

EC number:
203-234-3

2-ethylhexan-1-ol

CAS
number:
104-76-7

SAFETY DATA SHEET

Annex II

Exposure scenario

Substance Name: 2-ethylhexan-1-ol

EC Number: 203-234-3

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1. EXPOSURE ASSESSMENT

1.0 General information

1.0.1 Overview

An overview of the exposure scenarios is given in Table1.

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

ES no.	ES short title	Manufacture	Identified uses			Resulting life cycle stage		SU ¹	PC	PROC	AC	ERC
			Formulation	End use	Consumer use	Service life (for articles)	Waste stage					
ES 1	Manufacture	X					3 (8, 9)	NA	1, 2, 3, 4, 8a,b, 15	NA	1, 4 *	
ES 2	Distribution	X					3 (10)	NA	1, 2, 3, 4, 8a,b, 9, 15	NA	1, 2 *	
ES 3	Formulation		X				3 (10)	NA	1, 2, 3, 4, 5, 8a,b, 9, 14, 15	NA	2 *	
ES 4	Use in coatings (ind.)			X			3	5, 9a,b	1, 2, 3, 4, 5, 7, 8a,b, 9, 10, 13, 14, 15	NA	4 *	
ES 5	Use in coatings (prof.)			X			22	5, 9a,b	1, 2, 3, 4, 5, 8a,8b, 10, 11, 13, 15, 19	NA	8a,d *	
ES 6	Dilution of a concentrate (prof.)			X			22	NA ²	5, 8a,b	NA	8d [#]	
ES 7	Dilution of a concentrate (cons.)				X		21	NA ²	NA	NA	8d [#]	
ES 8	Use in laboratories			X			3	NA	10, 15	NA	2, 4 *	
ES 9	Use in functional fluids (ind.)			X			3	4, 17, 24	1, 2, 3, 4, 8a,b, 9, 20	NA	7 *	
ES 10	Use in functional fluids (prof.)			X			22	4, 17, 24	1, 2, 3, 8a, 9, 20	NA	9a,b *	
ES 11	Use in cleaning products			X			22	35	2, 3, 4, 8a, 8b, 10, 11, 13	NA	8a,d *	
ES 12	Use in oil and gas field drilling			X			3 (2b)	20	1, 2, 3, 4, 8a,b	NA	4 *	

CONF: confidential

¹ SU: Sector of use; PC: Product category; PROC: Process category; AC: Article category; ERC: Environmental Release Category

² Different products categories are covered by this scenario but exposure is determined by the dilution event and not by the type of product

* specific ERCs (spERCs) were used in the exposure estimation; see the following chapters

[#] also covers ERC 8a

1.0.2. Scope and type of exposure assessment

General scope

A complete quantitative exposure assessment has been performed for both the environment and for human health hazards.

Exposure modelling and input parameters

ConsExpo (version 4.1) was used for consumer exposure assessment (see ES 7 below) and the ECETOC TRA integrated tool (version July 2010) was used for exposure estimation of both workers and the environment. The following adaptations were used:

- Consumers: the adaptations are fully explained in the respective ES 7 below.
- Workers: in agreement with the ECHA Guidance on information requirements and chemical safety assessment (Chapter R.14, May 2010) the effectiveness of the local exhaust ventilation regarding dermal exposure was set to 50%, a value “significantly below the 90 to 99% assumed in the TRA” as envisaged in the Guidance.
- Environment: specific environmental release categories (spERCs) developed by ESIG/ESVOC were used for all exposure scenarios but ES 6 and ES 7. These spERCs are implemented in the ECETOC TRA tool and are documented online (<http://www.esig.org/en/regulatory-information/reach/ges-library/ges-spercs-2>).

The following general input parameters were used in the exposure assessment:

Parameter	Value	Comment
Molecular weight [g/mol]	130.23	
Vapour pressure [Pa]	99	based on experimental value of <100 Pa at 20°C
Water solubility [mg/L]	900	
Partition coefficient octanol/water (Kow)	794.33	
Biodegradability test result	readily biodegradable	
Koc [L/kg] used for partitioning modelling	chemical class QSAR	

Data presentation

The results of the environmental exposure estimation are fully given for the respective exposure scenarios. For workers, only the maximum exposure estimated in ECETOC TRA across all PROCs are shown for each ES due to the large number of PROCs. However, all PROCs requiring refinement in the exposure estimate are identified and the necessary measures (often impossible to model in ECETOC TRA) explained. Detailed results per PROC obtained from ECETOC TRA are given in the Appendix 1.

All necessary operational conditions of use (e.g. a limitation of the exposure duration) and risk management measures (e.g. use of LEV) are given in the exposure scenarios. This refers both to those OCs and RMMs already included in ECETOC TRA in the initial exposure assessment and those applied outside the ECETOC TRA tool.

Peak inhalation exposures at the workplace

Short term (peak) exposure situations (inhalation exposure) at the workplace are considered as follows:

The substance is classified with

- Acute Tox 4 (H332)
- Skin Irrit. 2 (Hazard statement: H315)
- Eye Irrit. 2A (Hazard statement: H319) and
- STOT Single Exp. 3 (Hazard statement: H335).

A DNEL of 10 ppm (53.2 mg/m³) has been derived for long-term (8 h shift average, chronic exposure) exposure at the workplace. A DNEL of 20 ppm (106.4 mg/m³) has been derived as a short-term value for peak exposure situations of up to 15 min duration. This short-term DNEL, equivalent to the German OEL, is explicitly meant to protect also from sensory and respiratory irritation. According to ECHA Guidance on Information Requirements and Chemical Safety Assessment, R.14 (Occupational Exposure Assessment), shift average estimates obtained by ECETOC TRA can be considered to represent conservative 90th percentiles of the distribution of exposure concentrations. According to the Guidance document, potential peak exposure concentrations at the workplace (representing 95th percentiles of the peak exposure concentrations) can be extrapolated from these shift average concentrations by an additional factor of 2. No information is available from the use and practical experience with the substance, which would require a higher factor.

Based on this extrapolation peak exposures may exceed ECETOC TRA estimated shift averages by a factor of 2, whereas the DNEL for short-term exposure is twice the long-term DNEL. Hence, it can be concluded that for all workplace situations, where safe use could be demonstrated based on exposure estimates from ECETOC TRA, that also potential peak exposures would not give rise to increased risks.

Qualitative risk characterisation

The substance is classified as skin and eye irritant (Skin Irrit. 2 - H315; Eye Irrit. 2A - H319). For these effects a qualitative risk assessment has been performed in Chapter 10.

The substance is not classified for human health hazards from physico-chemical properties. Hence, no risk characterisation is required for these types of risks.

1.0.3. Regional environmental exposure from the releases of all exposure scenarios covered

1.0.3.1. Regional exposure: environment

The regional PECs presented in the following table were calculated for the region with the largest manufacturer.

Table 2: Summary of predicted regional exposure concentrations (Regional PEC)

Protection target	Regional PEC	
Water [mg/l]:	0.001	Surface water
	0.000087	Sea water
Air [mg/m ³]:	0.00002	
Soil [mg/kg dw]:	0.00045	Agricultural soil
	0.0000046	Natural soil
	0.0000046	Industrial soil

1.0.3.2. Regional exposure: man via environment

The regional total daily intake was calculated for the region with the largest manufacturer.

Regional total estimated daily intake for humans: 0.16 µg/kg bw / d

Table 3: Summary of estimated daily human doses through intake and concentrations in food from regional exposure

Type of food	Estimated daily human doses [µg/kg bw x d]
Drinking water	0.029
Fish	0.097
Leaf crops	0.00085
Root crops	0.023
Meat	0.0000053
Milk	0.0000039
Sum oral doses	0.15

The following exposure scenarios communicate all operational conditions and risk management measures necessary to ensure safe use of the substance. This information refers to the PROC level based on ECETOC TRA calculations for workers and relates to the following data:

- Concentration of substance in mixture
- Frequency and duration
- Processing temperature and pressure
- Ventilation (LEV)
- personal protective equipment (PPE)

In addition, the field "Technical conditions and measures at process level (source) to prevent release" contains task-specific advice taken from the ESVOC generic exposure scenarios. All sentences in blue refer to good practice advice beyond REACH Chemical Safety Assessments.

1.1. Manufacture of substance (ES 1)**1.1. ES1 - Manufacture of isobutanol (Industrial)****1.1.1. Exposure scenario**

Section 1		Exposure Scenario Title
Title	Manufacture of 2-ethylhexan-1-ol; CAS: 104-76-7	
Use Descriptor	Sector of Use: Industrial (SU8, SU9)	
	Process Categories: PROC1, PROC2, PROC3, PROC4, PROC8a, PROC8b, PROC15	
	Environmental Release Categories: ERC1, ERC4, ERC6a	
Processes, tasks, activities covered	Use as process chemical or extraction agent. Includes recycling/ recovery, material transfers, storage, maintenance and loading (including marine vessel/barge, road/rail car and bulk container), sampling and associated laboratory activities	
Section 2		Operational conditions and risk management measures
Section 2.1		Control of worker exposure
Product characteristics		
Physical form of product	Liquid, vapour pressure 0.5 - 10 kPa [OC4].	
Concentration of substance in product	Covers percentage substance in the product up to 100 % (unless stated differently) [G13].	
Amounts used	<i>Not applicable</i>	
Frequency and duration of use	Covers daily exposures up to 8 hours (unless stated differently) [G2]	
Human factors not influenced by risk management	<i>Not applicable</i>	
Other Operational Conditions affecting worker exposure	Assumes a good basic standard of occupational hygiene is implemented [G1]. Assumes activities are at ambient temperature (unless stated differently) [G17]. Operation is carried out at elevated temperature (> 20°C above ambient temperature) [OC7]. (PROC17, PROC18)	
Contributing Scenarios	PROCs	Risk Management Measures
General exposures (closed systems) [CS15]. Continuous process [CS54].	1	Minimization of manual phases. #1 Avoid frequent and direct contact with substance. #1 Supervision in place to check that the RMMs in place are being used correctly and OCs followed. #1 Use suitable eye protection and gloves [PPE14]. #1
General exposures (closed systems) [CS15]. Continuous process [CS54]. With sample collection [CS56]. Equipment cleaning and	2	Minimization of manual phases. #1 Avoid frequent and direct contact with substance. #1 Supervision in place to check that the RMMs in place are being used correctly and OCs followed.

maintenance [CS39].		#1 Use suitable eye protection and gloves [PPE14]. ^{#1}
General exposures (closed systems) [CS15]. Batch process [CS55]. With sample collection [CS56].	3	Minimization of manual phases. ^{#1} Avoid frequent and direct contact with substance. ^{#1} Supervision in place to check that the RMMs in place are being used correctly and OCs followed. ^{#1} Use suitable eye protection and gloves [PPE14]. ^{#1}
General exposures (open systems) [CS16]. Batch process [CS55]. With sample collection [CS56].	4	Minimization of manual phases. ^{#1} Avoid frequent and direct contact with substance. ^{#1} Supervision in place to check that the RMMs in place are being used correctly and OCs followed. ^{#1} Use suitable eye protection and gloves [PPE14]. ^{#1}
Transfer from/pouring from containers [CS22]. Non-dedicated facility [CS82]	8a	Provide extract ventilation to points where emissions occur [E54]. (effectiveness LEV: 90%) Minimization of manual phases. ^{#1} Avoid frequent and direct contact with substance. ^{#1} Supervision in place to check that the RMMs in place are being used correctly and OCs followed. ^{#1} Use suitable eye protection and gloves [PPE14]. ^{#1}
Transfer from/pouring from containers [CS22]. Dedicated facility [CS81]	8b	Provide extract ventilation to points where emissions occur [E54]. (effectiveness LEV: 97%) Minimization of manual phases. ^{#1} Avoid frequent and direct contact with substance. ^{#1} Supervision in place to check that the RMMs in place are being used correctly and OCs followed. ^{#1} Use suitable eye protection and gloves [PPE14]. ^{#1}
Laboratory activities [CS36]. Small scale [CS61].	15	Minimization of manual phases. ^{#1} Avoid frequent and direct contact with substance. ^{#1} Supervision in place to check that the RMMs in place are being used correctly and OCs followed. ^{#1} Use suitable eye protection and gloves [PPE14]. ^{#1}

^{#1} refers to qualitative assessment

1.1.2. Exposure estimation

Table 4: Exposure levels after assessment of safe use for ES1 - Manufacture of 2-ethylhexan-1-ol (Industrial)

Contributing Scenarios	PROCs	Inhalative Exposure (long term) Predicted Inhalative Exposure (mg/m³)
General exposures (closed systems) [CS15]. Continuous process [CS54].	1	0.03
General exposures (closed systems) [CS15]. ; Continuous process [CS54]. With sample collection [CS56]. Equipment cleaning and maintenance [CS39].	2	30.88
General exposures (closed systems) [CS15]. Batch process [CS55]. With sample collection [CS56].	3	77.19
General exposures (open systems) [CS16]. Batch process [CS55]. With sample collection [CS56].	4	61.75
Transfer from/pouring from containers [CS22]. Non-dedicated facility [CS82]	8a	15.44
Transfer from/pouring from containers [CS22]. Dedicated facility [CS81]	8b	4.63
Laboratory activities [CS36]. Small scale [CS61].	15	30.88

For dermal exposure and effects on the eyes, a qualitative assessment was conducted.

1.2. Distribution of substance (ES 2)

1.2.1. Exposure Scenario for Distribution of substance (ES 2)

Table 5. exposure scenario 2: distribution

Exposure Scenario 2: Distribution of substance	
Industrial use: SU 3 (SU 10)	
Environmental exposure scenario: ESVOC 3, spERC 1.1b.v1 (specifies ERC 1, 2)	
Workers scenario ESVOC GES 1A (industrial); PROC 1, 2, 3, 4, 8a, 8b, 9, 15	
Loading (including marine vessel/barge, rail/road car and IBC loading) and repacking (including drums and small packs) of substance, including its sampling, storage, unloading and associated laboratory activities	
Environmental exposure	
Based on ESVOC spERC: ESVOC 3 (ECETOC TRA) = spERC 1.1b.v1	
Loading (including marine vessel/barge, rail car and IBC loading) and repacking (including drums and small packs), including losses during off-site storage (e.g. terminals)	
Product characteristics	
Physical state	Liquid
Vapour pressure of substance	< 100 Pa at 20°C
Concentration of substance in mixture	N/A
Amounts used	
Annual amount (per industrial use)	200.000 t/a
Daily amount (per site for industrial use) (M_{use})	1.3 t/d (calculated by ECETOC TRA)
M_{safe}	20 t/d (calculated by ECETOC TRA)
Frequency and duration of use	
Continuous use/release	
Environment factors not influenced by risk management	
Flow rate of receiving surface water	18000 m ³ /day (ECETOC TRA default)
Other given operational conditions affecting environmental	
Processing setting (indoor/outdoor)	Indoor and outdoor use
Processing temperature and pressure	Ambient temperature and pressure
Technical conditions and measures at process level (source) to prevent release	
none	
Technical onsite conditions and measures to reduce or limit discharges, air emissions and releases to	
Industrial sewage treatment plant	No
Organizational measures to prevent/limit release from site	
None	
Conditions and measures related to municipal sewage treatment plant	
Municipal sewage treatment plant	yes
STP discharge rate	2 x 10 ³ m ³ /day (ECETOC TRA default)
Efficacy (substance removal in STP)	88% (calculated by ECETOC TRA)
Sludge treatment technique	disposal or recovery
Conditions and measures related to external treatment of waste for disposal	
Dispose of waste solvent or used containers according to local regulations [ENVT12]	
Conditions and measures related to external recovery of waste	
None	
Additional good practice advice (for environment) beyond the REACH CSA	
None	
Worker exposure	
Based on ESVOC GES 1A: Distribution of substance (industrial), low volatility solvent with DNEL inhalation ≥ 10 ppm, DNEL dermal ≥ 5 mg/kg/d	
Product characteristics	
Physical state	Liquid

