use/exposure		
Duration of exposure	> 4 hours	per day
Frequency of exposure	≤ 240	days/year
Other given operational conditions affecting workers exposure		
Location	Indoor	
Domain	Industrial	
Technical conditions and measures at process level (source) to prevent release		
Not relevant		
Technical conditions and measures to control dispersion from source towards the worker		
Appropriate local exhaust ventilation	No	
Organisational measures to prevent /limit releases, dispersion and exposure		
Avoiding frequent and direct contact with substance. Minimisation of manual phases. Regular cleaning of equipment and work area. Supervision in place to check that the RMMs in place are being used correctly and OCs followed.		
Conditions and measures related to personal protection, hygiene and health evaluation		
Use of suitable respiratory protection	No	
Use of suitable chemical resistant gloves	Cross reference to Qualitative Exposure Assessment	
Use of suitable eye protection		
Control of workers exposure for PROC 8b		
Title information related to contributing scenario		
Workers related free short title	Transfer of substance or preparation (charging/discharging) from/to vessels/large containers at dedicated facilities	
Use descriptor covered	PROC 8b	
Processes, tasks, activities covered	Transfer/filling dedicate following preparation of blends, Caprolactam included in polymer matrix	

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Exposure Assessment Method		Tool used: ECETOC TRA Worker (v2.0)	
Product characteristic			
Physical state	Solid	Operation conditions: ambient temperature	
Concentration of substance	TRA 5-25	%	
Dustiness	Low		
Vapour pressure of the substance	0.0013 (corresponds to ambient temperature)	hPa	
Amounts used			
Not relevant in ECETOC TRA			
Frequency and duration of use/exposure			
Duration of exposure	> 4 hours	per day	
Frequency of exposure	≤ 240	days/year	
Other given operational conditions affecting workers exposure			
Location	Indoor		
Domain	Industrial		
Technical conditions and measures at process level (source) to prevent release			
Not relevant			
Technical conditions and measures to control dispersion from source towards the worker			
Appropriate local exhaust ventilation	No		
Organisational measures to prevent /limit releases, dispersion and exposure			
Avoiding frequent and direct contact with substance. Minimisation of manual phases. Regular cleaning of equipment and work area. Supervision in place to check that the RMMs in place are being used correctly and OCs followed.			
Conditions and measures related to personal protection, hygiene and health evaluation			
Use of suitable respiratory protection	No		
Use of suitable chemical resistant gloves in combination with basic employee training	Cross reference to Qualitative Exposure Assessment		
Use of suitable eye protection			
Control of workers exposure for PROC 9			
Title information related to contributing scenario			
Workers related free short title	Transfer of substance or preparation into small containers (dedicated filling line, including weighing)		
Use descriptor covered	PROC 9		
Processes, tasks, activities covered	Transfer/filling dedicate following preparation of blends, Caprolactam included in polymer matrix		
Exposure Assessment Method	Tool used: ECETOC TRA Worker (v2.0)		
Product characteristic			
Physical state	Solid	Operation conditions: ambient temperature	
Concentration of substance	TRA 5-25	%	
Dustiness	Low		
Vapour pressure of the substance	0.0013 (corresponds to ambient temperature)	hPa	
Amounts used			
Not relevant in ECETOC TRA			
Frequency and duration of use/exposure			
Duration of exposure	> 4 hours	per day	
Frequency of exposure	≤ 240	days/year	
Other given operational conditions affecting workers exposure			
Location	Indoor		
Domain	Industrial		
Technical conditions and measures at process level (source) to prevent release			
Not relevant			
Technical conditions and measures to control dispersion from source towards the worker			
Appropriate local exhaust ventilation	No		
Organisational measures to prevent /limit releases, dispersion and exposure			
Avoiding frequent and direct contact with substance. Minimisation of manual phases. Regular cleaning of equipment and work area. Supervision in place to check that the RMMs in place are being used correctly and OCs followed.			
Conditions and measures related to personal protection, hygiene and health evaluation			
Use of suitable respiratory protection	No		
Use of suitable chemical resistant gloves in combination with basic employee training	Cross reference to Qualitative Exposure Assessment		
Use of suitable eye protection			

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Exposure Estimation

Estimated exposure for workers

Route of exposure	Concentrations		Justification
	Value	Unit	
Long-term exposure, local, inhalative – PROC 3	0.06	mg/m ³	
Long-term exposure, local, inhalative – PROC 4	0.3	mg/m ³	
Long-term exposure, local, inhalative – PROC 5	0.3	mg/m ³	
Long-term exposure, local, inhalative – PROC 8b	0.3	mg/m ³	
Long-term exposure, local, inhalative – PROC 9	0.06	mg/m ³	

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4. Exposure Scenario 4: Industrial/professional formulation of liquid preparations

Number of the ES	4	
Title of exposure scenario	Industrial/professional formulation of liquid preparations	
List of all use descriptors related to the life cycle stage	SU3, 22; PROC 2, 3, 4, 5, 8a, 8b, 9; ERC 2	
Name of contributing environmental scenario and corresponding ERC	Formulation of preparation (ERC 2)	
Name(s) of contributing worker scenarios and corresponding PROCs	PROC 2: Use in closed, continuous process with occasional controlled exposure PROC 3: Use in closed batch process (synthesis or formulation) PROC 4: Use in batch and other process (synthesis) where opportunity for exposure arises PROC 5: Mixing or blending in batch processes for formulation of preparations and articles (multistage and/or significant con-tact) PROC 8a: Transfer of substance or preparation (charging/discharging) from/to vessels/large containers at non-dedicated facilities PROC 8b: Transfer of substance or preparation (charging/discharging) from/to vessels/large containers at dedicated facilities PROC 9: Transfer of substance or preparation into small containers (dedicated filling line, including weighing)	
Contributing exposure scenario controlling worker exposure for PROC 2, 3, 4, 5, 8a, 8b and 9		
Control of workers exposure for PROC 2		
Title information related to contributing scenario		
Workers related free short title	Use in closed, continuous process with occasional controlled exposure	
Use descriptor covered	PROC 2	
Processes, tasks, activities covered	Storage of liquid Caprolactam for formulation in closed container/bulk with sampling.	
Exposure Assessment Method	Tool used: ECETOC TRA Worker (v2.0)	
Product characteristic		
Physical state	Liquid	Operation conditions: temperature 90 °C
Concentration of substance	100	%
Fugacity	Low	
Vapour pressure of the substance	1.0 (corresponds to 90 °C)	hPa
Amounts used		
Not relevant in ECETOC TRA		
Frequency and duration of use/exposure		
Duration of exposure	> 4	hours/day
Frequency of exposure	≤ 240	days/year
Other given operational conditions affecting workers exposure		
Location	Indoors	
Domain	Industrial	
Technical conditions and measures at process level (source) to prevent release		
Not relevant		
Technical conditions and measures to control dispersion from source towards the worker		
Local exhaust ventilation required	No	
Organisational measures to prevent /limit releases, dispersion and exposure		
Avoiding frequent and direct contact with substance. Minimisation of manual phases. Regular cleaning of equipment and work area. Supervision in place to check that the RMMs in place are being used correctly and OCs followed.		
Conditions and measures related to personal protection, hygiene and health evaluation		
Use of suitable respiratory protection	No	
Use of suitable chemical resistant gloves in combination with basic employee training	Cross reference to Qualitative Exposure Assessment	
Use of suitable eye protection		
Best practice advise		
Probing/sampling with considerable vapor release should not exceed 1h/day. Otherwise appropriate risk reduction measures (e.g. outside, LEV or breathing protection) are recommended.		
Control of workers exposure for PROC 3		
Title information related to contributing scenario		
Workers related free short title	Use in closed batch process (synthesis or formulation)	
Use descriptor covered	PROC 3	
Processes, tasks, activities covered	Covers formulation of all types of products (e.g. mixing of preparations and/or	

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		repackaging).	
Exposure Assessment Method		Tool used: ECETOC TRA Worker (v2.0)	
Product characteristic			
Physical state	Liquid	Operation conditions: temperature 90°C	
Concentration of substance	TRA 5-25	%	
Fugacity	Low		
Vapour pressure of the substance	1.0 (corresponds to 90°C)	hPa	
Amounts used			
Not relevant in ECETOC TRA			
Frequency and duration of use/exposure			
Duration of exposure	15 min – 1h	per day	
Frequency of exposure	≤ 240	days/year	
Other given operational conditions affecting workers exposure			
Location	Indoors		
Domain	Industrial		
Technical conditions and measures at process level (source) to prevent release			
Not relevant			
Technical conditions and measures to control dispersion from source towards the worker			
Appropriate local exhaust ventilation	No		
Organisational measures to prevent/limit releases, dispersion and exposure			
Avoiding frequent and direct contact with substance. Minimisation of manual phases. Regular cleaning of equipment and work area. Supervision in place to check that the RMMs in place are being used correctly and OCs followed.			
Conditions and measures related to personal protection, hygiene and health evaluation			
Use of suitable respiratory protection	No		
Use of suitable chemical resistant gloves in combination with basic employee training	Cross reference to Qualitative Exposure Assessment		
Use of suitable eye protection			
Control of workers exposure for PROC 4			
Title information related to contributing scenario			
Workers related free short title	Use in batch and other process (synthesis) where opportunity for exposure arises		
Use descriptor covered	PROC 4		
Processes, tasks, activities covered	Use in batch manufacture of a chemical where significant opportunity for exposure arises, e.g. during charging, sampling or discharge of material, and when the nature of the design is likely to result in exposure		
Exposure Assessment Method	Tool used: ECETOC TRA Worker (v2.0)		
Product characteristic			
Physical state	Liquid	Operation conditions: temperature 90°C	
Concentration of substance	TRA 1-5	%	
Fugacity	Low		
Vapour pressure of the substance	1 (corresponds to 90°C)	hPa	
Amounts used			
Not relevant in ECETOC TRA			
Frequency and duration of use/exposure	Industrial Domain	Professional Domain	
Duration of exposure	1- 4 hours	15min – 1h	per day
Frequency of exposure	≤ 240	≤ 240	days/year
Other given operational conditions affecting workers exposure			
Location	Indoor	Indoor	
Domain	Industrial	Professional	
Technical conditions and measures at process level (source) to prevent release			
Not relevant			
Technical conditions and measures to control dispersion from source towards the worker			
Appropriate local exhaust ventilation	No		
Organisational measures to prevent /limit releases, dispersion and exposure			
Avoiding frequent and direct contact with substance. Minimisation of manual phases. Regular cleaning of equipment and work area. Supervision in place to check that the RMMs in place are being used correctly and OCs followed.			
Conditions and measures related to personal protection, hygiene and health evaluation			
Use of suitable respiratory protection	No		
Use of suitable chemical resistant gloves in combination with basic employee training	Cross reference to Qualitative Exposure Assessment		
Use of suitable eye protection			