Vapour pressure of substance	< 100 Pa at 20°C
Concentration of substance in mixture	Pure substance (up to 100%)
Amounts used	
Not relevant for ECETOC TRA exposure estimates	
Frequency and duration of use/exposure	
Frequency and duration	Covers daily exposures up to 8 hours on 5 days/week
Human factors not influenced by risk management	
Potentially exposed body parts	Hands
Exposed skin surface	The extent of hand exposure (one hand or both hands, one side or both sides) differs between different PROCs, with the following values assumed in ECETOC TRA: 240 cm ² (PROC1, 3, 15), 480 cm ² (PROC2, 4, 8B, 9) or 960 cm ² (PROC8A)
Other given operational conditions affecting workers exposure	
Setting (indoor/outdoor)	Indoor and outdoor use
Room size	Not relevant for ECETOC TRA exposure estimates
Processing temperature and pressure	Assumes use at not more than 20°C above ambient temperature [G15]
Technical conditions and measures at process level (source) to prevent release	
<ul style="list-style-type: none"> - <i>General exposures (Closed systems) CS15</i>: Handle substance within a closed system. E47 Ensure material transfers are under containment or extract ventilation E66 - <i>General exposures (Open systems) CS16</i>: Ensure material transfers are under containment or extract ventilation [E66] Clear transfer lines prior to de-coupling E39 - <i>Process sampling [CS2]</i>: Ensure material transfers are under containment or extract ventilation E66 Avoid dip sampling E42 - <i>Laboratory activities [CS36]</i>: Handle in a fume cupboard or under extract ventilation E83 - <i>Bulk transfers CS14</i>: Ensure material transfers are under containment or extract ventilation E66 Clear lines transfer lines prior to decoupling E38 Ensure operation is undertaken outdoors E69 - <i>Drum and small pack filling CS6</i>: Fill containers/cans at dedicated fill points supplied with local extract ventilation E51 Clear spills immediately C&H13 Put lids on containers immediately after use E9 - <i>Equipment cleaning and maintenance [CS39]</i>: Apply vessel entry procedures including use of forced supplied air. AP15 Drain down and flush system prior to equipment break-in or maintenance. E55 Transfer via enclosed lines E52 Retain drain downs in sealed storage pending disposal or for subsequent recycle. ENVT4 - <i>Material Storage CS67</i>: Store substance within a closed system. E84 Transfer via enclosed lines. E52 Avoid dip sampling E42 	
Ventilation	For PROC8a only: LEV required
Efficiency rate	90%
Organisational measures to prevent /limit releases, dispersion and exposure	
<ul style="list-style-type: none"> - Provide a good standard of general ventilation. Natural ventilation is from windows and doors etc. Controlled ventilation means air is supplied or removed by a powered fan [E1] - Avoid manual contact with wet work pieces [E17] - Avoid splashing [C&H15] - Assumes a good basic standard of occupational hygiene is implemented [G1] 	
Conditions and measures related to personal protection, hygiene and health evaluation	
PPE to prevent dermal exposure	<ul style="list-style-type: none"> - Wear suitable gloves tested to EN374 [PPE15] for activities, where direct contact with substance is possible - Wear suitable coveralls to prevent exposure to the skin [PPE27] for activities, where direct contact with substance is possible
PPE to prevent eye exposure	- Use suitable eye protection [PPE26], where direct contact (e.g. splashes) with substance is possible

Respiratory protection	Not required
Additional good practice advice (for environment) beyond the REACH CSA	
None	

1.2.2. Exposure estimation for Distribution of substance (ES 2)

The results of the exposure estimation are shown in the following table.

Table 6. exposure estimation: ES 2

Workers		Environment	
		Additional input data	
Inhalation exposure		Life cycle stage	Manufacturing
Maximum exposure [mg/m ³]	27.13	ERC	ERC1
Dermal exposure		Based on spERC?	ESVOC 3
Maximum exposure [mg/kg x d]	6.86	Site-specific data for STP used?	no
		PECs	
		PEC STP [mg/L]	0.00078
		PEC freshwater [mg/L]	0.00110
		PEC freshwater sediment [mg/kg d.w.]	0.00864
		PEC soil [mg/kg d.w.]	0.00007
Total exposure (inhalation + dermal)		PEC marine water [mg/L]	0.00010
Maximum exposure [mg/kg x d]	10.73	PEC marine sediment [mg/kg d.w.]	0.00075
		Total daily intake via local environment [mg/kg x d]	0.00014

The results of the exposure estimation are compared to DNELs and PNECs in the risk characterisation section 10.

1.3. Formulation of substance (ES 3)

1.3.1. Exposure Scenario for Formulation of substance (ES 3)

Table 7. Exposure Scenario 3: formulation of substance

Exposure Scenario 3: Formulation of substance	
Industrial use: SU 3 (SU 10)	
Environmental exposure scenario: ESVOC 4, spERC 2.2.v1 (specifies ERC 2)	
Workers scenario ESVOC GES 2 (industrial); PROC1, 2, 3, 4, 5, 8a, 8b, 9, 14, 15	
Formulation, blending, packing and re-packing of the substance and its mixtures in batch or continuous operations, including storage, materials transfers, mixing, large and small scale packing, maintenance and associated laboratory activities.	
Environmental exposure	
Based on ESVOC spERC: ESVOC 4 (ECETOC TRA) = spERC 2.2.v1	
Formulation & packing of mixtures in batch or continuous operations, including storage, materials transfers, large and small scale packing, and maintenance	
Product characteristics	
Physical state	Liquid
Vapour pressure of substance	< 100 Pa at 20°C
Concentration of substance in mixture	N/A
Amounts used	
Annual amount (per site for industrial use)	400 t/a
Daily amount (per site for industrial use) (M_{use})	1.33 t/d (calculated by ECETOC TRA)
M_{safe}	1.36 t/d (calculated by ECETOC TRA)
Frequency and duration of use	
Use/release on 300 d/year	
Environment factors not influenced by risk management	
Flow rate of receiving surface water	18000 m ³ /day (ECETOC TRA default)
Other given operational conditions affecting environmental exposure	
Processing setting (indoor/outdoor)	Indoor
Processing temperature and pressure	Ambient temperature and pressure
Technical conditions and measures at process level (source) to prevent release	
None	
Technical onsite conditions and measures to reduce or limit discharges, air emissions and releases to soil	
Industrial sewage treatment plant	No
Organizational measures to prevent/limit release from site	
None	
Conditions and measures related to municipal sewage treatment plant	
Municipal sewage treatment plant	yes
STP discharge rate	2 x 10 ³ m ³ /day (ECETOC TRA default)
Efficacy (substance removal in STP)	88% (calculated by ECETOC TRA)
Sludge treatment technique	disposal or recovery
Dispose of waste solvent or used containers according to local regulations [ENVT12]	
Conditions and measures related to external recovery of waste	
None	
Additional good practice advice (for environment) beyond the REACH CSA	
None	
Worker exposure	
Based on ESVOC GES 2: Formulation and (re-)packing of substances and mixtures (industrial), low volatility solvent with DNEL inhalation ≥ 10 ppm, DNEL dermal ≥ 5 mg/kg/d	
Product characteristics	
Physical state	Liquid

Vapour pressure of substance	< 100 Pa at 20°C
Concentration of substance in mixture	Covers percentage substance in the product up to 100 % (unless stated differently) [G13]
Amounts used	
Not relevant for ECETOC TRA exposure estimates	
Frequency and duration of use/exposure	
Frequency and duration	Covers daily exposures up to 8 hours (unless stated differently) [G2]
Human factors not influenced by risk management	
Potentially exposed body parts	Hands
Exposed skin surface	The extent of hand exposure (one hand or both hands, one side or both sides) differs between different PROCs, with the following values assumed in ECETOC TRA: 240 cm ² (PROC1, 3, 15), 480 cm ² (PROC2, 4, 5, 8B, 9, 14) or 960 cm ² (PROC8A)
Other given operational conditions affecting workers exposure	
Setting (indoor/outdoor)	Indoor use
Room size	Not relevant for ECETOC TRA exposure estimates
Processing temperature and pressure	Assumes use at not more than 20°C above ambient temperature [G15]
Technical conditions and measures at process level (source) to prevent release	
<p>- <i>General exposures (closed systems) CS15</i>: Handle substance within a closed system. E47 Ensure material transfers are under containment or extract ventilation E66</p> <p>- <i>General exposures (open systems) CS16</i>: Provide extract ventilation to points where emissions occur E54</p> <p>- <i>Batch processes at elevated temperatures CS136</i>: Formulate in enclosed or ventilated mixing vessels E46 Ensure material transfers are under containment or extract ventilation E66</p> <p>- <i>Process sampling CS2</i>: Ensure material transfers are under containment or extract ventilation E66 Avoid dip sampling. E42</p> <p>- <i>Laboratory activities CS36</i>: Handle in a fume cupboard or under extract ventilation E83</p> <p>- <i>Bulk transfers CS14</i>: Ensure material transfers are under containment or extract ventilation E66 Clear lines prior to decoupling. E39 Clear spillages immediately C&H13 Remotely vent displaced vapours ENVT17</p> <p>- <i>Mixing operations (open systems) CS30</i>: Provide extract ventilation to points where emissions occur E54</p> <p>- <i>Drum and batch transfers CS8</i>: Provide extract ventilation to points where emissions occur E54 Use drum pumps or carefully pour from container. E64 Avoid spillage when withdrawing pump. C&H16</p> <p>- <i>Production or preparation of articles by tableting, compression, extrusion or pelletisation CS100</i>: Handle substance within a predominantly closed system provided with extract ventilation E49</p> <p>- <i>Drum and small package filling CS6</i>: Fill containers/cans at dedicated fill points supplied with local extract ventilation E51 Put lids on containers immediately after use. E9 Clear spills immediately C&H13</p> <p>- <i>Equipment clean down and maintenance CS39</i>: Apply vessel entry procedures including use of forced supplied air. AP15 Drain down and flush system prior to equipment break-in or maintenance. E55 Transfer via enclosed lines E52 Retain drain downs in sealed storage pending disposal or for subsequent recycle. ENVT4</p> <p>- <i>Material storage CS67</i>: Store substance within a closed system. E84 Transfer via enclosed lines. E52 Avoid dip sampling E42</p>	
Ventilation	- For PROC5 and PROC8a only: LEV required
Efficiency rate	90%
Organisational measures to prevent /limit releases, dispersion and exposure	
<p>- Provide a good standard of general ventilation. Natural ventilation is from windows and doors etc. Controlled ventilation means air is supplied or removed by a powered fan [E1]</p> <p>- Avoid manual contact with wet work pieces [E117]</p> <p>- Avoid splashing [C&H15]</p> <p>- Assumes a good basic standard of occupational hygiene is implemented [G1]</p>	
Conditions and measures related to personal protection, hygiene and health evaluation	

PPE to prevent dermal exposure	- Wear suitable gloves tested to EN374 [PPE15] for activities, where direct contact with substance is possible - Wear suitable coveralls to prevent exposure to the skin [PPE27] for activities, where direct contact with substance is possible
PPE to prevent eye exposure	- Use suitable eye protection [PPE26], where direct contact (e.g. splashes) with substance is possible
Respiratory protection	Not required
Additional good practice advice (for environment) beyond the REACH CSA	
None	

1.3.2. Exposure estimation for Formulation of substance (ES 3)

The results of the exposure estimation are shown in the following table.

Table 8. exposure estimation: ES 3

Workers		Environment	
		Additional input data	
Inhalation exposure		Life cycle stage	Formulation
Maximum exposure [mg/m ³]	27.13	ERC	ERC2
Dermal exposure		Based on spERC?	ESVOC 4
Maximum exposure [mg/kg x d]	6.86	Site-specific data for STP used? (see comments)	no
		PECs	
		PEC STP [mg/L]	0.15561
		PEC freshwater [mg/L]	0.01657
		PEC freshwater sediment [mg/kg d.w.]	0.13048
		PEC soil [mg/kg d.w.]	0.01393
Total exposure (inhalation + dermal)		PEC marine water [mg/L]	0.00164
Maximum exposure [mg/kg x d]	10.73	PEC marine sediment [mg/kg d.w.]	0.01294
		Total daily intake via local environment [mg/kg x d]	0.0024

The results of the exposure estimation are compared to DNELs and PNECs in the risk characterisation section 10.

1.4. Use in coatings (industrial) (ES 4)

1.4.1. Exposure Scenario for Use in coatings (industrial) (ES 4)

Table 9. Exposure Scenario 4: use in coatings (industrial)

Exposure Scenario 4: Use in coatings (industrial)	
Industrial use: SU 3	
Environmental exposure scenario: ESVOC 5, spERC 4.3a.v1 (specifies ERC 4)	
Workers scenario ESVOC GES 3 (industrial); PROC 1, 2, 3, 4, 5, 7, 8a, 8b, 9, 10, 13, 14, 15	
Covers the use in coatings (paints, inks, adhesives, etc) including exposures during use (including materials receipt, storage, preparation and transfer from bulk and semi-bulk, application by spray, roller, spreader, dip, flow, fluidised bed on production lines and film formation) and equipment cleaning, maintenance and associated laboratory activities.	
Environmental exposure	
Based on ESVOC spERC: ESVOC 5 (ECETOC TRA) = spERC 4.3a.v1	
Covers the use in coatings (paints, inks, adhesives, etc) including exposures during use (including materials transfer from bulk and semi-bulk and spraying, brushing and other manual application tasks); and equipment cleaning	
Product characteristics	
Physical state	Liquid
Vapour pressure of substance	< 100 Pa at 20°C
Concentration of substance in mixture	Covers percentage substance in the product up to 100 % (unless stated differently) [G13]
Amounts used	
Annual amount per site for industrial use	100 t/a
Daily amount (per site for industrial use) (M_{use})	333 kg/d (calculated by ECETOC TRA)
M_{safe}	387 kg/d (calculated by ECETOC TRA)
Frequency and duration of use	
Use/release on 300 d/year	
Environment factors not influenced by risk management	
Flow rate of receiving surface water	18.000 m ³ /day (ECETOC TRA default)
Other given operational conditions affecting environmental exposure	
Processing setting (indoor/outdoor)	Indoor and outdoor use
Processing temperature and pressure	Ambient temperature and pressure
Technical conditions and measures at process level (source) to prevent release	
None	
Technical onsite conditions and measures to reduce or limit discharges, air emissions and releases to soil	
Industrial sewage treatment plant	No
Organizational measures to prevent/limit release from site	
None	
Conditions and measures related to municipal sewage treatment plant	
Municipal sewage treatment plant	yes
STP discharge rate	2 x 10 ³ m ³ /day (ECETOC TRA default)
Efficacy (removal in STP)	88% (calculated by ECETOC TRA)
Sludge treatment technique	disposal or recovery
Conditions and measures related to external treatment of waste for disposal	
Dispose of waste solvent or used containers according to local regulations [ENVT12]	
Conditions and measures related to external recovery of waste	
None	
Additional good practice advice (for environment) beyond the REACH CSA	
None	
Worker exposure	
Based on ESVOC GES 3: Coatings (industrial application), low volatility solvent with DNEL inhalation ≥ 10 ppm, DNEL dermal ≥ 5 mg/kg/d	
Product characteristics	

Physical state	Liquid
Vapour pressure of substance	< 100 Pa at 20°C
Concentration of substance in mixture	Covers percentage substance in the product up to 100 % (unless stated differently) [G13]
Amounts used	
Not relevant for ECETOC TRA exposure estimates	
Frequency and duration of use/exposure	
Frequency and duration	Covers daily exposures up to 8 hours (unless stated differently) [G2]
Human factors not influenced by risk management	
Potentially exposed body parts	Hands and forearms
Exposed skin surface	The extent of hand exposure (one hand or both hands, one side or both sides) differs between different PROCs; exposure of forearms is only assumed in industrial spraying activities (PROC7), the following range of values is assumed in ECETOC TRA: 240 cm ² (e.g. PROC1) – 1500 cm ² (PROC7)
Other given operational conditions affecting workers exposure	
Setting (indoor/outdoor)	Indoor and outdoor use
Room size	Not relevant for ECETOC TRA exposure estimates
Processing temperature and pressure	Assumes use at not more than 20°C above ambient temperature [G15]
Technical conditions and measures at process level (source) to prevent release	
<p><i>General exposures (closed systems)</i> [CS15]: Handle substance within a closed system [E47].</p> <p><i>General exposures (closed systems) [CS15] with sample collection [CS56]. Use in contained systems [CS38]:</i> Handle substance within a closed system [E47]. Ensure material transfers are under containment or extract ventilation [E66].</p> <p><i>Film formation - force drying (50 - 100°C). Stoving (>100°C). UV/EB radiation curing [CS94]:</i> Handle substance within a closed system [E47]. Ensure material transfers are under containment or extract ventilation [E66].</p> <p>Mixing operations (closed systems) [CS29]. <i>General exposures (closed systems)</i> [CS15]: Handle substance within a closed system [E47].</p> <p>Film formation - air drying [CS95]: Provide extract ventilation to points where emissions occur [E54].</p> <p>Preparation of material for application [CS96]. <i>Mixing operations (open systems)</i> [CS30]: Provide extract ventilation to points where emissions occur [E54].</p> <p>Spraying (automatic/robotic) [CS97]: Carry out in a vented booth provided with laminar airflow [E59].</p> <p><i>Manual [CS34] Spraying [CS10]:</i> Provide a good standard of general or controlled ventilation (5 to 10 air changes per hour) [E40].</p> <p>Material transfers [CS3]: Clear transfer lines prior to de-coupling [E39]. Provide extract ventilation to points where emissions occur [E54].</p> <p>Roller, spreader, flow application [CS98]: Minimise exposure by partial enclosure of the operation or equipment and provide extract ventilation at openings [E60].</p> <p>Dipping, immersion and pouring [CS4]: Provide extract ventilation to points where emissions occur [E54]. Clear up spills immediately and dispose of waste safely [E19].</p> <p>Laboratory activities [CS36]: {Provide a good standard of general or controlled ventilation (5 to 10 air changes per hour) [E40]}. Provide extract ventilation to points where emissions occur [E54].</p> <p>Material transfers [CS3]. <i>Drum/batch transfers [CS8]. Transfer from/pouring from containers [CS22]:</i> Ensure transfer points are supplied with extract ventilation [E73].</p> <p><i>Production or preparation or articles by tableting, compression, extrusion or pelletisation [CS100]:</i> Provide extract ventilation to points where emissions occur [E54].</p>	
Technical conditions and measures to control dispersion from source towards the worker	
Ventilation	LEV is required for: - PROCs 5, 7, 8a, 10, 13 and - PROC2: for film formation - force drying (50-100°C), stoving (>100°C). UV/EB radiation curing (PROC2) due to elevated temperatures

Efficiency rate	95% (PROC7) and 90% (PROCs 5, 8a, 10, 13)
Organisational measures to prevent /limit releases, dispersion and exposure	
<ul style="list-style-type: none"> - Provide a good standard of general ventilation. Natural ventilation is from windows and doors etc. Controlled ventilation means air is supplied or removed by a powered fan [E1] - Avoid manual contact with wet work pieces [E117] - Avoid splashing [C&H15] - Assumes a good basic standard of occupational hygiene is implemented [G1] 	
Conditions and measures related to personal protection, hygiene and health evaluation	
PPE to prevent dermal exposure	<ul style="list-style-type: none"> - Wear suitable gloves tested to EN374 [PPE15] for activities, where direct contact with substance is possible - Wear suitable coveralls to prevent exposure to the skin [PPE27] for activities, where direct contact with substance is possible
PPE to prevent eye exposure	- Use suitable eye protection [PPE26], where direct contact (e.g. splashes) with substance is possible
Respiratory protection	For PROC7: open manual industrial spraying (if LEV is not feasible): Wear a respirator conforming to EN140 with Type A filter or better [PPE22]. For all other activities: Not required
Respiratory PPE efficacy	90%
Additional good practice advice (for environment) beyond the REACH CSA	
None	

1.4.2. Exposure estimation for Use in coatings (industrial) (ES 4)

The results of the exposure estimation are shown in the following table.

Table 10. exposure estimation: ES 4

Workers		Environment	
		Additional input data	
Inhalation exposure		Life cycle stage	Service life
Maximum exposure [mg/m ³]	27.13	ERC	ERC4
Dermal exposure		Based on spERC?	ESVOC 5
Maximum exposure [mg/kg x d]	21.43	Site-specific data for STP used? (see comments)	no
Maximum exposure [mg/kg x d] considering dermal PPE (see text)	4.286	PECs	
		PEC STP [mg/L]	0.13616
		PEC freshwater [mg/L]	0.01463
		PEC freshwater sediment [mg/kg d.w.]	0.11521
		PEC soil [mg/kg d.w.]	0.01300
Total exposure (inhalation + dermal)		PEC marine water [mg/L]	0.00145
Maximum exposure [mg/kg x d] without dermal PPE	25.30	PEC marine sediment [mg/kg d.w.]	0.01141
		Total daily intake via local environment [mg/kg x d]	0.0042

The results of the exposure estimation are compared to DNELs and PNECs in the risk characterisation section 10, where the effect of PPE on the exposure estimate and risk characterisation is more fully explained.

1.5. Use in coatings (professional) (ES 5)

1.5.1. Exposure Scenario for Use in coatings (professional) (ES 5)

Table 11. Exposure Scenario 5: use in coatings (professional)

Exposure Scenario 5: Use in coatings (professional)	
Professional use: SU 22	
Environmental exposure scenario: ESVOC 6, spERC 8.3b.v1 (specifies ERC 8a,d)	
Workers scenario ESVOC GES 3 (professional); PROC 1, 2, 3, 4, 5, 8a, 8b, 10, 11, 13, 15, 19	
Covers the use in coatings (paints, inks, adhesives, etc) including exposures during use (including materials receipt, storage, preparation and transfer from bulk and semi-bulk, application by spray, roller, brush, spreader by hand or similar methods, and film formation), and equipment cleaning, maintenance and associated laboratory activities.	
Environmental exposure	
Based on ESVOC spERC: ESVOC 6 (ECETOC TRA) = spERC 8.3b.v1	
Covers the use in coatings (paints, inks, adhesives, etc) including exposures during use (including materials transfer and spraying, brushing and other manual application tasks); and equipment cleaning	
Product characteristics	
Physical state	Liquid
Vapour pressure of substance	< 100 Pa at 20°C
Concentration of substance in mixture	Covers percentage substance in the product up to 100 % (unless stated differently) [G13]
Amounts used	
Annual amount (total for EU)	100 t/a
Daily amount (M_{use})	0.137 kg/d (calculated by ECETOC TRA)
M_{safe}	2.25 kg/d (calculated by ECETOC TRA)
Frequency and duration of use	
Continuous use/release	
Environment factors not influenced by risk management	
Flow rate of receiving surface water	18.000 m ³ /day (ECETOC TRA default)
Other given operational conditions affecting environmental exposure	
Processing setting (indoor/outdoor)	Indoor and outdoor use
Processing temperature and pressure	Ambient temperature and pressure
Technical conditions and measures at process level (source) to prevent release	
None	
Technical onsite conditions and measures to reduce or limit discharges, air emissions and releases to soil	
Industrial sewage treatment plant	No
Organizational measures to prevent/limit release from site	
None	
Conditions and measures related to municipal sewage treatment plant	
Municipal sewage treatment plant	yes
STP discharge rate	2 x 10 ³ m ³ /day (ECETOC TRA default)
Efficacy (substance removal in STP)	88% (calculated by ECETOC TRA)
Sludge treatment technique	disposal or recovery
Conditions and measures related to external treatment of waste for disposal	
Dispose of waste solvent or used containers according to local regulations [ENVT12]	
Conditions and measures related to external recovery of waste	
None	
Additional good practice advice (for environment) beyond the REACH CSA	
None	
Worker exposure	
Based on ESVOC GES 3: Coatings (professional application), low volatility solvent with DNEL inhalation ≥ 10 ppm, DNEL dermal ≥ 5 mg/kg/d	

Product characteristics	
Physical state	Liquid
Vapour pressure of substance	< 100 Pa at 20°C
Concentration of substance in mixture	Covers percentage substance in the product up to 100 % (unless stated differently) [G13]
Amounts used	
Not relevant for ECETOC TRA exposure estimates	
Frequency and duration of use/exposure	
Frequency and duration	PROC11: Indoors: Avoid carrying out operation for more than 1 hour [OC11] Outdoors: Avoid carrying out operation for more than 4 hours [OC12]. PROC19: Avoid carrying out operation for more than 1 hour [OC11] All others: Covers daily exposures up to 8 hours (unless stated differently) [G2]
Human factors not influenced by risk management	
Potentially exposed body parts	Hands and forearms
Exposed skin surface	The extent of hand exposure (one hand or both hands, one side or both sides) differs between different PROCs; exposure of forearms is only assumed in non-industrial spraying activities (PROC11), the following range of values is assumed in ECETOC TRA: 240 cm ² (e.g. PROC3) – 1980 cm ² (PROC19)
Other given operational conditions affecting workers exposure	
Setting (indoor/outdoor)	Indoor and outdoor use
Room size	Not relevant for ECETOC TRA exposure estimates
Processing temperature and pressure	Assumes use at not more than 20°C above ambient temperature [G15]
Technical conditions and measures at process level (source) to prevent release	
<p><i>General exposures (closed systems) [CS15]:</i> Handle substance within a closed system [E47].</p> <p><i>Filling / preparation of equipment from drums or containers. [CS45]:</i> Handle substance within a closed system [E47]. <i>Use drum pumps or carefully pour from container</i> [E64].</p> <p><i>General exposures (closed systems) [CS15]. Use in contained systems [CS38]:</i> Handle substance within a closed system [E47].</p> <p><i>Preparation of material for application [CS96]:</i> <i>Use drum pumps or carefully pour from container</i> [E64]. <i>Minimise exposure by partial enclosure of the operation or equipment and provide extract ventilation at openings</i> [E60]. <i>Clear up spills immediately and dispose of waste safely</i> [E19].</p> <p><i>Film formation - air drying [CS95]. Outdoor [OC9]:</i></p> <p><i>Film formation - air drying [CS95]. Indoor [OC8]:</i> Provide a good standard of general or controlled ventilation (5 to 10 air changes per hour) [E40]. <i>Provide extract ventilation to points where emissions occur</i> [E54].</p> <p><i>Preparation of material for application [CS96]. Indoor [OC8]:</i> Provide a good standard of general or controlled ventilation (5 to 10 air changes per hour) [E40].</p> <p><i>Preparation of material for application [CS96]. Outdoor [OC9]:</i> Avoid carrying out operation for more than 4 hours [OC12]., or: [G9].</p> <p><i>Material transfers [CS3]. Drum/batch transfers [CS8]:</i> Minimise exposure by partial enclosure of the operation or equipment and provide extract ventilation at openings (professional use) [E78]. <i>Use drum pumps or carefully pour from container</i> [E64].</p> <p><i>Manual [CS34]. Spraying [CS10]. Indoor [OC8]:</i> Carry out in a vented booth [E57]</p> <p><i>Manual [CS34]. Spraying [CS10]. Outdoor [OC9]:</i> Ensure operation is undertaken outdoors [E69].</p> <p><i>Dipping, immersion and pouring [CS4]. Indoor [OC8]:</i> Provide extract ventilation to points where emissions occur [E54]. <i>Clear up spills immediately and dispose of waste safely</i> [E19].</p>	

<p><i>Dipping, immersion and pouring [CS4]. Outdoor [OC9]:</i> Ensure operation is undertaken outdoors [E69]. <i>Clear up spills immediately and dispose of waste safely [E19].</i> <i>Laboratory activities [CS36]:</i> Provide a good standard of general or controlled ventilation (5 to 10 air changes per hour) [E40]. Provide extract ventilation to points where emissions occur [E54]. <i>Hand application - fingerpaints, pastels, adhesives [CS72]. Indoor [OC8]:</i> Ensure doors and windows are opened [E72]. <i>Hand application - fingerpaints, pastels, adhesives [CS72]. Outdoor [OC9]:</i> Ensure operation is undertaken outdoors [E69].</p>	
Technical conditions and measures to control dispersion from source towards the worker	
Ventilation	Local exhaust ventilation is required for: - PROCs 4, 5, 8a, 8b, 10, 11, and 13
Efficiency rate	90% (PROC8b) and 80% (all others)
Organisational measures to prevent /limit releases, dispersion and exposure	
<p>- Provide a good standard of general ventilation. Natural ventilation is from windows and doors etc. Controlled ventilation means air is supplied or removed by a powered fan [E1] - Avoid manual contact with wet work pieces [E117] - Avoid splashing [C&H15] - Assumes a good basic standard of occupational hygiene is implemented [G1]</p>	
Conditions and measures related to personal protection, hygiene and health evaluation	
PPE to prevent dermal exposure	<p>- Wear suitable gloves tested to EN374 [PPE15] for activities, where direct contact with substance is possible; - Wear suitable coveralls to prevent exposure to the skin [PPE27] for activities, where direct contact with substance is possible For hand application (PROC19): Wear chemically resistant gloves (tested to type EN374) in combination with specific activity training [PPE17]</p>
PPE to prevent eye exposure	- Use suitable eye protection [PPE26], where direct contact (e.g. splashes) with substance is possible
Respiratory protection	<p>For roller application or brushing (PROC10, outdoors) and manual spraying (PROC11, outdoors), when LEV is not feasible: Wear a respirator conforming to EN140 with Type A filter or better [PPE22] For all other activities: Not required</p>
Respiratory PPE efficacy	90%
Additional good practice advice (for environment) beyond the REACH CSA	
None	

1.5.2. Exposure estimation for Use in coatings (professional) (ES 5)

The results of the exposure estimation are shown in the following table.

Table 12. exposure stimation: ES 5

Workers		Environment	
		Additional input data	
Inhalation exposure		Life cycle stage	Service life
Maximum exposure [mg/m ³]	27.13	ERC	ERC8a
Dermal exposure		Based on spERC?	ESVOC 6
Maximum exposure [mg/kg x d]	141.43	Site-specific data for STP used?	no
Maximum exposure [mg/kg x d] considering dermal PPE (see text)	10.7	PECs	
		PEC STP [mg/L]	0.00008
		PEC freshwater [mg/L]	0.00103

		PEC freshwater sediment [mg/kg d.w.]	0.00809
		PEC soil [mg/kg d.w.]	0.00001
Total exposure (inhalation + dermal)		PEC marine water [mg/L]	0.00009
Maximum exposure [mg/kg x d] without dermal PPE	145.30	PEC marine sediment [mg/kg d.w.]	0.00070
		Total daily intake via local environment [mg/kg x d]	0.00013

The results of the exposure estimation are compared to DNELs and PNECs in the risk characterisation section 10, which also details the refinement in the exposure estimates for the PROCs giving high exposure estimates.