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Control of workers exposure for PROC 5			
Title information related to contributing scenario			
Workers related free short title	Mixing or blending in batch processes for formulation of preparations and articles (multistage and/or significant con-tact)		
Use descriptor covered	PROC 5		
Processes, tasks, activities covered	Manufacture or formulation of chemical products or articles using technologies related to mixing and blending, where the process is in stages and provides the opportunity for significant contact at any stage		
Exposure Assessment Method	Tool used: ECETOC TRA Worker (v2.0)		
Product characteristic			
Physical state	Liquid	Operation conditions: 90°C	
Concentration of substance	TRA 1-5	%	
Fugacity	Low		
Vapour pressure of the substance	1 (corresponds to 90°C)	hPa	
Amounts used			
Not relevant in ECETOC TRA			
Frequency and duration of use/exposure	Industrial Domain	Professional Domain	
Duration of exposure	1- 4 hours	15min – 1h	per day
Frequency of exposure	≤ 240	≤ 240	days/year
Other given operational conditions affecting workers exposure			
Location	Indoor	Indoor	
Domain	Industrial	Professional	
Technical conditions and measures at process level (source) to prevent release			
Not relevant			
Technical conditions and measures to control dispersion from source towards the worker			
Appropriate local exhaust ventilation	No		
Organisational measures to prevent /limit releases, dispersion and exposure			
Avoiding frequent and direct contact with substance. Minimisation of manual phases. Regular cleaning of equipment and work area. Supervision in place to check that the RMMs in place are being used correctly and OCs followed.			
Conditions and measures related to personal protection, hygiene and health evaluation			
Use of suitable respiratory protection	No		
Use of suitable chemical resistant gloves in combination with basic employee training	Cross reference to Qualitative Exposure Assessment		
Use of suitable eye protection			
Control of workers exposure for PROC 8a			
Title information related to contributing scenario			
Workers related free short title	Transfer of substance or preparation (charging/discharging) from/to vessels/large containers at non-dedicated facilities		
Use descriptor covered	PROC 8a		
Processes, tasks, activities covered	e.g. sampling		
Exposure Assessment Method	Tool used: ECETOC TRA Worker (v2.0)		
Product characteristic			
Physical state	Liquid	Operation conditions: 90°C	
Concentration of substance	TRA 1-5	%	
Fugacity	Low		
Vapour pressure of the substance	1 (corresponds to 90 °C)	hPa	
Amounts used			
Not relevant in ECETOC TRA			
Frequency and duration of use/exposure	Industrial Domain	Professional Domain	
Duration of exposure	15 min - 1 hours	< 15 min	per day
Frequency of exposure	≤ 240	≤ 240	days/year
Other given operational conditions affecting workers exposure			
Location	Indoor	Indoor	
Domain	Industrial	Professional	
Technical conditions and measures at process level (source) to prevent release			
Not relevant			
Technical conditions and measures to control dispersion from source towards the worker			
Appropriate local exhaust ventilation	No		
Organisational measures to prevent /limit releases, dispersion and exposure			

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Avoiding frequent and direct contact with substance. Minimisation of manual phases. Regular cleaning of equipment and work area. Supervision in place to check that the RMMs in place are being used correctly and OCs followed.			
Conditions and measures related to personal protection, hygiene and health evaluation			
Use of suitable respiratory protection	No		
Use of suitable chemical resistant gloves in combination with basic employee training	Cross reference to Qualitative Exposure Assessment		
Use of suitable eye protection			
Control of workers exposure for PROC 8b			
Title information related to contributing scenario			
Workers related free short title	Transfer of substance or preparation (charging/discharging) from/to vessels/large containers at dedicated facilities		
Use descriptor covered	PROC 8b		
Processes, tasks, activities covered	Sampling		
Exposure Assessment Method	Tool used: ECETOC TRA Worker (v2.0)		
Product characteristic			
Physical state	Liquid	Operation conditions: 90°C	
Concentration of substance	TRA 1-5	%	
Fugacity	Low		
Vapour pressure of the substance	1 (corresponds to 90°C)	hPa	
Amounts used			
Not relevant			
Frequency and duration of use/exposure	Industrial Domain	Professional Domain	
Duration of exposure	1-4 hours	15min – 1h	per day
Frequency of exposure	≤ 240	≤ 240	days/year
Other given operational conditions affecting workers exposure			
Location	Indoor	Indoor	
Domain	Industrial	Professional	
Technical conditions and measures at process level (source) to prevent release			
Not relevant			
Technical conditions and measures to control dispersion from source towards the worker			
Appropriate local exhaust ventilation	No		
Organisational measures to prevent /limit releases, dispersion and exposure			
Avoiding frequent and direct contact with substance. Minimisation of manual phases. Regular cleaning of equipment and work area. Supervision in place to check that the RMMs in place are being used correctly and OCs followed.			
Conditions and measures related to personal protection, hygiene and health evaluation			
Use of suitable respiratory protection	No		
Use of suitable chemical resistant gloves in combination with basic employee training	Cross reference to Qualitative Exposure Assessment		
Use of suitable eye protection			
Control of workers exposure for PROC 9			
Title information related to contributing scenario			
Workers related free short title	Transfer of substance or preparation into small containers (dedicated filling line, including weighing)		
Use descriptor covered	PROC 9		
Processes, tasks, activities covered	Maintenance and clean down		
Exposure Assessment Method	Tool used: ECETOC TRA Worker (v2.0)		
Product characteristic			
Physical state	Liquid	Operation conditions: 90 °C	
Concentration of substance	TRA 1-5	%	
Fugacity	Low		
Vapour pressure of the substance	1 (corresponds to 90 °C)	hPa	
Amounts used			
Not relevant in ECETOC TRA			
Frequency and duration of use/exposure	Industrial Domain	Professional Domain	
Duration of exposure	1-4 hours	15min – 1h	per day
Frequency of exposure	≤ 240	≤ 240	days/year
Other given operational conditions affecting workers exposure			
Location	Indoor	Indoor	

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Domain	Industrial	Professional
Technical conditions and measures at process level (source) to prevent release		
Not relevant		
Technical conditions and measures to control dispersion from source towards the worker		
Appropriate local exhaust ventilation	No	
Organisational measures to prevent /limit releases, dispersion and exposure		
Avoiding frequent and direct contact with substance. Minimisation of manual phases. Regular cleaning of equipment and work area. Supervision in place to check that the RMMs in place are being used correctly and OCs followed.		
Conditions and measures related to personal protection, hygiene and health evaluation		
Use of suitable respiratory protection	No	
Use of suitable chemical resistant gloves in combination with basic employee training	Cross reference to Qualitative Exposure Assessment	
Use of suitable eye protection		

Exposure Estimation**Estimated exposure for workers PROC2 and 3**

Route of exposure	Concentrations		Justification
	Value	Unit	
Long-term exposure, local, inhalative – PROC2	4.72	mg/m ³	
Long-term exposure, local, inhalative - PROC3	1.69	mg/m ³	

Estimated exposure for workers – PROC 4, 5, 8a, 8b, 9

Route of exposure	Concentrations			Justification
	Industrial Domain	Professional Domain	Unit	
Long-term exposure, local, inhalativer – PROC4	2.83	1.89	mg/m ³	
Long-term exposure, local, inhalativer - PROC5	2.83	1.89	mg/m ³	
Long-term exposure, local, inhalativer – PROC8a	1.89	2.36	mg/m ³	
Long-term exposure, local, inhalativer – PROC8b	2.83	1.89	mg/m ³	
Long-term exposure, local, inhalativer – PROC9	2.83	1.89	mg/m ³	

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5. Exposure Scenario 5: Use as intermediate

Number of the ES	5	
Title of exposure scenario	Use as intermediate	
List of all use descriptors related to the life cycle stage	SU3, 8, 9; PROC 1, 2, 3, 4, 8b and 9; ERC 6a; PC19	
Name of contributing environmental scenario and corresponding ERC	Industrial use resulting in manufacture of another substance (use of intermediates) (ERC6a)	
Name(s) of contributing worker scenarios and corresponding PROCs	PROC 1: Use in closed process, no likelihood of exposure PROC 2: Use in closed, continuous process with occasional controlled exposure PROC 3: Use in closed batch process (synthesis or formulation) PROC 4: Use in batch and other process (syn-thesis) where opportunity for exposure arises PROC 8b: Transfer of substance or preparation (charging/discharging) from/to vessels/large containers at dedicated facilities PROC 9: Transfer of substance or preparation into small containers (dedicated filling line, including weighing)	
Contributing exposure scenario controlling worker exposure for PROC 1, 2, 3, 4, 8b and 9		
Control of workers exposure for PROC 1		
Title information related to contributing scenario		
Workers related free short title	Use in closed process, no likelihood of exposure	
Use descriptor covered	PROC 1	
Processes, tasks, activities covered	Use of the substance in high integrity contained system where little potential exists for exposures, e.g. any sampling via closed loop systems	
Exposure Assessment Method	Tool used: ECETOC TRA Worker (v2.0)	
Product characteristic		
Physical state	Liquid	Operation conditions: temperature ca. 90°C
Concentration of substance	100	%
Fugacity	Low	
Vapour pressure of the substance	1.0 (corresponds to ca. 90°C)	hPa
Amounts used		
Not relevant in ECETOC TRA		
Frequency and duration of use/exposure		
Duration of exposure	> 4	hours/day
Frequency of exposure	≤ 240	days/year
Other given operational conditions affecting workers exposure		
Location	Indoors	
Domain	Industrial	
Technical conditions and measures at process level (source) to prevent release		
Not applicable – closed system		
Technical conditions and measures to control dispersion from source towards the worker		
Local exhaust ventilation required	No	
Organisational measures to prevent /limit releases, dispersion and exposure		
Not relevant in ECETOC TRA		
Conditions and measures related to personal protection, hygiene and health evaluation		
Use of suitable respiratory protection	No	
Control of workers exposure for PROC 2		
Title information related to contributing scenario		
Workers related free short title	Use in closed, continuous process with occasional controlled exposure	
Use descriptor covered	PROC 2	
Processes, tasks, activities covered	Continuous process but where the design philosophy is not specifically aimed at minimizing emissions. Occasional exposure will arise e.g. through maintenance, sampling and equipment breakages	
Exposure Assessment Method	Tool used: ECETOC TRA Worker (v2.0)	
Product characteristic		
Physical state	Liquid	Operation conditions: temperature ca. 90°C
Concentration of substance	100	%
Fugacity	Low	
Vapour pressure of the substance	1.0 (corresponds to ca. 90 °C)	hPa

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Amounts used		
Not relevant in ECETOC TRA		
Frequency and duration of use/exposure		
Duration of exposure	> 4	hours/day
Frequency of exposure	≤ 240	days/year
Other given operational conditions affecting workers exposure		
Location	Indoors	
Domain	Industrial	
Technical conditions and measures at process level (source) to prevent release		
Not relevant		
Technical conditions and measures to control dispersion from source towards the worker		
Local exhaust ventilation required	No	
Organisational measures to prevent /limit releases, dispersion and exposure		
Avoiding frequent and direct contact with substance. Minimisation of manual phases. Regular cleaning of equipment and work area. Supervision in place to check that the RMMs in place are being used correctly and OCs followed.		
Conditions and measures related to personal protection, hygiene and health evaluation		
Use of suitable respiratory protection	No	
Use of suitable chemical resistant gloves	Cross reference to Qualitative Exposure Assessment	
Use of suitable eye protection		
Best practice advise		
Probing/sampling with considerable vapor release should not exceed 1h/day. Otherwise appropriate risk reduction measures (e.g. outside, LEV or breathing protection) are recommended.		
Control of workers exposure for PROC 3		
Title information related to contributing scenario		
Workers related free short title	Use in closed batch process (synthesis or formulation)	
Use descriptor covered	PROC 3	
Processes, tasks, activities covered	Batch manufacture where the predominant handling is in a contained manner, e.g. through enclosed transfers, but where some opportunity for contact with chemicals occurs, e.g. through sampling	
Exposure Assessment Method	Tool used: ECETOC TRA Worker (v2.0)	
Product characteristic		
Physical state	Liquid	Operation conditions: temperature ca. 90°C
Concentration of substance	100	%
Fugacity	Low	
Vapour pressure of the substance	1.0 (corresponds to 90 °C)	hPa
Amounts used		
Not relevant in ECETOC TRA		
Frequency and duration of use/exposure		
Duration of exposure	> 4 h	per day
Frequency of exposure	≤ 240	days per year
Other given operational conditions affecting workers exposure		
Location	Indoors	
Domain	Industrial	
Technical conditions and measures at process level (source) to prevent release		
Not relevant		
Technical conditions and measures to control dispersion from source towards the worker		
Appropriate local exhaust ventilation	No	
Organisational measures to prevent /limit releases, dispersion and exposure		
Avoiding frequent and direct contact with substance. Minimisation of manual phases. Regular cleaning of equipment and work area. Supervision in place to check that the RMMs in place are being used correctly and OCs followed.		
Conditions and measures related to personal protection, hygiene and health evaluation		
Use of suitable respiratory protection	No	
Use of suitable chemical resistant gloves	Cross reference to Qualitative Exposure Assessment	
Use of suitable eye protection		
Control of workers exposure for PROC 4		
Title information related to contributing scenario		
Workers related free short title	Use in batch and other process (synthesis) where opportunity for exposure arises	
Use descriptor covered	PROC 8b	
Processes, tasks, activities covered	Use in batch manufacture of a chemical where significant opportunity for exposure arises, e.g. during charging, sampling or discharge of material, and when the nature of the design is likely to result in exposure	

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Exposure Assessment Method		Tool used: ECETOC TRA Worker (v2.0)	
Product characteristic			
Physical state	Liquid	Operation conditions: temperature ca. 90°C	
Concentration of substance	100	%	
Fugacity	Low		
Vapour pressure of the substance	1 (corresponds to ca. 90°C)	hPa	
Amounts used			
Not relevant in ECETOC TRA			
Frequency and duration of use/exposure			
Duration of exposure	> 4 hours	per day	
Frequency of exposure	≤ 240	days/year	
Other given operational conditions affecting workers exposure			
Location	Indoor		
Domain	Industrial		
Technical conditions and measures at process level (source) to prevent release			
Not relevant			
Technical conditions and measures to control dispersion from source towards the worker			
Appropriate local exhaust ventilation	No		
Organisational measures to prevent /limit releases, dispersion and exposure			
Avoiding frequent and direct contact with substance. Minimisation of manual phases. Regular cleaning of equipment and work area. Supervision in place to check that the RMMs in place are being used correctly and OCs followed.			
Conditions and measures related to personal protection, hygiene and health evaluation			
Use of suitable respiratory protection	No		
Use of suitable chemical resistant gloves	Cross reference to Qualitative Exposure Assessment		
Use of suitable eye protection			
Control of workers exposure for PROC 8b			
Title information related to contributing scenario			
Workers related free short title	Transfer of substance or preparation (charging/discharging) from/to vessels/large containers at dedicated facilities		
Use descriptor covered	PROC 8b		
Processes, tasks, activities covered	Sampling, loading, filling, transfer, dumping, bagging in dedicated facilities. Exposure related to dust, vapour, aerosols or spillage, and cleaning of equipment to be expected.		
Exposure Assessment Method	Tool used: ECETOC TRA Worker (v2.0)		
Product characteristic			
Physical state	Liquid	Operation conditions: temperature ca. 90°C	
Concentration of substance	100	%	
Fugacity	Low		
Vapour pressure of the substance	1 (corresponds to ca. 90 °C)	hPa	
Amounts used			
Not relevant in ECETOC TRA			
Frequency and duration of use/exposure			
Duration of exposure	15min - 1h	per day	
Frequency of exposure	≤ 240	days/year	
Other given operational conditions affecting workers exposure			
Location	Indoors		
Domain	Industrial		
Technical conditions and measures at process level (source) to prevent release			
Not relevant			
Technical conditions and measures to control dispersion from source towards the worker			
Appropriate local exhaust ventilation	No		
Organisational measures to prevent /limit releases, dispersion and exposure			
Avoiding frequent and direct contact with substance. Minimisation of manual phases. Regular cleaning of equipment and work area. Supervision in place to check that the RMMs in place are being used correctly and OCs followed.			
Conditions and measures related to personal protection, hygiene and health evaluation			
Use of suitable respiratory protection	No		
Use of suitable chemical resistant gloves	Cross reference to Qualitative Exposure Assessment		
Use of suitable eye protection			
Control of workers exposure for PROC 9			
Title information related to contributing scenario			

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Workers related free short title	Transfer of substance or preparation into small containers (dedicated filling line, including weighing)	
Use descriptor covered	PROC 9	
Processes, tasks, activities covered	Maintenance, clean down	
Exposure Assessment Method	Tool used: ECETOC TRA Worker (v2.0)	
Product characteristic		
Physical state	Liquid	Operation conditions: temperature ca. 90°C
Concentration of substance	TRA 1-5	%
Fugacity	Low	
Vapour pressure of the substance	1 (corresponds to ca. 90°C)	hPa
Amounts used		
Not relevant in ECETOC TRA		
Frequency and duration of use/exposure		
Duration of exposure	15 min - 1 hours	per day
Frequency of exposure	≤ 240	days/year
Other given operational conditions affecting workers exposure		
Location	Indoors	
Domain	Industrial	
Technical conditions and measures at process level (source) to prevent release		
Not relevant		
Technical conditions and measures to control dispersion from source towards the worker		
Appropriate local exhaust ventilation	No	
Organisational measures to prevent /limit releases, dispersion and exposure		
Avoiding frequent and direct contact with substance. Minimisation of manual phases. Regular cleaning of equipment and work area. Supervision in place to check that the RMMs in place are being used correctly and OCs followed.		
Conditions and measures related to personal protection, hygiene and health evaluation		
Use of suitable respiratory protection	No	
Use of suitable chemical resistant gloves	Cross reference to Qualitative Exposure Assessment	
Use of suitable eye protection		