1.6. Dilution of a concentrate to prepare end use mixture (professional) (ES 6)

1.6.1. Exposure Scenario for Dilution of a concentrate to prepare end use mixture (professional) (ES 6)

Table 13. Exposure Scenario 6: Dilution of a concentrate to prepare end use mixture (professional)

Exposure Scenario 6: Dilution of a concentrate to prepare end use mixture (professional)	
Professional use: SU 22	
Environmental exposure scenario: ERC 8d	
Workers scenario; PROC 5, 8a, 8b	
Dilution of a concentrate to prepare various end use mixtures at dedicated and non-dedicated facilities, wide dispersive use, concentration in end use mixture < 1%	
Environmental exposure	
ERC8d (outdoor use); outdoor use was chosen since many of these concentrates will be used outdoors and to cover maximum environmental release; this also covers indoor use (ERC 8a)	
Dilution of a concentrate to prepare various end use mixtures at dedicated and non-dedicated facilities, wide dispersive use, concentration in end use mixture < 1%	
Product characteristics	
Physical state	Liquid
Vapour pressure of substance	< 100 Pa at 20°C
Concentration of substance in mixture	Covers percentage substance in the product up to 25 % [G12]
Amounts used	
Annual amount (total for EU)	50 t/a
Daily amount (M_{use})	0.274 kg/d (calculated by ECETOC TRA)
M_{safe}	1.77 kg/d (calculated by ECETOC TRA)
Frequency and duration of use	
Continuous use/release	
Environment factors not influenced by risk management	
Flow rate of receiving surface water	18.000 m ³ /day (ECETOC TRA default)
Other given operational conditions affecting environmental exposure	
Processing setting (indoor/outdoor)	Indoor and outdoor use
Processing temperature and pressure	Ambient temperature and pressure
Technical conditions and measures at process level (source) to prevent release	
None	
Technical onsite conditions and measures to reduce or limit discharges, air emissions and releases to soil	
Industrial sewage treatment plant	No
Organizational measures to prevent/limit release from site	
None	
Conditions and measures related to municipal sewage treatment plant	
Municipal sewage treatment plant	yes
STP discharge rate	2 x 10 ³ m ³ /day (ECETOC TRA default)
Efficacy (substance removal in STP)	88% (calculated by ECETOC TRA)
Sludge treatment technique	disposal or recovery
Conditions and measures related to external treatment of waste for disposal	
Dispose of waste solvent or used containers according to local regulations [ENVT12]	
Conditions and measures related to external recovery of waste	
None	
Additional good practice advice (for environment) beyond the REACH CSA	
None	
Worker exposure	
Based on PROC 5, 8a, 8b: Mixing or blending in batch processes for formulation of mixtures; Transfer of substance or preparation from and to vessels/large containers at dedicated and non-dedicated facilities	
Product characteristics	

Physical state	Liquid
Vapour pressure of substance	< 100 Pa at 20°C
Concentration of substance in mixture	Covers percentage substance in the product up to 25 % [G12] If clean-down and maintenance of equipment and disposal of wastes (PROC8a) have to be carried out for 1-4 hours daily and local exhaust ventilation cannot be provided, use only concentrates with up to 5%
Amounts used	
Not relevant for ECETOC TRA exposure estimates	
Frequency and duration of use/exposure	
Frequency and duration	PROC8a: Avoid carrying out operation for more than 1 hour [OC11] PROC 5 and 8b: Avoid carrying out operation for more than 4 hours [OC12]
Human factors not influenced by risk management	
Potentially exposed body parts	Hands and forearms
Exposed skin surface	The extent of hand exposure (one hand or both hands, one side or both sides) differs between different PROCs; exposure of forearms is only assumed in non-industrial spraying activities (PROC11), the following range of values is assumed in ECETOC TRA: 480 cm ² (e.g. PROC5) – 960 cm ² (PROC8a)
Other given operational conditions affecting workers exposure	
Setting (indoor/outdoor)	Indoor and outdoor use
Room size	Not relevant for ECETOC TRA exposure estimates
Processing temperature and pressure	Assumes use at not more than 20°C above ambient temperature [G15]
Technical conditions and measures at process level (source) to prevent release	
<ul style="list-style-type: none"> - <i>Transfer from/pouring from containers (PROC8b): Carefully pour from containers E62</i> - <i>Clean-down and maintenance of equipment and disposal of wastes (PROC8a): Drain down system prior to equipment break-in or maintenance E65. Retain drain downs in sealed storage pending disposal or for subsequent recycle. ENVT4</i> 	
Technical conditions and measures to control dispersion from source towards the worker	
Ventilation	Local exhaust ventilation is generally not required. If PROC8a activities have to be carried out for 1-4 hours daily, provide local exhaust ventilation
Efficiency rate	80%
Organisational measures to prevent /limit releases, dispersion and exposure	
<ul style="list-style-type: none"> - Provide a good standard of general ventilation. Natural ventilation is from windows and doors etc. Controlled ventilation means air is supplied or removed by a powered fan [E1] - Avoid manual contact with wet work pieces [E117] - Avoid splashing [C&H15] - Assumes a good basic standard of occupational hygiene is implemented [G1] 	
Conditions and measures related to personal protection, hygiene and health evaluation	
PPE to prevent dermal exposure	<ul style="list-style-type: none"> - Wear suitable gloves tested to EN374 [PPE15] for activities, where direct contact with substance is possible - Wear suitable coveralls to prevent exposure to the skin [PPE27] for activities, where direct contact with substance is possible
PPE to prevent eye exposure	<ul style="list-style-type: none"> - Use suitable eye protection [PPE26], where direct contact (e.g. splashes) with substance is possible

Respiratory protection	Not required
Respiratory PPE efficacy	N/A
Additional good practice advice (for environment) beyond the REACH CSA	
None	

1.6.2. Exposure estimation for Dilution of a concentrate to prepare end use mixture (professional) (ES 6)

The results of the exposure estimation are shown in the following table.

Table 14. exposure estimation: ES 6

Workers		Environment	
		Additional input data	
Inhalation exposure		Life cycle stage	Service life
Maximum exposure [mg/m ³]	19.53	ERC	ERC8d
Dermal exposure		Based on spERC?	no
Maximum exposure [mg/kg x d]	13.71	Site-specific data for STP used? (see comments)	no
		PECs	
		PEC STP [mg/L]	0.01599
		PEC freshwater [mg/L]	0.00262
		PEC freshwater sediment [mg/kg d.w.]	0.02062
		PEC soil [mg/kg d.w.]	0.00141
Total exposure (inhalation + dermal)		PEC marine water [mg/L]	0.00025
Maximum exposure [mg/kg x d]	16.50	PEC marine sediment [mg/kg d.w.]	0.00195
		Total daily intake via local environment [mg/kg x d]	0.00035

The results of the exposure estimation are compared to DNELs and PNECs in the risk characterisation section 10.

1.7. Dilution of a concentrate to prepare end use mixture (consumers) (ES 7)

1.7.1. Exposure Scenario for Dilution of a concentrate to prepare end use mixture (consumers) (ES 7)

Table 15. Exposure Scenario 7: Dilution of a concentrate to prepare end use mixture (consumers)

Exposure Scenario 7: Dilution of a concentrate to prepare end use mixture (consumers)	
Consumer use: SU21	
Environmental exposure scenario: ERC 8d	
Product category: covers many different products with the dilution of the concentrate being more important than the final product category	
Dilution of a concentrate to prepare various end use mixtures at dedicated and non-dedicated facilities, wide dispersive use, concentration in end use mixture < 1%	
Environmental exposure	
ERC8d (outdoor use); outdoor use was chosen since many of these concentrates will be used outdoors and to cover maximum environmental release; this also covers indoor use (ERC 8a)	
Covers uses as described above	
Product characteristics	
Physical state	Liquid
Vapour pressure of substance	< 100 Pa at 20°C
Concentration of substance in mixture	Covers percentage substance in the product up to 25% [G12]
Amounts used	
Annual amount (total for EU)	10 t/a
Daily amount (M_{use})	0.0548 kg/d (calculated by ECETOC TRA)
M_{safe}	0.69 kg/d (calculated by ECETOC TRA)
Frequency and duration of use	
Continuous use/release	
Environment factors not influenced by risk management	
Flow rate of receiving surface water	18.000 m ³ /day (ECETOC TRA default)
Other given operational conditions affecting environmental exposure	
Processing setting (indoor/outdoor)	Indoor and outdoor use
Processing temperature and pressure	Ambient temperature and pressure
Conditions and measures related to municipal sewage treatment plant	
Municipal sewage treatment plant	yes
STP discharge rate	2 x 10 ³ m ³ /day (ECETOC TRA default)
Efficacy (substance removal in STP)	88% (calculated by ECETOC TRA)
Sludge treatment technique	disposal or recovery
Conditions and measures related to external treatment of waste for disposal	
Dispose of waste solvent or used containers according to local regulations [ENVT12]	
Conditions and measures related to external recovery of waste	
None	
Additional good practice advice (for environment) beyond the REACH CSA	
None	
Consumer exposure	
Based on default assumptions in ConsExpo (v. 4.1) for a similar task ("mixing and loading of liquids" for pest control products) and product-specific data on concentrations of the substance in concentrates	
Product characteristic	
Covers liquid concentrate mixtures (preparations) with concentrations of the substance of up to 25%, which are then diluted (concentration in the final product < 1%)	
Amounts used	
Covers mixtures (preparations) containing 25% of the substance in amounts of up to 1000 g per event (ConsExpo default amount of 500 g doubled to cover larger package sizes)	
Frequency and duration of use/exposure	
Covers the use (dilution event) up to 24 times per year (2 times per months; ConsExpo default multiplied with 4 to cover more frequent uses), each dilution event lasting 1.33 minutes (ConsExpo default)	

Human factors not influenced by risk management	
Potentially exposed body parts	Fingertips and hand (due to splashes and leakages)
Exposed skin surface	Not relevant for ConsExpo exposure estimates
Other given operational conditions affecting consumers exposure	
Setting (indoor/outdoor)	Indoor and outdoor use
Room size	1 m ³ (ConsExpo default as a surrogate for the “personal volume” around the user)
Processing temperature and pressure	Assumes activities are at ambient temperature (unless stated differently) [G17]
Conditions and measures related to information and behavioural advice to consumers	
For consumer products containing concentrations >10% give the following advice to end users: - Provide a good standard of general ventilation. Natural ventilation is from windows and doors etc. Controlled ventilation means air is supplied or removed by a powered fan. [E1] - Avoid manual contact with wet work pieces [E117] - Use suitable eye protection and gloves [PPE14] Alternative to recommendation of personal protection equipment: design product in a way that skin and eye contact is impossible	
Conditions and measures related to personal protection and hygiene	
None	
Additional good practice advice (for environment) beyond the REACH CSA	
None	

1.7.2. Exposure estimation for Dilution of a concentrate to prepare end use mixture (consumer) (ES 7)

The following exposure estimation relates to indoor use of concentrates (maximum 2-EH concentration: 25%) diluted into an end-use product. Many of the products covered by this ES will be used outdoors (resulting in much lower exposure), but since indoor use cannot be ruled out, this is estimated below.

From these dilution processes various products intended for use by consumers (e.g. lubricants, fuels) are obtained, which contain 2-EH in concentrations below 1% w/w. Due to these low concentrations, no relevant exposure and no risk is expected from these uses and, in accordance with the limit concentrations given in REACH Art. 14, no exposure estimation and no risk characterisation is performed for these end uses.

Model and input parameter selection

The ECETOC TRA consumer tool is product-oriented (selection by product or article categories) and does not contain a specific model to estimate exposure from the dilution of a concentrate. Therefore, ConsExpo (v. 4.1, with database update, July 2010) was used for this task. The software contains a product database from which “mixing and loading of liquids” for pest control products was chosen that reflects exposure to liquid concentrate during mixing and loading (Bremmer et al., 2006). This was selected since it is considered to come closest to the exposure scenario to be assessed here. Upon selection of this default product, the software automatically assigns the following models:

- “Evaporation model” for inhalation exposure
- “Direct dermal contact with product: instant application” model for dermal exposure

The details of these models are described in Bremmer et al. (2006) and the parameters used are given in Annex 9.7.2-2. Briefly, exposure was estimated for diluting a concentrate containing 25% 2-ethylhexanol and the model calculates by default the concentration for a “room volume” of 1 m³, representing the “personal volume” around the user, for a duration of 1.33 minutes. The default model assumes carrying out such tasks 6 times per year with 500 g

of product per event (Bremmer et al., 2006) but these values were increased (see below) to reflect the exposure scenario under consideration.

Dermal exposure will depend on the amount of product expected to come into contact with the skin. The default value chosen by ConsExpo (10 mg) represents the 75th percentile from the UK POEM model for pouring of fluid from a 1 or 2 litre container of any closure into a receiving vessel (Bremmer et al., 2006). This model refers to consumer use and is therefore suited for the ES assessed here. However, to estimate a reasonable worst case exposure (defined as 95th percentile), the result obtained with a 75th input value can be multiplied with an additional factor of 2 (arbitrarily chosen), resulting in an amount in contact with the skin of 20 mg.

The following ConsExpo defaults were changed to reflect the ES assessed here rather than the pest control products of the ConsExpo database.

Table 16: ES-specific values used in ConsExpo

Parameter	ConsExpo default	Value used	Rationale
Product amount [g]	500	1000	To cover higher amounts used for some products
Use frequency [1/a]	6	24	To cover use of different products; twice per month
Amount in contact with the skin [mg]	10	20	To reflect reasonable worst case

The inhalation exposure estimate within the evaporation model is critically dependent on the mass transfer rate (better described as mass transfer coefficient), which describes transport conditions at the boundary layer immediately above the liquid surface (McCready and Fontaine, 2003; 2010). ConsExpo offers two different methods upon which the mass transfer coefficient can be calculated:

- Langmuir's method, which, according to ConsExpo, "will in general result in a high over-estimation of the peak concentrations in the room air"; a mass transfer rate of 3270 m/min is calculated in ConsExpo for 2-ethylhexanol
- Thibodeaux method, which approximates the evaporation of a solute from water and has limited validity for other media; a mass transfer rate of 0.259 m/min is calculated in ConsExpo for 2-ethylhexanol

Table 17: Input and output for mass transfer coefficient estimation

Parameter	Value	Rationale
Air velocity over the source	0.2 m/s	Typical value for indoor environments
Source/release area	0.002 m ²	ConsExpo default for the product chosen
Diffusivity	0.0223 m ² /h	Calculated with IAQX software
Mass transfer coefficient	11.53 m/h	Calculated with IAQX software
	0.192 m/min	Converted from value in m/h

The resulting mass transfer coefficient of 0.192 m/min was used in ConsExpo for modelling of the exposure concentration.

Results

The detailed input parameters and results are included in section 1.7.2-2 and are summarised in the following Table.

Table 18: Results for inhalation and dermal exposure (ConsExpo, v. 4.1)

Inhalation exposure	
Mean event concentration [mg/m ³]	1.19
Concentration on day of exposure [mg/m ³] ¹	0.0011
Yearly average concentration [mg/m ³] ²	7.21 x 10 ⁻⁵
Dermal exposure	
Per event [µg/kg b.w.]	76.9
Yearly average ² [µg/kg b.w. x d]	5.05

¹ Calculated in ConsExpo by: mean event concentration x 1.33 min/60 min x 1 h/24 h

² Calculated in ConsExpo by: concentration on day of exposure x 24 d/a / 365 d/a

Discussion

Consumer exposure was estimated with ConsExpo software with higher amounts used and increased frequency of use compared to default values. Most notably, the mass transfer coefficient was calculated by a more appropriate method than the ones offered in Cons Expo. This exposure estimation is considered to reflect a reasonable worst case situation for the following reasons:

- The air velocity of 0.2 m/s chosen here for estimation of the mass transfer coefficient is twice as high as the value typically chosen for indoor environments (Guo et al., 1999; Guo et al., 1998; McCready and Fontaine, 2003; 2010), but is still within the applicability domain of the Sparks method (0.04-0.6 m/s; McCready and Fontaine, 2010). A lower air velocity would result in a lower mass transfer coefficient and, as a consequence, a lower exposure estimate.
- Inhalation exposure estimates in ConsExpo do not consider other removal mechanisms, such as sink effects and peak concentrations modelled with mass transfer coefficients calculated with the Sparks method are higher than experimentally determined values (McCready and Fontaine, 2010).
- The concentrations modelled assumed a “personal volume” of 1 m³, which can be considered a conservative approach.
- For dermal exposure, the ConsExpo model simply assumes direct contact with the skin with all 2-ethylhexanol contained in the product being available for dermal exposure. Processes such as evaporation are not considered.