Exposure Estimation**Estimated exposure for workers**

Route of exposure	Concentrations		Justification
	Value	Unit	
Long-term exposure, local, inhalative - PROC1	0.047	mg/m ³	
Long-term exposure, local, inhalative – PROC2	4.72	mg/m ³	
Long-term exposure, local, inhalative – PROC3	1.41	mg/m ³	
Long-term exposure, local, inhalative – PROC4	2.36	mg/m ³	
Long-term exposure, local, inhalative – PROC8b	4.72	mg/m ³	
Long-term exposure, local, inhalative – PROC9	4.72	mg/m ³	

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6. Exposure Scenario 6: Use of caprolactam as monomer for polyamide, polymers, thermoplastics

Number of the ES	6		
Title of exposure scenario	Use of caprolactam as monomer for polyamide, polymers, thermoplastics		
List of all use descriptors related to the life cycle stage	SU3, 12; PROC 1, 2, 3, 8b; ERC 6c, PC32		
Name of contributing environmental scenario and corresponding ERC	Industrial use of monomers for manufacture of thermo-plastics (ERC6c)		
Name(s) of contributing worker scenarios and corresponding PROCs	PROC 1: Use in closed process, no likelihood of exposure PROC 2: Use in closed, continuous process with occasional controlled exposure PROC 3: Use in closed batch process (synthesis or formulation) PROC 8b: Transfer of substance or preparation (charging/discharging) from/to vessels/large containers at dedicated facilities		
Contributing exposure scenario controlling worker exposure for PROC 1, 2, 3, 8b			
Control of workers exposure for PROC 1			
Title information related to contributing scenario			
Workers related free short title	Use in closed process, no likelihood of exposure		
Use descriptor covered	PROC 1		
Processes, tasks, activities covered	Polymerization in closed system, 250°C		
Exposure Assessment Method	Tool used: ECETOC TRA Worker (v2.0)		
Product characteristic			
Physical state	Liquid	Operation conditions: temperature ca. 250°C	
Concentration of substance	100	%	
Fugacity	High		
Vapour pressure of the substance	700 (corresponds to ca. 250°C)	hPa	
Amounts used			
Not relevant in ECETOC TRA			
Frequency and duration of use/exposure			
Duration of exposure	> 4	hours/day	
Frequency of exposure	≤ 240	days/year	
Other given operational conditions affecting workers exposure			
Location	Indoors		
Domain	Industrial		
Technical conditions and measures at process level (source) to prevent release			
Not applicable – closed system			
Technical conditions and measures to control dispersion from source towards the worker			
Local exhaust ventilation required	No		
Organisational measures to prevent /limit releases, dispersion and exposure			
Not relevant			
Conditions and measures related to personal protection, hygiene and health evaluation			
Use of suitable respiratory protection	No		
Control of workers exposure for PROC 2			
Title information related to contributing scenario			
Workers related free short title	Use in closed, continuous process with occasional controlled exposure		
Use descriptor covered	PROC 2		
Processes, tasks, activities covered	Spinning and cooling of the unextracted melt		
Exposure Assessment Method	Tool used: ECETOC TRA Worker (v2.0)		
Product characteristic			
Physical state	Liquid	Operation conditions: temperature ca. 250°C	
Concentration of substance	TRA 1-5	%	
Fugacity	High		
Vapour pressure of the substance	700 (corresponds to ca. 250°C)	hPa	
Amounts used			
Not relevant in ECETOC TRA			
Frequency and duration of use/exposure			
Duration of exposure	> 4 h	hours per day	
Frequency of exposure	≤ 240	days/year	
Other given operational conditions affecting workers exposure			

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Location	Indoors	
Domain	Industrial	
Technical conditions and measures at process level (source) to prevent release		
Not relevant		
Technical conditions and measures to control dispersion from source towards the worker		
Appropriate local exhaust ventilation	Yes	Effectiveness: 90 %
Organisational measures to prevent /limit releases, dispersion and exposure		
Avoiding frequent and direct contact with substance. Minimisation of manual phases. Regular cleaning of equipment and work area. Supervision in place to check that the RMMs in place are being used correctly and OCs followed.		
Conditions and measures related to personal protection, hygiene and health evaluation		
Use of suitable respiratory protection	No	
Use of suitable chemical resistant gloves	Cross reference to Qualitative Exposure Assessment	
Use of suitable eye protection		
Best practice advise		
Probing/sampling with considerable vapor release should not exceed 1h/day. Otherwise appropriate risk reduction measures (e.g. outside, LEV or breathing protection) are recommended.		
Control of workers exposure for PROC 3		
Title information related to contributing scenario		
Workers related free short title	Use in closed batch process (synthesis or formulation)	
Use descriptor covered	PROC 3	
Processes, tasks, activities covered	Mixing and feeding of batch vessel	
Exposure Assessment Method	Tool used: ECETOC TRA Worker (v2.0)	
Product characteristic		
Physical state	Liquid	Operation conditions: temperature ca. 90°C
Concentration of substance	100	%
Fugacity	Low	
Vapour pressure of the substance	1 (corresponds to ca. 90 °C)	hPa
Amounts used		
Not relevant in ECETOC TRA		
Frequency and duration of use/exposure		
Duration of exposure	15min - 1h	per day
Frequency of exposure	≤ 240	days/year
Other given operational conditions affecting workers exposure		
Location	Indoors	
Domain	Industrial	
Technical conditions and measures at process level (source) to prevent release		
Not relevant		
Technical conditions and measures to control dispersion from source towards the worker		
Appropriate local exhaust ventilation	No	
Organisational measures to prevent /limit releases, dispersion and exposure		
Avoiding frequent and direct contact with substance. Minimisation of manual phases. Regular cleaning of equipment and work area. Supervision in place to check that the RMMs in place are being used correctly and OCs followed.		
Conditions and measures related to personal protection, hygiene and health evaluation		
Use of suitable respiratory protection	No	
Use of suitable chemical resistant gloves in combination with basic employee training	Cross reference to Qualitative Exposure Assessment	
Use of suitable eye protection		
Control of workers exposure for PROC 8b: Operation conditions at 90°C		
Title information related to contributing scenario		
Workers related free short title	Transfer of substance or preparation (charging/discharging) from/to vessels/large containers at dedicated facilities	
Use descriptor covered	PROC 8b	
Processes, tasks, activities covered	Sampling	
Exposure Assessment Method	Tool used: ECETOC TRA Worker (v2.0)	
Product characteristic		
Physical state	Liquid	Operation conditions: temperature 90°C
Concentration of substance	100	%
Fugacity	Low	
Vapour pressure of the substance	1 (corresponds to 90°C)	hPa
Amounts used		
Not relevant in ECETOC TRA		

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Frequency and duration of use/exposure		
Duration of exposure	15min-1h	per day
Frequency of exposure	≤ 240	days/year
Other given operational conditions affecting workers exposure		
Location	Indoors	
Domain	Industrial	
Technical conditions and measures at process level (source) to prevent release		
Not relevant		
Technical conditions and measures to control dispersion from source towards the worker		
Appropriate local exhaust ventilation	No	
Organisational measures to prevent /limit releases, dispersion and exposure		
Avoiding frequent and direct contact with substance. Minimisation of manual phases. Regular cleaning of equipment and work area. Supervision in place to check that the RMMs in place are being used correctly and OCs followed.		
Conditions and measures related to personal protection, hygiene and health evaluation		
Use of suitable respiratory protection	No	
Use of suitable chemical resistant gloves in combination with basic employee training	Cross reference to Qualitative Exposure Assessment	
Use of suitable eye protection		
Control of workers exposure for PROC 8b: Operation conditions at 250°C		
Title information related to contributing scenario		
Workers related free short title	Transfer of substance or preparation (charging/discharging) from/to vessels/large containers at dedicated facilities	
Use descriptor covered	PROC 8b	
Processes, tasks, activities covered	Sampling, handling of unextracted polyamide melt, cooling down	
Exposure Assessment Method	Tool used: ECETOC TRA Worker (v2.0)	
Product characteristic		
Physical state	Liquid	Operation conditions: at 250°C
Concentration of substance	TRA 1-5	%
Fugacity	High	
Vapour pressure of the substance	700 (corresponds to 250°C)	hPa
Amounts used		
Not relevant		
Frequency and duration of use/exposure		
Duration of exposure	1-4 hours	per day
Frequency of exposure	≤ 240	days/year
Other given operational conditions affecting workers exposure		
Location	Indoors	
Domain	Industrial	
Technical conditions and measures at process level (source) to prevent release		
Minimisation of manual phases. Avoidance of contact with contaminated tools and objects		
Technical conditions and measures to control dispersion from source towards the worker		
Appropriate local exhaust ventilation	Yes	Effectiveness: 97 % (as PROC relates to dedicated facilities)
Organisational measures to prevent /limit releases, dispersion and exposure		
Avoiding frequent and direct contact with substance. Minimisation of manual phases. Regular cleaning of equipment and work area. Supervision in place to check that the RMMs in place are being used correctly and OCs followed.		
Conditions and measures related to personal protection, hygiene and health evaluation		
Use of suitable respiratory protection	No	
Use of suitable chemical resistant gloves in combination with basic employee training	Cross reference to Qualitative Exposure Assessment	
Use of suitable eye protection		