Final estimates for risk characterisation

On the basis of the data presented, the mean event concentration modelled is taken as an acute exposure estimate. While this is an average, it needs to be noted that this concentration only exists for 1.33 minutes with the concentration on the day of exposure being three orders of magnitude lower.

For long-term inhalation exposure, the yearly average obtained in ConsExpo modelling is chosen. This is more a theoretical value since – due to the low frequency of use of these products – the acute exposure situation is more relevant.

In summary, the following rounded values are taken for risk characterisation:

Table 19.

Inhalation exposure	
2-EH concentration for acute inhalation exposure	1.2 mg/m ³
2-EH concentration for long-term inhalation exposure	0.1 µg/m ³
Dermal exposure	
2-EH dermal dose for acute dermal exposure	80 µg/kg b.w.
2-EH dermal dose for long-term dermal exposure	5 µg/kg b.w. x d

The results of the exposure estimation are compared to DNELs and PNECs in the risk characterisation section 10, which also deals with effects from local exposure.

ConsExpo 4.1 report**Product**

Dilution ES

Compound

Compound name :	2-EH	
CAS number :	104-76-7	
molecular weight	130	g/mol
vapour pressure	99	Pascal
KOW	794	linear

General Exposure Data

exposure frequency	24	1/year
body weight	65	kilogram

Inhalation model: Exposure to vapour : evaporation

weight fraction compound	0.25	fraction
exposure duration	1.33	minute
room volume	1	m ³
ventilation rate	0.6	1/hr
applied amount	1E3	gram
release area	20	cm ²
application duration	1.33	minute
mol weight matrix	3E3	g/mol
mass transfer rate	0.192	m/min

Dermal model: Direct dermal contact with product : instant application

weight fraction compound	0.25	fraction
applied amount	0.02	gram

Output**Inhalation (point estimates)**

inhalation mean event concentration :	1.19	mg/m ³
inhalation mean concentration on day of exposure:	0.0011	mg/m ³
inhalation air concentration year average :	7.21E-5	mg/m ³

Dermal : point estimates

dermal external dose :	0.0769	mg/kg
dermal chronic dose :	0.00505	mg/kg/day

1.8. Use in laboratories (industrial) (ES 8)

1.8.1. Exposure Scenario for Use in laboratories (industrial) (ES 8)**Table 20. exposure scenario 8: use in laboratories (industrial)**

Exposure Scenario 8: Use in laboratories (industrial)	
Industrial use: SU 3	
Environmental exposure scenario: ESVOC 38, spERC 4.24.v1 (specifies ERC 2, 4)	
Workers scenario ESVOC GES 17 (industrial); PROC 10, 15	
Use in laboratory settings	
Environmental exposure	
Based on ESVOC spERC: ESVOC 38 (ECETOC TRA) = spERC 4.24.v1	
Use of the substance within laboratory setting, including pilot plants	
Product characteristics	
Physical state	Liquid
Vapour pressure of substance	< 100 Pa at 20°C
Concentration of substance	Covers percentage substance in the product up to 100% (unless stated differently) [G13]
Amounts used	
Annual amount (per site for industrial use)	5 t/a
Daily amount (per site for industrial use) (M_{use})	100 kg/d (calculated by ECETOC TRA)
M_{safe}	133 kg/d (calculated by ECETOC TRA)
Frequency and duration of use	
Covers use on 20 d/year	
Environment factors not influenced by risk management	
Flow rate of receiving surface water	18.000 m ³ /day (ECETOC TRA default)
Other given operational conditions affecting environmental exposure	
Processing setting (indoor/outdoor)	Indoor use
Processing temperature and pressure	Assumes use at not more than 20 °C above ambient temperature [G15]
Technical conditions and measures at process level (source) to prevent release	
None	
Technical onsite conditions and measures to reduce or limit discharges, air emissions and releases to soil	
Industrial sewage treatment plant	No
Organizational measures to prevent/limit release from site	
None	
Conditions and measures related to municipal sewage treatment plant	
Municipal sewage treatment plant	yes
STP discharge rate	2 x 10 ³ m ³ /day (ECETOC TRA default)
Efficacy (substance removal in STP)	88% (calculated by ECETOC TRA)
Sludge treatment technique	disposal or recovery
Conditions and measures related to external treatment of waste for disposal	
Dispose of waste solvent or used containers according to local regulations [ENVT12]	
Conditions and measures related to external recovery of waste	
None	
Additional good practice advice (for environment) beyond the REACH CSA	
None	
Worker exposure	
Based on ESVOC GES 17: Use as solvent in laboratories handled in small quantities (typically less than 1 litre), low volatility solvent with DNEL inhalation ≥ 10 ppm, DNEL dermal ≥ 5 mg/kg/d	
Product characteristics	
Physical state	Liquid
Vapour pressure of substance	< 100 Pa at 20°C
Concentration of substance	Covers percentage substance in the product up to 100% (unless stated differently) [G13]
Amounts used	

Not relevant for ECETOC TRA exposure estimates	
Frequency and duration of use/exposure	
Frequency and duration	Covers daily exposures up to 8 hours (unless stated differently) [G2] For cleaning (wiping, brushing, flushing, PROC10) activities: Avoid carrying out operation for more than 1 hour [OC11]
Human factors not influenced by risk management	
Potentially exposed body parts	Hands and forearms
Exposed skin surface	The extent of hand exposure (one hand or both hands, one side or both sides) differs between different PROCs; the following values are assumed in ECETOC TRA: 240 cm ² (PROC15) and 960 cm ² (PROC10)
Other given operational conditions affecting workers exposure	
Setting (indoor/outdoor)	Indoor use
Room size	Not relevant for ECETOC TRA exposure estimates
Processing temperature and pressure	Assumes use at not more than 20°C above ambient temperature [G15]
Technical conditions and measures at process level (source) to prevent release	
<ul style="list-style-type: none"> - General risk management measures applicable to all activities (CS_new): Provide a good standard of general or controlled ventilation (5 to 10 air changes per hour) (E40); E74 - Ensure ventilation system is regularly maintained and tested; E62 - Carefully pour from containers E50 - Put lids (caps) on containers (bottles) immediately after use - CS36 Laboratory activities: EI18 – No specific measures identified; E66 - Ensure materials transfers are under containment or extract ventilation; - CS47 Cleaning [wiping, brushing, flushing]: E66 - Ensure materials transfers are under containment or extract ventilation; Use fume cupboard (BDI 03.03.01.01.01-12000) - CS47 Cleaning [wiping, brushing, flushing]: Avoid carrying out operation for more than 4 hours (OC12); E66 - Ensure materials transfers are under containment or extract ventilation 	
Technical conditions and measures to control dispersion from source towards the worker	
Ventilation	Local exhaust ventilation is not required
Efficiency rate	N/A
Organisational measures to prevent /limit releases, dispersion and exposure	
<ul style="list-style-type: none"> - Provide a good standard of general ventilation. Natural ventilation is from windows and doors etc. Controlled ventilation means air is supplied or removed by a powered fan [E1] - Avoid manual contact with wet work pieces [EI17] - Avoid splashing [C&H15] - Assumes a good basic standard of occupational hygiene is implemented [G1] 	
Conditions and measures related to personal protection, hygiene and health evaluation	
PPE to prevent dermal exposure	<ul style="list-style-type: none"> - Wear suitable gloves tested to EN374 [PPE15] for activities, where direct contact with substance is possible - Wear suitable coveralls to prevent exposure to the skin [PPE27] for activities, where direct contact with substance is possible
PPE to prevent eye exposure	- Use suitable eye protection [PPE26], where direct contact (e.g. splashes) with substance is possible
Respiratory protection	Not required
Respiratory PPE efficacy	N/A
Additional good practice advice (for environment) beyond the REACH CSA	
None	

1.8.2. Exposure estimation for Use in laboratories (industrial) (ES 8)

The results of the exposure estimation are shown in the following table.

Table 21. exposure estimation: ES 8

Workers		Environment	
		Additional input data	
Inhalation exposure		Life cycle stage	Service life
Maximum exposure [mg/m ³]	27.13	ERC	ERC2
Dermal exposure		Based on spERC?	ESVOC 38
Maximum exposure [mg/kg x d]	27.43	Site-specific data for STP used? (see comments)	no
Maximum exposure [mg/kg x d] considering dermal PPE	5.46	PECs	
		PEC STP [mg/L]	0.11671
		PEC freshwater [mg/L]	0.01269
		PEC freshwater sediment [mg/kg d.w.]	0.09990
		PEC soil [mg/kg d.w.]	0.01030
Total exposure (inhalation + dermal)		PEC marine water [mg/L]	0.00125
Maximum exposure [mg/kg x d] without dermal PPE	28.98	PEC marine sediment [mg/kg d.w.]	0.00988
		Total daily intake via local environment [mg/kg x d]	0.00038

The results of the exposure estimation are compared to DNELs and PNECs in the risk characterisation section 10, which also details the refinement in the exposure estimates for the PROCs giving high exposure estimates.

1.9. Use in functional fluids (industrial) (ES 9)

1.9.1. Exposure Scenario for Use in functional fluids (industrial) (ES 9)

Table 22. exposure scenario 9: use in functional fluids (industrial)

Exposure Scenario 9: Use in functional fluids (industrial)	
Industrial use: SU 3	
Environmental exposure scenario: ESVOC 31, spERC 7.13a.v1 (specifies ERC 7)	
Workers scenario ESVOC GES 13 (industrial); PROC 1, 2, 3, 4, 8a, 8b, 9, 20	
Use as functional fluids e.g. cable oils, transfer oils, coolants, insulators, refrigerants, hydraulic fluids in industrial equipment including maintenance and related material transfers	
Environmental exposure	
Based on ESVOC spERC: ESVOC 31 (ECETOC TRA) = spERC 7.13a.v1	
Use as functional fluids e.g. cable oils, transfer oils, insulators, hydraulic fluids in industrial equipment including maintenance and related material transfers	
Product characteristics	
Physical state	Liquid
Vapour pressure of substance	< 100 Pa at 20°C
Concentration of substance in mixture	Covers percentage substance in the product up to 25% [G12]
Amounts used	
Annual amount (per site for industrial use)	100 t/a
Daily amount (per site for industrial use) (M_{use})	500 kg/d (calculated by ECETOC TRA)
M_{safe}	4480 kg/d (calculated by ECETOC TRA)
Frequency and duration of use	
Release on 20 d/year	
Environment factors not influenced by risk management	
Flow rate of receiving surface water	18.000 m ³ /day (ECETOC TRA default)
Other given operational conditions affecting environmental exposure	
Processing setting (indoor/outdoor)	Indoor and outdoor use
Processing temperature and pressure	Ambient temperature and pressure
Technical conditions and measures at process level (source) to prevent release	
None	
Technical onsite conditions and measures to reduce or limit discharges, air emissions and releases to soil	
Industrial sewage treatment plant	No
Organizational measures to prevent/limit release from site	
None	
Conditions and measures related to municipal sewage treatment plant	
Municipal sewage treatment plant	yes
STP discharge rate	2 x 10 ³ m ³ /day (ECETOC TRA default)
Efficacy (substance removal in STP)	88% (calculated by ECETOC TRA)
Sludge treatment technique	disposal or recovery
Conditions and measures related to external treatment of waste for disposal	
Dispose of waste solvent or used containers according to local regulations [ENVT12]	
Conditions and measures related to external recovery of waste	
None	
Additional good practice advice (for environment) beyond the REACH CSA	
None	
Worker exposure	
Based on ESVOC GES 13: Use as functional fluid (industrial application), low volatility solvent with DNEL inhalation ≥ 10 ppm, DNEL dermal ≥ 5 mg/kg/d	
Product characteristics	

Physical state	Liquid
Vapour pressure of substance	< 100 Pa at 20°C
Concentration of substance in mixture	Covers percentage substance in the product up to 25% [G12]
Amounts used	
Not relevant for ECETOC TRA exposure estimates	
Frequency and duration of use/exposure	
Frequency and duration	PROC 8a: Avoid carrying out operation for more than 4 hours [OC12] All other PROCs: Covers daily exposures up to 8 hours (unless stated differently) [G2]
Human factors not influenced by risk management	
Potentially exposed body parts	Hands and forearms
Exposed skin surface	The extent of hand exposure (one hand or both hands, one side or both sides) differs between different PROCs; exposure of forearms is only assumed in industrial spraying activities (PROC7), the following range of values is assumed in ECETOC TRA: 240 cm ² (e.g. PROC1) – 960 cm ² (PROC8a)
Other given operational conditions affecting workers exposure	
Setting (indoor/outdoor)	Indoor and outdoor use
Room size	Not relevant for ECETOC TRA exposure estimates
Processing temperature and pressure	Assumes use at not more than 20°C above ambient temperature [G15] If applicable for PROC4 (see below): Operation is carried out at elevated temperature (> 20°C above ambient temperature) [OC7]
Technical conditions and measures at process level (source) to prevent release	
<ul style="list-style-type: none"> - <i>Bulk transfers CS14</i>: Transfer via enclosed lines. E52 Clear lines prior to decoupling E39. - <i>Drum/batch transfers CS8</i>: Use drum pumps or carefully pour from container. E64 Avoid spillage when withdrawing pump. C&H16 - <i>Filling / preparation of equipment from drums or containers CS45</i> Use drum pumps or carefully pour from container E64 - <i>Equipment operation (closed systems) CS15</i>: No specific measures identified EI18 - <i>Equipment operation (open systems) CS16</i>: Minimise exposure by enclosing the operation or equipment and provide extract ventilation at openings if operation carried out at elevated temperatures E75 - <i>Equipment maintenance CS5</i>: Drain down system prior to equipment break-in or maintenance E65. Transfer via enclosed lines E52. Retain drain downs in sealed storage pending disposal or for subsequent recycle. ENVT4 - <i>Re-work and re-manufacture of articles CS19</i>: Drain down system prior to equipment break-in or maintenance E65 Retain drainings in sealed storage pending disposal. ENVT4 - <i>Equipment maintenance CS5</i>: Drain down system prior to equipment break-in or maintenance E65 . Retain drain downs in sealed storage pending disposal or for subsequent recycle. ENVT4 - <i>Material storage CS67</i>: Store substance within a closed system. E84 Ensure dedicated transfer points are provided. E66 	
Technical conditions and measures to control dispersion from source towards the worker	
Ventilation	Local exhaust ventilation is required for: PROC4 when used at elevated temperatures of up to 80°C
Efficiency rate	90%
Organisational measures to prevent /limit releases, dispersion and exposure	
<ul style="list-style-type: none"> - Provide a good standard of general ventilation. Natural ventilation is from windows and doors etc. Controlled ventilation means air is supplied or removed by a powered fan [E1] - Avoid manual contact with wet work pieces [EI17] 	

- Avoid splashing [C&H15]	
- Assumes a good basic standard of occupational hygiene is implemented [G1]	
Conditions and measures related to personal protection, hygiene and health evaluation	
PPE to prevent dermal exposure	- Wear suitable gloves tested to EN374 [PPE15] for activities, where direct contact with substance is possible - Wear suitable coveralls to prevent exposure to the skin [PPE27] for activities, where direct contact with substance is possible
PPE to prevent eye exposure	- Use suitable eye protection [PPE26], where direct contact (e.g. splashes) with substance is possible
Respiratory protection	Not required
Respiratory PPE efficacy	N/A
Additional good practice advice (for environment) beyond the REACH CSA	
None	

1.9.2. Exposure estimation for Use in functional fluids (industrial) (ES 9)

The results of the exposure estimation are shown in the following table.

Table 23. exposure estimation ES 9

Workers		Environment	
		Additional input data	
Inhalation exposure		Life cycle stage	Service life
Maximum exposure [mg/m ³]	19.53	ERC	ERC7
Dermal exposure		Based on spERC?	ESVOC 31
Maximum exposure [mg/kg x d]	13.71	Site-specific data for STP used? (see comments)	no
		PECs	
		PEC STP [mg/L]	0.00875
		PEC freshwater [mg/L]	0.00190
		PEC freshwater sediment [mg/kg d.w.]	0.01492
		PEC soil [mg/kg d.w.]	0.00078
Total exposure (inhalation + dermal)		PEC marine water [mg/L]	0.00018
Maximum exposure [mg/kg x d]	28.98	PEC marine sediment [mg/kg d.w.]	0.00138
		Total daily intake via local environment [mg/kg x d]	0.00015

The results of the exposure estimation are compared to DNELs and PNECs in the risk characterisation section 10.