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Exposure Estimation

Estimated exposure for workers

Route of exposure	Concentrations		Justification
	Value	Unit	
Long-term exposure, local, inhalative - PROC1	0.047	mg/m ³	
Long-term exposure, local, inhalative – PROC2	4.72	mg/m ³	
Long-term exposure, local, inhalative – PROC3	2.83	mg/m ³	
Long-term exposure, local, inhalative – PROC8b (90°C)	4.72	mg/m ³	
Long-term exposure, local, inhalative – PROC8b (250°C)	2.55	mg/m ³	

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7. Exposure Scenario 7: Use of caprolactam as monomer for resins

Number of the ES	7	
Title of exposure scenario	Use of caprolactam as monomer for resins	
List of all use descriptors related to the life cycle stage	SU3; PROC 1, 2, 3, 8b; ERC 6c	
Name of contributing environmental scenario and corresponding ERC	Industrial use of monomers for manufacture of thermo-plastics (ERC6c)	
Name(s) of contributing worker scenarios and corresponding PROCs	PROC 1: Use in closed process, no likelihood of exposure PROC 2: Use in closed, continuous process with occasional controlled exposure PROC 3: Use in closed batch process (synthesis or formulation) PROC 8b: Transfer of substance or preparation (charging/discharging) from/to vessels/large containers at dedicated facilities	
Contributing exposure scenario controlling worker exposure for PROC 1, 2, 3, 8b		
Control of workers exposure for PROC 1		
Title information related to contributing scenario		
Workers related free short title	Use in closed process, no likelihood of exposure	
Use descriptor covered	PROC 1	
Processes, tasks, activities covered	Use of the substances in high integrity contained system where little potential exists for exposures, e.g. any sampling via closed loop systems	
Exposure Assessment Method	Tool used: ECETOC TRA Worker (v2.0)	
Product characteristic		
Physical state	Liquid	Operation conditions: temperature ca. 250°C
Concentration of substance	100	%
Fugacity	High	
Vapour pressure of the substance	700 (corresponds to ca. 250°C)	hPa
Amounts used		
Not relevant in ECETOC TRA		
Frequency and duration of use/exposure		
Duration of exposure	> 4	hours/day
Frequency of exposure	≤ 240	days/year
Other given operational conditions affecting workers exposure		
Location	Indoors	
Domain	Industrial	
Technical conditions and measures at process level (source) to prevent release		
Not applicable – closed system		
Technical conditions and measures to control dispersion from source towards the worker		
Local exhaust ventilation required	No	
Organisational measures to prevent /limit releases, dispersion and exposure		
Not relevant		
Conditions and measures related to personal protection, hygiene and health evaluation		
Use of suitable respiratory protection	No	
Control of workers exposure for PROC 2		
Title information related to contributing scenario		
Workers related free short title	Use in closed, continuous process with occasional controlled exposure	
Use descriptor covered	PROC 2	
Processes, tasks, activities covered	Continuous process but where the design philosophy is not specifically aimed at minimizing emissions e.g. spinning and cooling of the unextracted melts. Occasional exposure will arise e.g. through maintenance, sampling and equipment breakages.	
Exposure Assessment Method	Tool used: ECETOC TRA Worker (v2.0)	
Product characteristic		
Physical state	Liquid	Operation conditions: temperature ca. 100°C
Concentration of substance	TRA 1-5	%
Fugacity	High	
Vapour pressure of the substance	700 (corresponds to ca. 250°C)	hPa
Amounts used		
Not relevant		
Frequency and duration of use/exposure		
Duration of exposure	> 4 h	hours per day

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Frequency of exposure	≤ 240	days/year	
Other given operational conditions affecting workers exposure			
Location	Indoors		
Domain	Industrial		
Technical conditions and measures at process level (source) to prevent release			
Not relevant			
Technical conditions and measures to control dispersion from source towards the worker			
Appropriate local exhaust ventilation	Yes		Effectiveness: 90%
Organisational measures to prevent /limit releases, dispersion and exposure			
Avoiding frequent and direct contact with substance. Minimisation of manual phases. Regular cleaning of equipment and work area. Supervision in place to check that the RMMs in place are being used correctly and OCs followed.			
Conditions and measures related to personal protection, hygiene and health evaluation			
Use of suitable respiratory protection	No		
Use of suitable chemical resistant gloves	Cross reference to Qualitative Exposure Assessment		
Use of suitable eye protection			
Best practice advise			
Probing/sampling with considerable vapor release should not exceed 1h/day. Otherwise appropriate risk reduction measures (e.g. outside, LEV or breathing protection) are recommended.			
Control of workers exposure for PROC 3			
Title information related to contributing scenario			
Workers related free short title	Use in closed batch process (synthesis or formulation)		
Use descriptor covered	PROC 3		
Processes, tasks, activities covered	Mixing and feeding		
Exposure Assessment Method	Tool used: ECETOC TRA Worker (v2.0)		
Product characteristic			
Physical state	Liquid		Operation conditions: temperature ca. 90°C
Concentration of substance	100		%
Fugacity	Low		
Vapour pressure of the substance	1 (corresponds to ca. 90°C)		hPa
Amounts used			
Not relevant in ECETOC TRA			
Frequency and duration of use/exposure			
Duration of exposure	15min - 1h		per day
Frequency of exposure	≤ 240		days/year
Other given operational conditions affecting workers exposure			
Location	Indoors		
Domain	Industrial		
Technical conditions and measures at process level (source) to prevent release			
Not relevant			
Technical conditions and measures to control dispersion from source towards the worker			
Appropriate local exhaust ventilation	No		
Organisational measures to prevent /limit releases, dispersion and exposure			
Avoiding frequent and direct contact with substance. Minimisation of manual phases. Regular cleaning of equipment and work area. Supervision in place to check that the RMMs in place are being used correctly and OCs followed.			
Conditions and measures related to personal protection, hygiene and health evaluation			
Use of suitable respiratory protection	No		
Use of suitable chemical resistant gloves in combination with basic employee training	Cross reference to Qualitative Exposure Assessment		
Use of suitable eye protection			
Control of workers exposure for PROC 8b			
Title information related to contributing scenario			
Workers related free short title	Transfer of substance or preparation (charging/discharging) from/to vessels/large containers at dedicated facilities		
Use descriptor covered	PROC 8b		
Processes, tasks, activities covered	Sampling		
Exposure Assessment Method	Tool used: ECETOC TRA Worker (v2.0)		
Product characteristic			
Physical state	Liquid		Operation conditions: temperature 90°C
Concentration of substance	100		%
Fugacity	Low		
Vapour pressure of the substance	1 (corresponds to 90°C)		hPa

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Amounts used		
Not relevant in ECETOC TRA		
Frequency and duration of use/exposure		
Duration of exposure	15min-1h	per day
Frequency of exposure	≤ 240	days/year
Other given operational conditions affecting workers exposure		
Location	Indoors	
Domain	Industrial	
Technical conditions and measures at process level (source) to prevent release		
Not relevant		
Technical conditions and measures to control dispersion from source towards the worker		
Appropriate local exhaust ventilation	No	
Organisational measures to prevent /limit releases, dispersion and exposure		
Avoiding frequent and direct contact with substance. Minimisation of manual phases. Regular cleaning of equipment and work area. Supervision in place to check that the RMMs in place are being used correctly and OCs followed.		
Conditions and measures related to personal protection, hygiene and health evaluation		
Use of suitable respiratory protection	No	
Use of suitable chemical resistant gloves in combination with basic employee training	Cross reference to Qualitative Exposure Assessment	
Use of suitable eye protection		

Exposure Estimation

Estimated exposure for workers

Route of exposure	Concentrations		Justification
	Value	Unit	
Long-term exposure, local, inhalative - PROC1	0.047	mg/m ³	
Long-term exposure, local, inhalative – PROC2	4.72	mg/m ³	
Long-term exposure, local, inhalative – PROC3	2.83	mg/m ³	
Long-term exposure, local, inhalative – PROC8b	4.72	mg/m ³	

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8. Exposure Scenario 8: Use of caprolactam as monomer for thermo hardened resins