1.10. Use in functional fluids (professional) (ES 10)**1.10.2. Exposure Scenario for Use in functional fluids (professional) (ES 10)****Table 24. Exposure Scenario 9: use in functional fluids (professional)**

Exposure Scenario 9: Use in functional fluids (professional)	
Professional use: SU 22	
Environmental exposure scenario: ESVOC 32, spERC 9.13b.v1 (specifies ERC 9a,b)	
Workers scenario ESVOC GES 13 (industrial); PROC 1, 2, 3, 8a, 9, 20	
Use as functional fluids e.g. cable oils, transfer oils, coolants, insulators, refrigerants, hydraulic fluids in industrial equipment including maintenance and related material transfers	
Environmental exposure	
Based on ESVOC spERC: ESVOC 32 (ECETOC TRA) = spERC 9.13b.v1	
Use as functional fluids e.g. cable oils, transfer oils, insulators, hydraulic fluids in industrial equipment including maintenance and related material transfers	
Product characteristics	
Physical state	Liquid
Vapour pressure of substance	< 100 Pa at 20°C
Concentration of substance in mixture	Covers percentage substance in the product up to 25% [G12]
Amounts used	
Annual amount (total for EU)	10 t/a
Daily amount (per site for industrial use) (M_{use})	0.014 kg/d (calculated by ECETOC TRA)
M_{safe}	0.227 kg/d (calculated by ECETOC TRA)
Frequency and duration of use	
Continuous use/release	
Environment factors not influenced by risk management	
Flow rate of receiving surface water	18.000 m ³ /day (ECETOC TRA default)
Other given operational conditions affecting environmental exposure	
Processing setting (indoor/outdoor)	Indoor and outdoor use
Processing temperature and pressure	Ambient temperature and pressure
Technical conditions and measures at process level (source) to prevent release	
None	
Technical onsite conditions and measures to reduce or limit discharges, air emissions and releases to soil	
Industrial sewage treatment plant	No
Organizational measures to prevent/limit release from site	
None	
Conditions and measures related to municipal sewage treatment plant	
Municipal sewage treatment plant	yes
STP discharge rate	2 x 10 ³ m ³ /day (ECETOC TRA default)
Efficacy (substance removal in STP)	88% (calculated by ECETOC TRA)
Sludge treatment technique	disposal or recovery
Conditions and measures related to external treatment of waste for disposal	
Dispose of waste solvent or used containers according to local regulations [ENVT12]	
Conditions and measures related to external recovery of waste	
None	
Additional good practice advice (for environment) beyond the REACH CSA	
None	
Worker exposure	
Based on ESVOC GES 13: Use as functional fluid (professional application), low volatility solvent with DNEL inhalation ≥ 10 ppm, DNEL dermal ≥ 5 mg/kg/d	
Product characteristics	

Physical state	Liquid
Vapour pressure of substance	< 100 Pa at 20°C
Concentration of substance in mixture	Covers percentage substance in the product up to 25% [G12]
Amounts used	
Not relevant for ECETOC TRA exposure estimates	
Frequency and duration of use/exposure	
Frequency and duration	Covers daily exposures up to 8 hours (unless stated differently) [G2] PROC 8a: Avoid carrying out operation for more than 1 hour [OC11]
Human factors not influenced by risk management	
Potentially exposed body parts	Hands and forearms
Exposed skin surface	The extent of hand exposure (one hand or both hands, one side or both sides) differs between different PROCs; exposure of forearms is only assumed in industrial spraying activities (PROC7), the following range of values is assumed in ECETOC TRA: 240 cm ² (e.g. PROC1) – 960 cm ² (PROC8a)
Other given operational conditions affecting workers exposure	
Setting (indoor/outdoor)	Indoor and outdoor use
Room size	Not relevant for ECETOC TRA exposure estimates
Processing temperature and pressure	Assumes use at not more than 20 °C above ambient temperature [G15] If applicable for PROC20 (see below): Operation is carried out at elevated temperature (> 20°C above ambient temperature) [OC7]
Technical conditions and measures at process level (source) to prevent release	
<ul style="list-style-type: none"> - <i>Drum/batch transfers</i> CS8: Use drum pumps or carefully pour from container. E64 Avoid spillage when withdrawing pump. C&H16 - <i>Transfer from/pouring from containers</i> CS22: Use drum pumps or carefully pour from container. E64 Clear up spills immediately and dispose of waste safely. E19 - <i>Filling / preparation of equipment from drums or containers.</i> CS45 Carefully pour from containers E62 - <i>Equipment operation (closed systems)</i> CS15 Minimise exposure by partial enclosure of the operation or equipment and provide extract ventilation at openings E60 No other specific measures identified EI21 - <i>Re-work and re-manufacture of articles</i> CS19 Provide enhanced general ventilation by mechanical means E48 Retain drain downs in sealed storage pending disposal or for subsequent recycle ENVT4 - <i>Equipment maintenance</i> CS5: Drain down system prior to equipment break-in or maintenance E65. Retain drain downs in sealed storage pending disposal or for subsequent recycle ENVT4 - <i>Storage</i> CS55: Store substance within a closed system. E47 Ensure dedicated transfer points are provided. E66 	
Technical conditions and measures to control dispersion from source towards the worker	
Ventilation	Local exhaust ventilation is required for: - PROC20 when used at elevated temperatures up to 80°C
Efficiency rate	80%
Organisational measures to prevent /limit releases, dispersion and exposure	
<ul style="list-style-type: none"> - Provide a good standard of general ventilation. Natural ventilation is from windows and doors etc. Controlled ventilation means air is supplied or removed by a powered fan [E1] - Avoid manual contact with wet work pieces [EI17] - Avoid splashing [C&H15] - Assumes a good basic standard of occupational hygiene is implemented [G1] 	
Conditions and measures related to personal protection, hygiene and health evaluation	
PPE to prevent dermal exposure	- Wear suitable gloves tested to EN374 [PPE15] for activities, where direct contact with

	substance is possible - Wear suitable coveralls to prevent exposure to the skin [PPE27] for activities, where direct contact with substance is possible
PPE to prevent eye exposure	- Use suitable eye protection [PPE26], where direct contact (e.g. splashes) with substance is possible
Respiratory protection	Not required
Respiratory PPE efficacy	N/A
Additional good practice advice (for environment) beyond the REACH CSA	
None	

1.10.3. Exposure estimation for Use in functional fluids (professional) (ES 10)

The results of the exposure estimation are shown in the following table.

Table 25. exposure estimation: ES 10

Workers		Environment	
		Additional input data	
Inhalation exposure		Life cycle stage	Service life
Maximum exposure [mg/m ³]	32.56	ERC	ERC9a
Dermal exposure		Based on spERC?	ESVOC 32
Maximum exposure [mg/kg x d]	13.71	Site-specific data for STP used? (see comments)	no
		PECs	
		PEC STP [mg/L]	0.00002
		PEC freshwater [mg/L]	0.00102
		PEC freshwater sediment [mg/kg d.w.]	0.00805
		PEC soil [mg/kg d.w.]	0.00001
Total exposure (inhalation + dermal)		PEC marine water [mg/L]	0.00009
Maximum exposure [mg/kg x d]	16.04	PEC marine sediment [mg/kg d.w.]	0.00069
		Total daily intake via local environment [mg/kg x d]	0.00013

The results of the exposure estimation are compared to DNELs and PNECs in the risk characterisation section 2.

1.11. Use in cleaning products (professional) (ES 11)

1.11.1. Exposure Scenario for Use in cleaning products (professional) (ES 11)

Table 26. Exposure Scenario 11: use in cleaning products (professional)

Exposure Scenario 11: Use in cleaning products (professional)	
Professional use: SU 22	
Environmental exposure scenario: ESVOC 9, spERC 8.4b.v1 (specifies ERC 8a,d)	
Workers scenario: ESVOC GES 4 (professional); PROC 2, 3, 4, 8a, 8b, 10, 11, 13	
Covers the professional use as a component of cleaning products including pouring/unloading from drums or containers	
Environmental exposure	
Based on ESVOC spERC: ESVOC 9 (ECETOC TRA) = spERC 8.4b.v1	
Covers the use as a component of cleaning products for professional use including pouring/unloading from drums or containers; and exposures during cleaning activities	
Product characteristics	
Physical state	Liquid
Vapour pressure of substance	< 100 Pa at 20°C
Concentration of substance in mixture	Covers percentage substance in the product up to 25% [G12]
Amounts used	
Annual amount (total for EU)	100 t/a
Daily amount (M_{use})	0.137 kg/d (calculated by ECETOC TRA)
M_{safe}	2.27 kg/d (calculated by ECETOC TRA)
Frequency and duration of use	
Continuous use/release	
Environment factors not influenced by risk management	
Flow rate of receiving surface water	18.000 m ³ /day (ECETOC TRA default)
Other given operational conditions affecting environmental exposure	
Processing setting (indoor/outdoor)	Indoor and outdoor use
Processing temperature and pressure	Ambient temperature and pressure
Technical conditions and measures at process level (source) to prevent release	
None	
Technical onsite conditions and measures to reduce or limit discharges, air emissions and releases to soil	
Industrial sewage treatment plant	No
Organizational measures to prevent/limit release from site	
None	
Conditions and measures related to municipal sewage treatment plant	
Municipal sewage treatment plant	yes
STP discharge rate	2 x 10 ³ m ³ /day (ECETOC TRA default)
Efficacy (substance removal in STP)	88% (calculated by ECETOC TRA)
Sludge treatment technique	disposal or recovery
Conditions and measures related to external treatment of waste for disposal	
Dispose of waste solvent or used containers according to local regulations [ENVT12]	
Conditions and measures related to external recovery of waste	
None	
Additional good practice advice (for environment) beyond the REACH CSA	
None	
Worker exposure	
Based on ESVOC GES 4: Cleaning (professional application), low volatility solvent with DNEL inhalation ≥ 10 ppm, DNEL dermal ≥ 5 mg/kg/d	
Product characteristics	

Physical state	Liquid
Vapour pressure of substance	< 100 Pa at 20°C
Concentration of substance in mixture	Covers percentage substance in the product up to 25% [G12]
Amounts used	
Not relevant for ECETOC TRA exposure estimates	
Frequency and duration of use/exposure	
Frequency and duration	Covers daily exposures up to 8 hours (unless stated differently) [G2] PROC8a: Avoid carrying out operation for more than 1 hour [OC11] PROC8b, 10 and 11: Avoid carrying out operation for more than 4 hours [OC12]
Human factors not influenced by risk management	
Potentially exposed body parts	Hands and forearms
Exposed skin surface	The extent of hand exposure (one hand or both hands, one side or both sides) differs between different PROCs; exposure of forearms is only assumed in non-industrial spraying activities (PROC11), the following range of values is assumed in ECETOC TRA: 240 cm ² (e.g. PROC3) – 1500 cm ² (PROC11)
Other given operational conditions affecting workers exposure	
Setting (indoor/outdoor)	Indoor and outdoor use
Room size	Not relevant for ECETOC TRA exposure estimates
Processing temperature and pressure	Assumes use at not more than 20°C above ambient temperature [G15]
Technical conditions and measures at process level (source) to prevent release	
Automated process with (semi) closed systems. [CS93]. Use in contained systems [CS38]. No specific measures identified [E118]. Automated process with (semi) closed systems. [CS93]. Drum/batch transfers [CS8]. Use in contained systems [CS38]. No specific measures identified [E118]. Filling / preparation of equipment from drums or containers. [CS45]. Ensure operation is undertaken outdoors [E69]. Cleaning with low-pressure washers [CS42]. Rolling, Brushing [CS51]. No spraying [CS60]. Limit the substance content in the product to 5 % [OC17]. Cleaning with high pressure washers [CS44]. Spraying [CS10]. Indoor [OC8]. Limit the substance content in the product to 1 % [OC16 Manual [CS34]. Surfaces [CS48]. Cleaning [CS47]. Spraying [CS10]. Avoid carrying out operation for more than 4 hours [OC12]. Limit the substance content in the product to 25 % [OC24] Ensure doors and windows are opened [E72]. Ad hoc manual application via trigger sprays, dipping, etc. [CS27]. Rolling, Brushing [CS51]. Provide extract ventilation to points where emissions occur [E54]. Cleaning of medical devices [CS74]. Provide extract ventilation to points where emissions occur [E54].	
Technical conditions and measures to control dispersion from source towards the worker	
Ventilation	Local exhaust ventilation is generally not envisaged. For roller application or brushing (PROC 10): use LEV (if not feasible, use either products containing up to 5% of the substance or durations < 1 h For non-industrial spraying (PROC 11): use LEV together with either products containing up to 5% of the substance or durations < 1 h
Efficiency rate	80%
Organisational measures to prevent /limit releases, dispersion and exposure	
- Provide a good standard of general ventilation. Natural ventilation is from windows and doors etc.	

Controlled ventilation means air is supplied or removed by a powered fan [E1] - Avoid manual contact with wet work pieces [E117] - Avoid splashing [C&H15] - Assumes a good basic standard of occupational hygiene is implemented [G1]	
Conditions and measures related to personal protection, hygiene and health evaluation	
PPE to prevent dermal exposure	- Wear suitable gloves tested to EN374 [PPE15] for activities, where direct contact with substance is possible - Wear suitable coveralls to prevent exposure to the skin [PPE27] for activities, where direct contact with substance is possible PROC 11: Wear chemically resistant gloves (tested to EN374) in combination with 'basic' employee training [PPE16]
PPE to prevent eye exposure	- Use suitable eye protection [PPE26], where direct contact (e.g. splashes) with substance is possible
Respiratory protection	PROC 11: Wear a half mask respirator conforming to EN140, 149 or equivalent [PPE22] (if the technical conditions and measures mentioned above are not feasible) PROC8a (if carried out for more than 1 hour): Wear a half mask respirator conforming to EN140, 149 or equivalent [PPE22]
Respiratory PPE efficacy	90%
Additional good practice advice (for environment) beyond the REACH CSA	
None	

1.11.2. Exposure estimation for Use in cleaning products (professional) (ES 11)

The results of the exposure estimation are shown in the following table.

Table 27. exposure estimation: ES 11

Workers		Environment	
		Additional input data	
Inhalation exposure		Life cycle stage	Service life
Maximum exposure [mg/m ³]	195.35	ERC	ERC8a
Dermal exposure		Based on spERC?	ESVOC 9
Maximum exposure [mg/kg x d]	107.14	Site-specific data for STP used? (see comments)	no
Maximum exposure [mg/kg x d], considering dermal PPE	13.71	PECs	
		PEC STP [mg/L]	0.00000
		PEC freshwater [mg/L]	0.00102
		PEC freshwater sediment [mg/kg d.w.]	0.00803
		PEC soil [mg/kg d.w.]	0.00000
Total exposure (inhalation + dermal)		PEC marine water [mg/L]	0.00009
Maximum exposure [mg/kg x d], not considering dermal PPE	135.05	PEC marine sediment [mg/kg d.w.]	0.00069
		Total daily intake via local environment [mg/kg x d]	0.00013

The results of the exposure estimation are compared to DNELs and PNECs in the risk characterisation section 10, which also details the refinement in the exposure estimates for the PROCs giving high exposure estimates.

1.12. Use in oil and gas field drilling (industrial) (ES 12)

1.12.1. Exposure Scenario for Use in oil and gas field drilling (industrial) (ES 12)

Table 28. Exposure Scenario 12: use in oil and gas field drilling (industrial)

Exposure Scenario 12: Use in oil and gas field drilling (industrial)	
Industrial use: SU 3 (2a, 2b)	
Environmental exposure scenario: ESVOC 11, spERC 4.5a.v1 (specifies ERC 4)	
Workers scenario: ESVOC GES 5 (industrial); PROC 1, 2, 3, 4, 8a, 8b	
Oil field well drilling and production operations (including drilling muds and well cleaning) including material transfers, on-site formulation, well head operations, shaker room activities and related maintenance.	
Environmental exposure	
Based on ESVOC spERC: ESVOC 11 (ECETOC TRA) = spERC 4.5a.v1	
Oil field well drilling and production operations (including drilling muds and well cleaning) including material transfers, on-site formulation, well head operations, shaker room activities and related maintenance.	
Product characteristics	
Physical state	Liquid
Vapour pressure of substance	< 100 Pa at 20°C
Concentration of substance in mixture	Covers percentage substance in the product up to 100% (unless stated differently) [G13]
Amounts used	
Annual amount (per site for industrial use)	1 t/a
Daily amount (per site for industrial use) (M_{use})	33.3 kg/d (calculated by ECETOC TRA)
M_{safe}	38.7 kg/d (calculated by ECETOC TRA)
Frequency and duration of use	
Release on 30 d/year	
Environment factors not influenced by risk management	
Flow rate of receiving surface water	18.000 m ³ /day (ECETOC TRA default)
Other given operational conditions affecting environmental exposure	
Processing setting (indoor/outdoor)	Indoor and outdoor use
Processing temperature and pressure	Ambient temperature and pressure
Technical conditions and measures at process level (source) to prevent release	
None	
Technical onsite conditions and measures to reduce or limit discharges, air emissions and releases to soil	
Industrial sewage treatment plant	No
Organizational measures to prevent/limit release from site	
None	
Conditions and measures related to municipal sewage treatment plant	
Municipal sewage treatment plant	yes
STP discharge rate	2 x 10 ³ m ³ /day (ECETOC TRA default)
Efficacy (substance removal in STP)	88% (calculated by ECETOC TRA)
Sludge treatment technique	disposal or recovery
Conditions and measures related to external treatment of waste for disposal	
Dispose of waste solvent or used containers according to local regulations [ENVT12]	
Conditions and measures related to external recovery of waste	
None	
Additional good practice advice (for environment) beyond the REACH CSA	
None	
Worker exposure	
Based on ESVOC GES 5: Use in Oil field drilling and production operations (industrial application), low volatility solvent with DNEL inhalation ≥ 10 ppm, DNEL dermal ≥ 5 mg/kg/d	
Product characteristics	

Physical state	Liquid
Vapour pressure of substance	< 100 Pa at 20°C
Concentration of substance in mixture	Covers percentage substance in the product up to 100% (unless stated differently) [G13]
Amounts used	
Not relevant for ECETOC TRA exposure estimates	
Frequency and duration of use/exposure	
Frequency and duration	Covers daily exposures up to 8 hours (unless stated differently) [G2] PROC 8a: Avoid carrying out operation for more than 1 hour [OC11]
Human factors not influenced by risk management	
Potentially exposed body parts	Hands and forearms
Exposed skin surface	The extent of hand exposure (one hand or both hands, one side or both sides) differs between different PROCs; the following range of values is assumed in ECETOC TRA: 240 cm ² (e.g. PROC1) – 960 cm ² (PROC8a)
Other given operational conditions affecting workers exposure	
Setting (indoor/outdoor)	Indoor and outdoor use
Room size	Not relevant for ECETOC TRA exposure estimates
Processing temperature and pressure	Assumes use at not more than 20°C above ambient [G15] PROC4 (if applicable): Operation is carried out at elevated temperature (> 20°C above ambient temperature) [OC7]
Technical conditions and measures at process level (source) to prevent release	
<p>Drilling mud (re-) formulation (PROC3): Handle substance within a predominantly closed system provided with extract ventilation (E49). Ensure the ventilation system is regularly maintained and tested (E74).</p> <p>Operation of solids filtering equipment - vapour exposures (PROC4): Aerosol generation due to elevated process temperature (OC25). Receptor hood for fumes/vapours. Re-circulation of exhaust air is not recommended. Ensure the ventilation system is regularly maintained and tested (E74).</p> <p>Cleaning of solids filtering equipment (PROC8a): Discharging to/from vessels (non-dedicated): Provide extract ventilation to points where emissions occur (E54). Ensure the ventilation system is regularly maintained and tested (E74).</p> <p>Treatment and disposal of filtered solids (PROC3): Provide extract ventilation to points where emissions occur (E54). Ensure the ventilation system is regularly maintained and tested (E74).</p> <p>Clean down and Maintenance (PROC8a): Drain or remove substance from equipment prior to break-in or maintenance (E81).</p> <p>General process exposures from enclosed processes (PROC1 and PROC2): Store substance within a closed system. Ensure dedicated transfer points are provided. Avoid dip sampling.</p>	
Technical conditions and measures to control dispersion from source towards the worker	
Ventilation	Local exhaust ventilation is required for: - PROC4 when used at elevated temperatures of up to 60°C
Efficiency rate	90%
Organisational measures to prevent /limit releases, dispersion and exposure	
<ul style="list-style-type: none"> - Provide a good standard of general ventilation. Natural ventilation is from windows and doors etc. Controlled ventilation means air is supplied or removed by a powered fan [E1] - Avoid manual contact with wet work pieces [E117] - Avoid splashing [C&H15] - Assumes a good basic standard of occupational hygiene is implemented [G1] 	
Conditions and measures related to personal protection, hygiene and health evaluation	
PPE to prevent dermal exposure	- Wear suitable gloves tested to EN374 [PPE15] for activities, where direct contact with substance is possible

	- Wear suitable coveralls to prevent exposure to the skin [PPE27] for activities, where direct contact with substance is possible - Wear rubber boots [PPE28] for drill floor operations (PROC4)
PPE to prevent eye exposure	- Use suitable eye protection [PPE26], where direct contact (e.g. splashes) with substance is possible
Respiratory protection	Not required
Respiratory PPE efficacy	N/A
Additional good practice advice (for environment) beyond the REACH CSA	
None	

1.12.2. Exposure estimation for Use in oil and gas field drilling (industrial) (ES 12)

The results of the exposure estimation are shown in the following table.

Table 27. exposure estimation: ES 12

Workers		Environment	
		Additional input data	
Inhalation exposure		Life cycle stage	Service life
Maximum exposure [mg/m ³]	27.13	ERC	ERC4
Dermal exposure		Based on spERC?	ESVOC 11
Maximum exposure [mg/kg x d]	13.71	Site-specific data for STP used? (see comments)	no
		PECs	
		PEC STP [mg/L]	0.13616
		PEC freshwater [mg/L]	0.01463
		PEC freshwater sediment [mg/kg d.w.]	0.11521
		PEC soil [mg/kg d.w.]	0.01201
Total exposure (inhalation + dermal)		PEC marine water [mg/L]	0.00145
Maximum exposure [mg/kg x d]	15.26	PEC marine sediment [mg/kg d.w.]	0.01141
		Total daily intake via local environment [mg/kg x d]	0.00045

The results of the exposure estimation are compared to DNELs and PNECs in the risk characterisation section 2.

2. RISK CHARACTERISATION

Based on the hazard assessment and the exposure estimation presented in previous sections of this CSR, the quantitative risk characterisation is conducted below. As detailed in section 1, only the maximum exposure (and thus the maximum risk characterisation ratios) estimated in ECETOC TRA across all PROCs are shown for each ES. However, all PROCs requiring refinement in the exposure estimate are identified and the necessary measures (often impossible to model in ECETOC TRA) explained. Detailed results per PROC obtained from ECETOC TRA are given in the Appendix 1.

In addition, a qualitative risk assessment is included in section 2.# for the endpoints skin and eye irritation.

2.1. Manufacture of substance (ES 1)

2.1.1. Human Health

2.1.1.1. Workers

Table shows the Risk Characterization Ratios (RCR) calculated by using the parameters, operational conditions and risk management measures specified in the exposure scenario in section 1.

2.1.1.2. Consumers

This exposure scenario does not address consumers.

2.1.1.3. Indirect exposure of humans via the environment

Table shows the RCR for humans via the environment in the environment section.

2.1.2. Environment

Table shows the RCRs calculated by using the parameters, operational conditions and risk management measures specified in the exposure scenario in section 1.

2.2. Distribution of substance (ES 2)

2.2.1. Human Health

2.2.1.1. Workers

Table shows the Risk Characterization Ratios (RCR) calculated by using the parameters, operational conditions and risk management measures specified in the exposure scenario in section 1.

2.2.1.2. Consumers

This exposure scenario does not address consumers.

2.2.1.3. Indirect exposure of humans via the environment

Table shows the RCR for humans via the environment in the environment section.

2.2.2. Environment

Table shows the RCRs calculated by using the parameters, operational conditions and risk management measures specified in the exposure scenario in section 1.

Table 30: Risk characterisation for ES 2

Workers		Environment	
Inhalation exposure		STP [mg/L]	
DNEL [mg/m ³]	53.2	PNEC	10
Maximum exposure [mg/m ³]	27.13	PEC	0.00078
Maximum RCR	0.510	RCR	0.00008
Dermal exposure		Freshwater [mg/L]	
DNEL dermal [mg/kg x d]	23	PNEC	0.01700
Maximum exposure [mg/kg x d]	6.86	PEC	0.00110
Maximum RCR	0.298	RCR	0.06458
		Freshwater sediment [mg/kg d.w.]	
Total exposure (inhalation + dermal)		PNEC	0.28000
Maximum exposure [mg/kg x d]	10.73	PEC	0.00864
Maximum RCR	0.808	RCR	0.03087
		Soil [mg/kg d.w.]	
Additional modification outside ECETOC TRA required?	NO	PNEC	0.04700
		PEC	0.00007
		RCR	0.00157
		Marine water [mg/L]	
		PNEC	0.00170
		PEC	0.00010
		RCR	0.05618
		Marine Sediment [mg/kg d.w.]	
		PNEC	0.02800
		PEC	0.00075
		RCR	0.02685
		Humans via the environment [mg/kg x d]	
		DNEL, gen. pop., long-term-systemic, oral	1.1
		Total daily intake via local environment	0.00014

	RCR	0.00013
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In summary, all RCRs are below 1 and further refinement is not required.

2.3. Formulation of substance (ES 3)

2.3.1. Human Health

2.3.1.1. Workers

Table shows the Risk Characterization Ratios (RCR) calculated by using the parameters, operational conditions and risk management measures specified in the exposure scenario in section 1.

2.3.1.2. Consumers

This exposure scenario does not address consumers.

2.3.1.3. Indirect exposure of humans via the environment

Table shows the RCR for humans via the environment in the environment section.

2.3.2. Environment

Table 31 shows the RCRs calculated by using the parameters, operational conditions and risk management measures specified in the exposure scenario in section 1.

Table 31: Risk characterisation for ES 3

Workers		Environment	
Inhalation exposure		STP [mg/L]	
DNEL [mg/m ³]	53.2	PNEC	10
Maximum exposure [mg/m ³]	27.13	PEC	0.15561
Maximum RCR	0.510	RCR	0.01556
Dermal exposure		Freshwater [mg/L]	
DNEL dermal [mg/kg x d]	23	PNEC	0.01700
Maximum exposure [mg/kg x d]	6.86	PEC	0.01657
Maximum RCR	0.298	RCR	0.97491
		Freshwater sediment [mg/kg d.w.]	
Total exposure (inhalation + dermal)		PNEC	0.28000
Maximum exposure [mg/kg x d]	10.73	PEC	0.13048
Maximum RCR	0.808	RCR	0.46598
		Soil [mg/kg d.w.]	
Additional modification outside ECETOC TRA required?	NO	PNEC	0.04700
		PEC	0.01393
		RCR	0.29636
		Marine water [mg/L]	
		PNEC	0.00170
		PEC	0.00164
		RCR	0.96655
		Marine Sediment [mg/kg d.w.]	
		PNEC	0.02800
		PEC	0.01294
		RCR	0.46199
		Humans via the environment [mg/kg x d]	
		DNEL, gen. pop., long-term-systemic, oral	1.1
		Total daily intake via local environment	0.002

		RCR	0.002
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In summary, all RCRs are below 1 for workers and the environment and further refinement is not required.

2.4. Use in coatings (industrial) (ES 4)

2.4.1. Human Health

2.4.1.1. Workers

Table 32 shows the Risk Characterization Ratios (RCR) calculated by using the parameters, operational conditions and risk management measures specified in the exposure scenario in section 1.

2.4.1.2. Consumers

This exposure scenario does not address consumers.

2.4.1.3. Indirect exposure of humans via the environment

Table 32 shows the RCR for humans via the environment in the environment section.

2.4.2. Environment

Table 32 shows the RCRs calculated by using the parameters, operational conditions and risk management measures specified in the exposure scenario in section 1.

Table 32: Risk characterisation for ES 4

Workers		Environment	
Inhalation exposure		STP [mg/L]	
DNEL [mg/m ³]	53.2	PNEC	10
Maximum exposure [mg/m ³]	27.13	PEC	0.13616
Maximum RCR	0.510	RCR	0.01362
Dermal exposure		Freshwater [mg/L]	
DNEL dermal [mg/kg x d]	23	PNEC	0.01700
Maximum exposure [mg/kg x d]	21.43	PEC	0.01463
Maximum RCR	0.932	RCR	0.86087
		Freshwater sediment [mg/kg d.w.]	
Total exposure (inhalation + dermal)		PNEC	0.28000
Maximum exposure [mg/kg x d]	25.30	PEC	0.11521
Maximum RCR	1.442	RCR	0.41148
		Soil [mg/kg d.w.]	
Additional modification outside ECETOC TRA required?	YES	PNEC	0.04700
for PROC(s)	7	PEC	0.01300
Dermal exposure OCs/RMMs		RCR	0.27667
Suitable gloves tested to EN374 [efficiency in %]	80	Marine water [mg/L]	
Dermal exposure [mg/kg x d]	4.286	PNEC	0.00170
Dermal RCR for PROC 7	0.186	PEC	0.00145
		RCR	0.85247
Inhalation exposure for PROC 7 [mg/m ³]	27.13	Marine Sediment [mg/kg d.w.]	
Inhalation RCR for PROC 7	0.510	PNEC	0.02800
		PEC	0.01141
		RCR	0.40746
		Humans via the environment [mg/kg x d]	
Total RCR with additional OCsRMMs	0.696	DNEL, gen. pop., long-term-systemic, oral	1.1

	Total daily intake via local environment	0.0042
	RCR	0.0038

In summary, all RCRs are below 1 for the environment and further refinement is not required. For workers, the initial ECETOC TRA estimation (total exposure for combined dermal and inhalation exposure) resulted in an RCR > 1 for PROC 7. As shown above, the RCR is < 1 if the PPE for dermal exposure communicated in the ES is considered in the estimate.

2.5. Use in coatings (professional) (ES 5)

2.5.1. Human Health

2.5.1.1. Workers

Table 33 shows the Risk Characterization Ratios (RCR) calculated by using the parameters, operational conditions and risk management measures specified in the exposure scenario in section 1.

2.5.1.2. Consumers

This exposure scenario does not address consumers.

2.5.1.3. Indirect exposure of humans via the environment

Table shows the RCR for humans via the environment in the environment section.

2.5.2. Environment

Table 33 shows the RCRs calculated by using the parameters, operational conditions and risk management measures specified in the exposure scenario in section 1.