Number of the ES	8	
Title of exposure scenario	Use of caprolactam as monomer for thermo hardened resins	
List of all use descriptors related to the life cycle stage	SU3; PROC 1, 3, 8a and 8b; ERC 6c	
Name of contributing environmental scenario and corresponding ERC	Industrial use of monomers for manufacture of thermo-plastics (ERC6c)	
Name(s) of contributing worker scenarios and corresponding PROCs	PROC 1: Use in closed process, no likelihood of exposure PROC 3: Use in closed batch process (synthesis or formulation) PROC 8a: Transfer of substance or preparation (charging/discharging) from/to vessels/large containers at non-dedicated facilities PROC 8b: Transfer of substance or preparation (charging/discharging) from/to vessels/large containers at dedicated facilities	
Contributing exposure scenario controlling worker exposure for PROC 1, 3, 8a and 8b		
Control of workers exposure for PROC 1		
Title information related to contributing scenario		
Workers related free short title	Use in closed process, no likelihood of exposure	
Use descriptor covered	PROC 1	
Processes, tasks, activities covered	Use of the substances in high integrity contained system where little potential exists for exposures, e.g. any sampling via closed loop systems	
Exposure Assessment Method	Tool used: ECETOC TRA Worker (v2.0)	
Product characteristic		
Physical state	Liquid	Operation conditions: temperature ca. 100°C
Concentration of substance	100	%
Fugacity	Low	
Vapour pressure of the substance	2 (corresponds to ca. 100°C)	hPa
Amounts used		
Not relevant		
Frequency and duration of use/exposure		
Duration of exposure	> 4	hours/day
Frequency of exposure	≤ 240	days/year
Other given operational conditions affecting workers exposure		
Location	Indoors	
Domain	Industrial	
Technical conditions and measures at process level (source) to prevent release		
Not applicable – closed system		
Technical conditions and measures to control dispersion from source towards the worker		
Local exhaust ventilation required	No	
Organisational measures to prevent /limit releases, dispersion and exposure		
Not relevant		
Conditions and measures related to personal protection, hygiene and health evaluation		
Use of suitable respiratory protection	No	
Control of workers exposure for PROC 3		
Title information related to contributing scenario		
Workers related free short title	Use in closed batch process (synthesis or formulation)	
Use descriptor covered	PROC 3	
Processes, tasks, activities covered	Batch manufacture where the predominant handling is in a contained manner, e.g. through enclosed transfers, but where some opportunity for contact with chemicals occurs, e.g. through sampling	
Exposure Assessment Method	Tool used: ECETOC TRA Worker (v2.0)	
Product characteristic		
Physical state	Liquid	Operation conditions: temperature ca. 100°C
Concentration of substance	100	%
Fugacity	Low	
Vapour pressure of the substance	2 (corresponds to ca. 100°C)	hPa
Amounts used		
Not relevant in ECETOC TRA		
Frequency and duration of use/exposure		
Duration of exposure	15min - 1h	per day

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Frequency of exposure	≤ 240	days/year
Other given operational conditions affecting workers exposure		
Location	Indoors	
Domain	Industrial	
Technical conditions and measures at process level (source) to prevent release		
Not relevant		
Technical conditions and measures to control dispersion from source towards the worker		
Appropriate local exhaust ventilation	No	
Organisational measures to prevent /limit releases, dispersion and exposure		
Avoiding frequent and direct contact with substance. Minimisation of manual phases. Regular cleaning of equipment and work area. Supervision in place to check that the RMMs in place are being used correctly and OCs followed.		
Conditions and measures related to personal protection, hygiene and health evaluation		
Use of suitable respiratory protection	No	
Use of suitable chemical resistant gloves in combination with basic employee training	Cross reference to Qualitative Exposure Assessment	
Use of suitable eye protection		
Control of workers exposure for PROC 8a		
Title information related to contributing scenario		
Workers related free short title	Transfer of substance or preparation (charging/discharging) from/to vessels/large containers at non-dedicated facilities	
Use descriptor covered	PROC 8a	
Processes, tasks, activities covered	Filling in non- dedicated facilities	
Exposure Assessment Method	Tool used: ECETOC TRA Worker (v2.0)	
Product characteristic		
Physical state	Solid	Operation conditions: ambient temperature (< 40°C)
Concentration of substance	100	%
Dustiness	Low	
Vapour pressure of the substance	0.0013 (corresponds to ambient temperature)	hPa
Amounts used		
Not relevant in ECETOC TRA		
Frequency and duration of use/exposure		
Duration of exposure	<15 min	per day
Frequency of exposure	≤ 240	days/year
Other given operational conditions affecting workers exposure		
Location	Indoors	
Domain	Industrial	
Technical conditions and measures at process level (source) to prevent release		
Not relevant		
Technical conditions and measures to control dispersion from source towards the worker		
Appropriate local exhaust ventilation	No	
Organisational measures to prevent /limit releases, dispersion and exposure		
Avoiding frequent and direct contact with substance. Minimisation of manual phases. Regular cleaning of equipment and work area. Supervision in place to check that the RMMs in place are being used correctly and OCs followed.		
Conditions and measures related to personal protection, hygiene and health evaluation		
Use of suitable respiratory protection	No	
Use of suitable chemical resistant gloves in combination with basic employee training	Cross reference to Qualitative Exposure Assessment	
Use of suitable eye protection		
Control of workers exposure for PROC 8b		
Title information related to contributing scenario		
Workers related free short title	Transfer of substance or preparation (charging/discharging) from/to vessels/large containers at dedicated facilities	
Use descriptor covered	PROC 8b	
Processes, tasks, activities covered	Sampling	
Exposure Assessment Method	Tool used: ECETOC TRA Worker (v2.0)	
Product characteristic		
Physical state	Liquid	Operation conditions: temperature 100°C
Concentration of substance	100	%
Fugacity	Low	

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Vapour pressure of the substance	2 (corresponds to 100°C)	hPa
Amounts used		
Not relevant		
Frequency and duration of use/exposure		
Duration of exposure	15min-1h	per day
Frequency of exposure	≤ 240	days/year
Other given operational conditions affecting workers exposure		
Location	Indoors	
Domain	Industrial	
Technical conditions and measures at process level (source) to prevent release		
Not relevant		
Technical conditions and measures to control dispersion from source towards the worker		
Appropriate local exhaust ventilation	No	
Organisational measures to prevent /limit releases, dispersion and exposure		
Avoiding frequent and direct contact with substance. Minimisation of manual phases. Regular cleaning of equipment and work area. Supervision in place to check that the RMMs in place are being used correctly and OCs followed.		
Conditions and measures related to personal protection, hygiene and health evaluation		
Use of suitable respiratory protection	No	
Use of suitable chemical resistant gloves in combination with basic employee training	Cross reference to Qualitative Exposure Assessment	
Use of suitable eye protection		

Exposure Estimation

Estimated exposure for workers

Route of exposure	Concentrations		Justification
	Value	Unit	
Long-term exposure, local, inhalative – PROC1	0.047	mg/m ³	
Long-term exposure, local, inhalative - PROC3	2.83	mg/m ³	
Long-term exposure, local, inhalative – PROC8a	0.05	mg/m ³	
Long-term exposure, local, inhalative – PROC8b	4.72	mg/m ³	

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9. Exposure Scenario 9: Use of caprolactam as plasticizer for polyamide

Number of the ES	9	
Title of exposure scenario	Use of caprolactam as plasticizer for polyamide	
List of all use descriptors related to the life cycle stage	SU3; PROC 2, 3, 8b and 14; ERC 5	
Name of contributing environmental scenario and corresponding ERC	Industrial use resulting in inclusion into or onto a matrix (ERC5)	
Name(s) of contributing worker scenarios and corresponding PROCs	PROC 2: Use in closed, continuous process with occasional controlled exposure PROC 3: Use in closed batch process (synthesis or formulation) PROC 8b: Transfer of substance or preparation (charging/discharging) from/to vessels/large containers at dedicated facilities PROC 14: Production of preparations or articles by tableting, compression, extrusion, pelletisation	
Contributing exposure scenario controlling worker exposure for PROC 2, 3, 8b and 14		
Control of workers exposure for PROC 2		
Title information related to contributing scenario		
Workers related free short title	Use in closed, continuous process with occasional controlled exposure	
Use descriptor covered	PROC 2	
Processes, tasks, activities covered	Continuous process but where the design philosophy is not specifically aimed at minimizing emissions. Occasional exposure will arise e.g. through maintenance, sampling and equipment breakages	
Exposure Assessment Method	Tool used: ECETOC TRA Worker (v2.0)	
Product characteristic		
Physical state	Liquid	Operation conditions: temperature ca. 250°C
Concentration of substance	TRA 1-5	%
Fugacity	High	
Vapour pressure of the substance	700 (corresponds to ca. 250°C)	hPa
Amounts used		
Not relevant in ECETOC TRA		
Frequency and duration of use/exposure		
Duration of exposure	> 4	hours/day
Frequency of exposure	≤ 240	days/year
Other given operational conditions affecting workers exposure		
Location	Indoors	
Domain	Industrial	
Technical conditions and measures at process level (source) to prevent release		
Not relevant		
Technical conditions and measures to control dispersion from source towards the worker		
Local exhaust ventilation required	Yes	Effectiveness: 90%
Organisational measures to prevent /limit releases, dispersion and exposure		
Avoiding frequent and direct contact with substance. Minimisation of manual phases. Regular cleaning of equipment and work area. Supervision in place to check that the RMMs in place are being used correctly and OCs followed.		
Conditions and measures related to personal protection, hygiene and health evaluation		
Use of suitable respiratory protection	No	
Use of suitable chemical resistant gloves in combination with basic employee training	Cross reference to Qualitative Exposure Assessment	
Use of suitable eye protection		
Best practice advise		
Probing/sampling with considerable vapor release should not exceed 1h/day. Otherwise appropriate risk reduction measures (e.g. outside, LEV or breathing protection) are recommended.		
Control of workers exposure for PROC 3		
Title information related to contributing scenario		
Workers related free short title	Use in closed batch process (synthesis or formulation)	
Use descriptor covered	PROC 3	
Processes, tasks, activities covered	Mixing and feeding of pellets	
Exposure Assessment Method	Tool used: ECETOC TRA Worker (v2.0)	
Product characteristic		
Physical state	Solid	Operation conditions: ambient temperature
Concentration of substance	100	%
Dustiness	Low	

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Vapour pressure of the substance	0.0013 (corresponds to ambient temperature)	hPa
Amounts used		
Not relevant in ECETOC TRA		
Frequency and duration of use/exposure		
Duration of exposure	>4h	per day
Frequency of exposure	≤ 240	days/year
Other given operational conditions affecting workers exposure		
Location	Indoors	
Domain	Industrial	
Technical conditions and measures at process level (source) to prevent release		
Not relevant		
Technical conditions and measures to control dispersion from source towards the worker		
Appropriate local exhaust ventilation	No	
Organisational measures to prevent /limit releases, dispersion and exposure		
Avoiding frequent and direct contact with substance. Minimisation of manual phases. Regular cleaning of equipment and work area. Supervision in place to check that the RMMs in place are being used correctly and OCs followed.		
Conditions and measures related to personal protection, hygiene and health evaluation		
Use of suitable respiratory protection	No	
Use of suitable chemical resistant gloves in combination with basic employee training	Cross reference to Qualitative Exposure Assessment	
Use of suitable eye protection		
Control of workers exposure for PROC 8b		
Title information related to contributing scenario		
Workers related free short title	Transfer of substance or preparation (charging/discharging) from/to vessels/large containers at dedicated facilities	
Use descriptor covered	PROC 8b	
Processes, tasks, activities covered	Granulation and transfer/filling in dedicated facilities, 60°C	
Exposure Assessment Method	Tool used: ECETOC TRA Worker (v2.0)	
Product characteristic		
Physical state	Solid	Operation conditions: temperature 60°C
Concentration of substance	TRA 1-5	%
Dustiness	low	
Vapour pressure of the substance	< 1 (corresponds to 60 °C)	hPa
Amounts used		
Not relevant in ECETOC TRA		
Frequency and duration of use/exposure		
Duration of exposure	> 4 h	per day
Frequency of exposure	≤ 240	days/year
Other given operational conditions affecting workers exposure		
Location	indoors	
Domain	Industrial	
Technical conditions and measures at process level (source) to prevent release		
Not relevant		
Technical conditions and measures to control dispersion from source towards the worker		
Appropriate local exhaust ventilation	No	
Organisational measures to prevent /limit releases, dispersion and exposure		
Avoiding frequent and direct contact with substance. Minimisation of manual phases. Regular cleaning of equipment and work area. Supervision in place to check that the RMMs in place are being used correctly and OCs followed.		
Conditions and measures related to personal protection, hygiene and health evaluation		
Use of suitable respiratory protection	No	
Use of suitable chemical resistant gloves in combination with basic employee training	Cross reference to Qualitative Exposure Assessment	
Use of suitable eye protection		
Control of workers exposure for PROC 14		
Title information related to contributing scenario		
Workers related free short title	Production of preparations or articles by tableting, compression, extrusion, pelletisation	
Use descriptor covered	PROC 8b	
Processes, tasks, activities covered	Pelletisation under cold water at ambient temperature, maximum 60°C	
Exposure Assessment Method	Tool used: ECETOC TRA Worker (v2.0)	

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Product characteristic		
Physical state	Solid	Operation conditions: temperature max. 60°C
Concentration of substance	TRA 1-5	%
Dustiness	Low	
Vapour pressure of the substance	< 1 (corresponds to 60°C)	hPa
Amounts used		
Not relevant in ECETOC TRA		
Frequency and duration of use/exposure		
Duration of exposure	> 4 h	per day
Frequency of exposure	≤ 240	days/year
Other given operational conditions affecting workers exposure		
Location	Indoors	
Domain	Industrial	
Technical conditions and measures at process level (source) to prevent release		
Not relevant		
Technical conditions and measures to control dispersion from source towards the worker		
Appropriate local exhaust ventilation	No	
Organisational measures to prevent/limit releases, dispersion and exposure		
Avoiding frequent and direct contact with substance. Minimisation of manual phases. Regular cleaning of equipment and work area. Supervision in place to check that the RMMs in place are being used correctly and OCs followed.		
Conditions and measures related to personal protection, hygiene and health evaluation		
Use of suitable respiratory protection	No	
Use of suitable chemical resistant gloves in combination with basic employee training	Cross reference to Qualitative Exposure Assessment	
Use of suitable eye protection		

Exposure Estimation**Estimated exposure for workers**

Route of exposure	Concentrations		Justification
	Value	Unit	
Long-term exposure, local, inhalative – PROC2	4.72	mg/m ³	
Long-term exposure, local, inhalative - PROC3	0.1	mg/m ³	
Long-term exposure, local, inhalative – PROC8b	0.1	mg/m ³	
Long-term exposure, local, inhalative – PROC14	0.02	mg/m ³	

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10. Exposure Scenario 10: Use of caprolactam in leather tanning, finishing, impregnation, coatings and paints

Number of the ES	10		
Title of exposure scenario	Use of caprolactam in leather tanning, finishing, impregnation, coatings and paints		
List of all use descriptors related to the life cycle stage	SU3, 22; PROC 10, 13; ERC 6b		
Name of contributing environmental scenario and corresponding ERC	Industrial use of reactive processing aids (ERC 6b)		
Name(s) of contributing worker scenarios and corresponding PROCs	PROC 10: Roller application or brushing PROC 13: Treatment of articles by dipping and pouring		
Contributing exposure scenario controlling worker exposure for PROC 10, 13			
Control of workers exposure for PROC 10			
Title information related to contributing scenario			
Workers related free short title	Roller application or brushing		
Use descriptor covered	PROC 10		
Processes, tasks, activities covered	Low energy spreading of e.g. coatings		
Exposure Assessment Method	Tool used: ECETOC TRA Worker (v2.0)		
Product characteristic			
Physical state	Liquid	Operation conditions: at ambient temperatures	
Concentration of substance	TRA 1-5	%	
Fugacity	Low		
Vapour pressure of the substance	0.0013 (corresponds to 90°C)	hPa	
Amounts used			
Not relevant in ECETOC TRA			
Frequency and duration of use/exposure	Industrial Domain	Professional Domain	
Duration of exposure	15min – 1h	15min – 1h	per day
Frequency of exposure	≤ 240	≤ 240	days/year
Other given operational conditions affecting workers exposure			
Location	Indoor	Indoor	
Domain	Industrial	Professional	
Technical conditions and measures at process level (source) to prevent release			
Not relevant			
Technical conditions and measures to control dispersion from source towards the worker			
Appropriate local exhaust ventilation	No		
Organisational measures to prevent /limit releases, dispersion and exposure			
Avoiding frequent and direct contact with substance. Minimisation of manual phases. Regular cleaning of equipment and work area. Supervision in place to check that the RMMs in place are being used correctly and OCs followed.			
Conditions and measures related to personal protection, hygiene and health evaluation			
Use of suitable respiratory protection	No		
Use of suitable chemical resistant gloves in combination with basic employee training	Cross reference to Qualitative Exposure Assessment		
Use of suitable eye protection			
Control of workers exposure for PROC 13			
Title information related to contributing scenario			
Workers related free short title	Treatment of articles by dipping and pouring		
Use descriptor covered	PROC 13		
Processes, tasks, activities covered	Immersion operations (low energy application onto a surface)		
Exposure Assessment Method	Tool used: ECETOC TRA Worker (v2.0)		
Product characteristic			
Physical state	Liquid	Operation conditions: at ambient temperatures	
Concentration of substance	TRA 1-5	%	
Fugacity	Low		
Vapour pressure of the substance	0.0013 (corresponds to 90°C)	hPa	
Amounts used			
Not relevant in ECETOC TRA			
Frequency and duration of use/exposure	Industrial Domain	Professional Domain	
Duration of exposure	15min – 1h	15min – 1h	per day
Frequency of exposure	≤ 240	≤ 240	days/year
Other given operational conditions affecting workers exposure			
Location	Indoor	Indoor	
Domain	Industrial	Professional	

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Technical conditions and measures at process level (source) to prevent release	
Not relevant	
Technical conditions and measures to control dispersion from source towards the worker	
Appropriate local exhaust ventilation	No
Organisational measures to prevent /limit releases, dispersion and exposure	
Avoiding frequent and direct contact with substance. Minimisation of manual phases. Regular cleaning of equipment and work area. Supervision in place to check that the RMMs in place are being used correctly and OCs followed.	
Conditions and measures related to personal protection, hygiene and health evaluation	
Use of suitable respiratory protection	No
Use of suitable chemical resistant gloves in combination with basic employee training	Cross reference to Qualitative Exposure Assessment
Use of suitable eye protection	

Exposure Estimation
Estimated exposure for workers – PROC 10, 13

Route of exposure	Concentrations		Unit	Justification
	Industrial Domain	Professional Domain		
Long-term exposure, local, inhalative - PROC10	2.83	4.72	mg/m ³	
Long-term exposure, local, inhalative – PROC13	2.83	2.83	mg/m ³	

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11. Exposure Scenario 11: Use as laboratory chemical

Number of the ES	11	
Title of exposure scenario	Use as laboratory chemical	
List of all use descriptors related to the life cycle stage	SU 22; PROC 15; ERC 8c, PC21	
Name of contributing environmental scenario and corresponding ERC	Wide dispersive indoor use resulting in inclusion into or onto a matrix (ERC 8c)	
Name(s) of contributing worker scenarios and corresponding PROCs	Use as laboratory reagent	
Contributing exposure scenario controlling worker exposure for PROC 15		
Control of workers exposure for PROC 15 (Solid)		
Title information related to contributing scenario		
Workers related free short title	Use as laboratory reagent	
Use descriptor covered	PROC 15	
Processes, tasks, activities covered	Analytical work in the lab	
Exposure Assessment Method	Tool used: ECETOC TRA Worker (v2.0)	
Product characteristic		
Physical state	Solid	Operation conditions: ambient temperature
Concentration of substance	100	%
Dustiness	Low	
Vapour pressure of the substance	0.0013 (corresponds to ambient temperature)	hPa
Amounts used		
Not relevant in ECETOC TRA		
Frequency and duration of use/exposure		
Duration of exposure	> 4h	per day
Frequency of exposure	≤ 240	days/year
Other given operational conditions affecting workers exposure		
Location	Indoors	
Domain	Professional	
Technical conditions and measures at process level (source) to prevent release		
Not relevant		
Technical conditions and measures to control dispersion from source towards the worker		
Appropriate local exhaust ventilation	No	
Organisational measures to prevent/limit releases, dispersion and exposure		
Avoiding frequent and direct contact with substance. Minimisation of manual phases. Regular cleaning of equipment and work area. Supervision in place to check that the RMMs in place are being used correctly and OCs followed.		
Conditions and measures related to personal protection, hygiene and health evaluation		
Use of suitable respiratory protection	No	
Use of suitable chemical resistant gloves in combination with basic employee training	Cross reference to Qualitative Exposure Assessment	
Use of suitable eye protection		
Control of workers exposure for PROC 15 (liquid)		
Title information related to contributing scenario		
Workers related free short title	Use as laboratory reagent	
Use descriptor covered	PROC 15	
Processes, tasks, activities covered	Analytical work in the lab	
Exposure Assessment Method	Tool used: ECETOC TRA Worker (v2.0)	
Product characteristic		
Physical state	Liquid	Operation conditions: 90°C
Concentration of substance	100	%
Fugacity	Low	
Vapour pressure of the substance	1 (corresponds to ambient temperature)	hPa
Amounts used		
Not relevant		
Frequency and duration of use/exposure		
Duration of exposure	> 4h	per day
Frequency of exposure	≤ 240	days/year
Other given operational conditions affecting workers exposure		

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Location	Indoors	
Domain	Professional	
Technical conditions and measures at process level (source) to prevent release		
Not relevant		
Technical conditions and measures to control dispersion from source towards the worker		
Appropriate local exhaust ventilation	Yes	Effectiveness 80%
Organisational measures to prevent /limit releases, dispersion and exposure		
Avoiding frequent and direct contact with substance. Minimisation of manual phases. Regular cleaning of equipment and work area. Supervision in place to check that the RMMs in place are being used correctly and OCs followed.		
Conditions and measures related to personal protection, hygiene and health evaluation		
Use of suitable respiratory protection	No	
Use of suitable chemical resistant gloves in combination with basic employee training	Cross reference to Qualitative Exposure Assessment	
Use of suitable eye protection		

Exposure Estimation**Estimated exposure for workers – PROC 15 (solid)**

Route of exposure	Concentrations		Justification
	Value	Unit	
Long-term exposure, local, inhalative	0.1	mg/m ³	

Estimated exposure for workers – PROC 15 (liquid)

Route of exposure	Concentrations		Justification
	Value	Unit	
Long-term exposure, local, inhalative	4.72	mg/m ³	

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12.Exposure Scenario 12: Consumer use in coatings/paints

General remarks: For the use of coatings, paints and adhesives containing caprolactam the use of ready-to-use products for which no dilution and mixing steps are necessary was assumed.

PC18: To reflect a reasonable worst case scenario, the following assumptions have been made:

- A toner contains 750g of printing ink
- 750g print ink is sufficient to print 8000 pages
- 500 pages per day are printed
- The printing rate is 50 pages per minute

Generally, two steps have been assessed. Refilling of toners (cartridges) (Part A) and the printing process itself (Part B-1 or Part B-2). For the step "Refilling of toners" the ConsExpo default database for Cleaning and washing/All-purpose cleaner/Liquid/Mixing and Loading was regarded to be suitable as a basis for the inhalative exposure estimation. The step "Printing process" was calculated using the evaporation model postulating instantaneous release as a worst case. Two possible scenarios were evaluated: Part B-1 and B-2.

Control of consumer exposure for PC 18		
Name of contributing scenario	Use in Printing inks	
Use descriptor covered	SU21, PC 18	
Processes, tasks, activities covered	Refilling of toners (cartridges) – Part A; Printing process – Part B: Part B-1 - Continuous printing of pages over a longer period of time (e.g. 500 pages over a period of 8 hours) Part B-2 - Printing of a large number of pages at once (e.g. 500 pages within 10 minutes)	
Assessment Method	ConsExpo 4.1 Refilling of toners (Part A): Based on the ConsExpo default database for Cleaning and washing/All-purpose cleaner/Liquid/Mixing and Loading Printing process: Inhalation – evaporation model/instantaneous release	
Part A. Refilling step		
Product characteristic		
Physical state	Liquid	
Concentration of substance	max. 5%	
Vapour pressure of the substance	0.0013 hPa (ambient temperature)	
Mol weight matrix	113.16 g/mol	High fraction of water is assumed
Mass transfer rate	0.284 m/min	Thibodeaux's method ¹ ;
Amounts used		
Applied amount	750 g	
Frequency and duration of use/exposure		
Duration of exposure	0.75 min	(Default value)
Duration of application	0.3 min	(Default value)
Frequency of exposure	365 days/year	Not relevant for the calculation of the mean concentration on day of exposure
Human factors not influenced by risk management		
Type of activity (inhalation rate)	Light activity	See footnote 2
Other given operational conditions affecting workers exposure		
Location	Inside	
Room volume	-	A "personal volume" of 1m ³ is assumed
Ventilation rate	0.5 per hour	(Default value)
Release area	20cm ²	(Default value)
Application temperature	25°C	
Conditions and measures related to information and behavioural advice to consumers		
Not applicable		
Conditions and measures related to personal protection and hygiene		
Not applicable		
Part B-1. Printing process/8 hours		
Product characteristic		
Physical state	Liquid	
Concentration of substance	max. 5%	
Vapour pressure of the substance	0.0013 hPa	
Amounts used		
Applied amount	46.8 g/day	Amount of printing ink needed to print 500 pages
Frequency and duration of use/exposure		
Duration of exposure	8 hours	
Frequency of exposure	365 days/year	Not relevant for the calculation of the mean concentration on day of exposure

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Human factors not influenced by risk management		
Type of activity (inhalation rate)	Light activity	See footnote 2
Other given operational conditions affecting workers exposure		
Location	Inside	
Room volume	25 m ³	See footnote 3
Ventilation rate	0.6 per hour	See footnote 4
Application temperature	25°C	
Organisational measures to prevent /limit releases, dispersion and exposure		
Not applicable		
Conditions and measures related to personal protection, hygiene and health evaluation		
Not applicable		
Part B-2. Printing process / 10 mins		
Product characteristic		
Physical state	Liquid	
Concentration of substance	max. 5%	
Vapour pressure of the substance	0.0013 hPa	
Amounts used		
Applied amount	46.8 g/day	Amount of printing ink needed to print 500 pages
Frequency and duration of use/exposure		
Duration of exposure	10 min	
Frequency of exposure	365 days/year	Not relevant for the calculation of the mean concentration on day of exposure
Human factors not influenced by risk management		
Type of activity (inhalation rate)	Light activity	See footnote 2
Other given operational conditions affecting workers exposure		
Location	Inside	
Room volume	25m ³	See footnote 3
Ventilation rate	0.6 per hour	See footnote 4
Application temperature	25°C	
Organisational measures to prevent /limit releases, dispersion and exposure		
Not applicable		
Conditions and measures related to personal protection, hygiene and health evaluation		
Not applicable		

¹ According to the ConsExpo Manual (Delmaar, J.E. et al., ConsExpo4.0 – Consumer Exposure and Uptake Models – Program Manual. RIVM report 320104004/2005) the Thibodeaux's method is an approximation for the evaporation of a solute from water. Thus the exposure estimation based on Thibodeaux's method applies for waterbased printing inks.

² The type of activity and the corresponding influence do not have direct relevance for the given exposure estimations. However the type of activity is regarded to be considered within the DNEL derivation.

³ A room volume of 25 m³ is postulated. This is considered to represent the worst case for the room volume of a home office (room with workstation and some racks)

⁴ An air exchange rate of 0.6 hour is considered to represent a reasonable average value (Wallace, L.A. et al., 2002. Continuous measurements of air exchange rates in an occupied house for 1 year. The effect of temperature, wind, fans and windows. Journal of Exposure Analysis and Environmental Epidemiology, 12, 296-306; Bremmer, H. J. et al. General Fact Sheet. Limiting conditions and reliability, ventilation, room size, body surface area Updated version for ConsExpo 4. RIVM report 320104002/2006)

Estimated exposure for consumers for PC18

Calculation tool used: ConsExpo 4.1

Route of exposure	dose/conc	Unit	Justification
Part A. Refilling step			
Long-term exposure, local, inhalative	3.09*10 ⁻⁵	mg/m ³	Estimated exposure value is regarded to be negligible and will be disregarded in further assessment (chapter 10)
Long-term exposure, local, dermal	NA	mg/kg bw/d	Quantitative assessment
Long-term exposure, systemic	NA	mg/kg bw/d	See General remarks
Part B-1. Printing process			
Long-term exposure, local, inhalative	0.000412	mg/m ³	
Long-term exposure, systemic, dermal	NA	mg/kg bw/d	Quantitative assessment
Long-term exposure, systemic	NA	mg/kg bw/d	See General remarks
Part B-2. Printing process			
Long-term exposure, systemic/local, inhalative	0.0198	mg/m ³	
Long-term exposure, systemic, dermal	NA	mg/kg bw/d	Quantitative assessment
Long-term exposure, systemic, oral	NA	mg/kg bw/d	See General remarks