Table 33: Risk characterisation for ES 5

Workers		Environment	
Inhalation exposure		STP [mg/L]	
DNEL [mg/m ³]	53.2	PNEC	10
Maximum exposure [mg/m ³]	27.13	PEC	0.00008
Maximum RCR	0.510	RCR	0.00001
Dermal exposure		Freshwater [mg/L]	
DNEL dermal [mg/kg x d]	23	PNEC	0.01700
Maximum exposure [mg/kg x d]	141.43	PEC	0.00103
Maximum RCR	6.149	RCR	0.06048
		Freshwater sediment [mg/kg d.w.]	
Total exposure (inhalation + dermal)		PNEC	0.28000
Maximum exposure [mg/kg x d]	145.30	PEC	0.00809
Maximum RCR	6.659	RCR	0.02891
		Soil [mg/kg d.w.]	
Additional modification outside ECETOC TRA required?	YES	PNEC	0.04700
for PROC(s)	10, 11, 19	PEC	0.00001
	(see text for details)	RCR	0.00025
		Marine water [mg/L]	
		PNEC	0.00170
		PEC	0.00009
		RCR	0.05207
		Marine Sediment [mg/kg d.w.]	
		PNEC	0.02800
		PEC	0.00070
		RCR	0.02489
		Humans via the environment [mg/kg x d]	
		DNEL, gen. pop., long-term-systemic, oral	1.1
		Total daily intake via local environment	0.00013
		RCR	0.00012

In summary, all RCRs are below 1 for the environment and further refinement is not required.

For workers, the initial ECETOC TRA estimation resulted in an RCR > 1 for PROCs 10, 11 and 19 7. Therefore a refined exposure assessment with all the RMMs/OCs and PPEs communicated in the ES was conducted and is shown in Table 34.

Table 34: Refined exposure assessment and risk characterisation for ES 5 (workers; all calculated values rounded to three significant figures)

Input	PROC ->	10	11	19
Duration of activity [hours/day] (> 4 hours = default)		>4 h	0.25-1 h	0.25-1 h
Use of ventilation ? (Indoors with or without LEV)		With		Without
Use of respiratory protection and, if so, minimum efficiency ?		No	No	No
Substance in preparation?		>25%	>25%	>25%
TRA estimate of exposures				
Inhalative Exposure Estimate (mg/m ³)		27.1	21.7	27.1
Dermal Exposure Estimate (mg/kg/day)		13.7	53.6	141
Total Exposure = Dermal + Inhalative (mg/kg/day)		17.6	56.7	145
TRA risk characterization				
Risk Characterisation Ratio - Inhalation		0.510	0.408	0.510
Risk Characterisation Ratio - Dermal		0.596	2.33	6.15
Risk Characterisation Ratio - Total Exposure		1.11	2.74	6.66
Advanced exposure modifiers (outside ECETOC TRA) - Dermal exposure				
<i>1) Chemically resistant gloves (tested to type EN374) in combination with specific activity training [PPE17] (95% efficiency)*</i>				
Dermal Exposure Estimate (mg/kg/day)				7.07
Risk Characterisation Ratio - Dermal				0.307
<i>3) Suitable gloves tested to EN374 (80% efficiency)*</i>				
Dermal Exposure Estimate (mg/kg/day)		2.74	10.7	
Risk Characterisation Ratio - Dermal		0.119	0.466	
Risk Characterisation Ratio - Total Exposure		0.629	0.874	0.817

* Assumed efficiency according to ESVOC GES

As shown in Table 34, the RCR is < 1 if the PPE for dermal exposure communicated in the ES is considered in the estimate.

2.6. Dilution of a concentrate to prepare end use mixture (professional) (ES 6)

2.6.1. Human Health

2.6.1.1. Workers

Table35 shows the Risk Characterization Ratios (RCR) calculated by using the parameters, operational conditions and risk management measures specified in the exposure scenario in section 1.

2.6.1.2. Consumers

This exposure scenario does not address consumers.

2.6.1.3. Indirect exposure of humans via the environment

Table35 shows the RCR for humans via the environment in the environment section.

2.6.2. Environment

Table35 shows the RCRs calculated by using the parameters, operational conditions and risk management measures specified in the exposure scenario in section 1.

Table35: Risk characterisation for ES 6

Workers		Environment	
Inhalation exposure		STP [mg/L]	
DNEL [mg/m ³]	53.2	PNEC	10
Maximum exposure [mg/m ³]	19.5	PEC	0.01599
Maximum RCR	0.367	RCR	0.00160
Dermal exposure		Freshwater [mg/L]	
DNEL dermal [mg/kg x d]	23	PNEC	0.01700
Maximum exposure [mg/kg x d]	13.71	PEC	0.00262
Maximum RCR	0.596	RCR	0.15404
		Freshwater sediment [mg/kg d.w.]	
Total exposure (inhalation + dermal)		PNEC	
Maximum exposure [mg/kg x d]	16.50	PEC	0.02062
Maximum RCR	0.963	RCR	0.07363
		Soil [mg/kg d.w.]	
Additional modification outside ECETOC TRA required?	NO	PNEC	0.04700
		PEC	
		RCR	
		0.00141	
		0.03010	
		Marine water [mg/L]	
		PNEC	
		0.00170	
		PEC	
		0.00025	
		RCR	
		0.14564	
		Marine Sediment [mg/kg d.w.]	
		PNEC	
		0.02800	
		PEC	
		0.00195	
		RCR	
		0.06961	
		Humans via the environment [mg/kg x d]	
		DNEL, gen. pop., long-term-systemic, oral	
		1.1	
		Total daily intake via local environment	
		0.00035	
		RCR	
		0.00032	

In summary, all RCRs are below 1 and further refinement is not required.

2.7. Dilution of a concentrate to prepare end use mixture (consumer) (ES 7)

2.7.1. Human Health

2.7.1.1. Workers

This exposure scenario does not address workers.

2.7.1.2. Consumers

Table36 shows the Risk Characterization Ratios (RCR) calculated by using the parameters, operational conditions and risk management measures specified in the exposure scenario in section 1.

2.7.1.3. Indirect exposure of humans via the environment

Table36 shows the RCR for humans via the environment in the environment section.

2.7.2. Environment

Table36 shows the RCRs calculated by using the parameters, operational conditions and risk management measures specified in the exposure scenario in section 1.

Table36: Risk characterisation for ES 7

Consumers		Environment	
Inhalation exposure		STP [mg/L]	
DNEL acute [mg/m ³]	53.2	PNEC	10
Acute exposure [mg/m ³]	1.2	PEC	0.00320
RCR acute inhalation	0.023	RCR	0.00032
		Freshwater [mg/L]	
DNEL long-term [mg/m ³]	2.3	PNEC	0.01700
Long-term exposure [mg/m ³]	0.0001	PEC	0.00134
RCR long-term inhalation	0.000043	RCR	0.07881
		Freshwater sediment [mg/kg d.w.]	
		PNEC	0.28000
		PEC	0.01055
		RCR	0.03767
Dermal exposure		Soil [mg/kg d.w.]	
DNEL long-term [mg/kg x d]	11.4	PNEC	0.04700
Long-term exposure [mg/kg x d]	0.005	PEC	0.00029
RCR dermal	0.000043	RCR	0.00610
		Marine water [mg/L]	
		PNEC	0.00170
		PEC	0.00012
		RCR	0.07041
Total RCR for long-term exposure	0.000086	Marine Sediment [mg/kg d.w.]	
		PNEC	0.02800
		PEC	0.00094
		RCR	0.03365
		Humans via the environment [mg/kg x d]	
		DNEL, gen. pop., long-term-systemic, oral	1.1
		Total daily intake via local environment	0.00018
		RCR	0.00016

In summary, all RCRs are below 1 and further refinement is not required.

2.8. Use in laboratories (industrial) (ES 8)

2.8.1. Human Health

2.8.1.1. Workers

Table37 shows the Risk Characterization Ratios (RCR) calculated by using the parameters, operational conditions and risk management measures specified in the exposure scenario in section 1.

2.8.1.2. Consumers

This exposure scenario does not address consumers.

2.8.1.3. Indirect exposure of humans via the environment

Table37 shows the RCR for humans via the environment in the environment section.

20.8.2. Environment

Table37 shows the RCRs calculated by using the parameters, operational conditions and risk management measures specified in the exposure scenario in section 1.

Table 37: Risk characterisation for ES 8

Workers		Environment	
Inhalation exposure		STP [mg/L]	
DNEL [mg/m ³]	53.2	PNEC	10
Maximum exposure [mg/m ³]	27.13	PEC	0.11671
Maximum RCR	0.510	RCR	0.01167
Dermal exposure		Freshwater [mg/L]	
DNEL dermal [mg/kg x d]	23	PNEC	0.01700
Maximum exposure [mg/kg x d]	27.43	PEC	0.01269
Maximum RCR	1.193	RCR	0.74646
		Freshwater sediment [mg/kg d.w.]	
Total exposure (inhalation + dermal)		PNEC	0.28000
Maximum exposure [mg/kg x d]	28.98	PEC	0.09990
Maximum RCR	1.397	RCR	0.35679
		Soil [mg/kg d.w.]	
Additional modification outside ECETOC TRA required?	YES	PNEC	0.04700
for PROC	10	PEC	0.01030
Dermal exposure OCs/RMMs		RCR	0.21914
Suitable gloves tested to EN374 [efficiency in %]	80	Marine water [mg/L]	
Dermal exposure [mg/kg x d]	5.486	PNEC	0.00170
Dermal RCR for PROC 10	0.239	PEC	0.00125
		RCR	0.73806
Inhalation exposure for PROC 10 [mg/m ³]	10.85	Marine Sediment [mg/kg d.w.]	
Inhalation RCR for PROC 10	0.204	PNEC	0.02800
		PEC	0.00988
		RCR	0.35278
		Humans via the environment [mg/kg x d]	
Total RCR with additional OCsRMMs	0.443	DNEL, gen. pop., long-term-systemic, oral	1.1
		Total daily intake via local environment	0.00038
		RCR	0.00035

In summary, all RCRs are below 1 for the environment and further refinement is not required. For workers, the initial ECETOC TRA estimation resulted in an RCR > 1 for PROC 10. As shown above, the RCR is < 1 if the PPE for dermal exposure communicated in the ES is considered in the estimate.

2.9. Use in functional fluids (industrial) (ES 9)

2.9.1. Human Health

2.9.1.1. Workers

Table 38 shows the Risk Characterization Ratios (RCR) calculated by using the parameters, operational conditions and risk management measures specified in the exposure scenario in section 1.

2.9.1.2. Consumers

This exposure scenario does not address consumers.

2.9.1.3. Indirect exposure of humans via the environment

Table 38 shows the RCR for humans via the environment in the environment section.

2.9.2. Environment

Table 38 shows the RCRs calculated by using the parameters, operational conditions and risk management measures specified in the exposure scenario in section 1.

Table 38: Risk characterisation for ES 9

Workers		Environment	
Inhalation exposure		STP [mg/L]	
DNEL [mg/m ³]	53.2	PNEC	10
Maximum exposure [mg/m ³]	19.53	PEC	0.00875
Maximum RCR	0.367	RCR	0.00088
Dermal exposure		Freshwater [mg/L]	
DNEL dermal [mg/kg x d]	23	PNEC	0.01700
Maximum exposure [mg/kg x d]	13.71	PEC	0.00190
Maximum RCR	0.596	RCR	0.11149
		Freshwater sediment [mg/kg d.w.]	
Total exposure (inhalation + dermal)		PNEC	0.28000
Maximum exposure [mg/kg x d]	16.50	PEC	0.01492
Maximum RCR	0.963	RCR	0.05329
		Soil [mg/kg d.w.]	
Additional modification outside ECETOC TRA required?	NO	PNEC	0.04700
		PEC	0.00078
For PROC 4 at temperatures up to 80°C		RCR	0.01654
Inhalation exposure OCs/RMMs		Marine water [mg/L]	
Provide LEV for PROC4 [efficiency in %]	90	PNEC	0.00170
Inhalation exposure [mg/m ³]	16.28	PEC	0.00018
Inhalation RCR for PROC 4 at elevated temperatures	0.306	RCR	0.10309
Dermal exposure OCs/RMMs		Marine Sediment [mg/kg d.w.]	
Reduced exposure due to LEV (50% efficiency)		PNEC	0.02800
Dermal exposure [mg/kg x d]	3.43	PEC	0.00138
Dermal RCR for PROC 4 at elevated temperatures	0.149	RCR	0.04927
		Humans via the environment [mg/kg x d]	
Total RCR with additional OCs/RMMs	0.455	DNEL, gen. pop., long-term-systemic, oral	1.1
		Total daily intake via local environment	0.00015
		RCR	0.00014

In summary, all RCRs are below 1 and further refinement is not required.

2.10. Use in functional fluids (professional) (ES 10)

2.10.1. Human Health

2.10.1.1. Workers

Table39 shows the Risk Characterization Ratios (RCR) calculated by using the parameters, operational conditions and risk management measures specified in the exposure scenario in section 1.

2.10.1.2. Consumers

This exposure scenario does not address consumers.

2.10.1.3. Indirect exposure of humans via the environment

Table39 shows the RCR for humans via the environment in the environment section.

2.10.2. Environment

Table39 shows the RCRs calculated by using the parameters, operational conditions and risk management measures specified in the exposure scenario in section 1.

Table39: Risk characterisation for ES 10

Workers		Environment	
Inhalation exposure		STP [mg/L]	
DNEL [mg/m ³]	53.2	PNEC	10
Maximum exposure [mg/m ³]	32.56	PEC	0.00002
Maximum RCR	0.612	RCR	0.00000
Dermal exposure		Freshwater [mg/L]	
DNEL dermal [mg/kg x d]	23	PNEC	0.01700
Maximum exposure [mg/kg x d]	13.71	PEC	0.00102
Maximum RCR	0.596	RCR	0.06012
		Freshwater sediment [mg/kg d.w.]	
Total exposure (inhalation + dermal)		PNEC	
Maximum exposure [mg/kg x d]	16.04	PEC	0.00805
Maximum RCR	0.910	RCR	0.02874
		Soil [mg/kg d.w.]	
Additional modification outside ECETOC TRA required?	NO	PNEC	0.04700
		PEC	0.00001
For PROC 20 at temperatures up to 80°C		RCR	
			0.00014
Inhalation exposure OCs/RMMs		Marine water [mg/L]	
Provide LEV for PROC20 [efficiency in %]	80	PNEC	0.00170
Inhalation exposure [mg/m ³]	32.56	PEC	0.00009
Inhalation RCR for PROC 20 at elevated temperatures	0.612	RCR	0.05172
Dermal exposure OCs/RMMs		Marine Sediment [mg/kg d.w.]	
Reduced exposure due to LEV (50% efficiency)		PNEC	0.02800
Dermal exposure [mg/kg x d]	0.86	PEC	0.00069
Dermal RCR for PROC 20 at elevated temperatures	0.037	RCR	0.02472
		Humans via the environment [mg/kg x d]	
Total RCR with additional OCs/RMMs	0.649	DNEL, gen. pop., long-term-systemic, oral	1.1
		Total daily intake via local environment	0.00013
		RCR	0.00012

In summary, all RCRs are below 1 and further refinement is not required.

2.11. Use in cleaning products (professional) (ES 11)

2.11.1. Human Health

2.11.1.1. Workers

Table40 shows the Risk Characterization Ratios (RCR) calculated by using the parameters, operational conditions and risk management measures specified in the exposure scenario in section 1.

2.11.1.2. Consumers

This exposure scenario does not address consumers.

2.11.1.3. Indirect exposure of humans via the environment

Table40 shows the RCR for humans via the environment in the environment section.

2.11.2. Environment

Table40 shows the RCRs calculated by using the parameters, operational conditions and risk management measures specified in the exposure scenario in section 1.

Table40: Risk characterisation for ES 11

Workers		Environment	
Inhalation exposure		STP [mg/L]	
DNEL [mg/m ³]	53.2	PNEC	10
Maximum exposure [mg/m ³]	195.35	PEC	0.00000
Maximum RCR	3.672	RCR	0.00000
Dermal exposure		Freshwater [mg/L]	
DNEL dermal [mg/kg x d]	23	PNEC	0.01700
Maximum exposure [mg/kg x d]	107.14	PEC	0.00102
Maximum RCR	4.658	RCR	0.06001
		Freshwater sediment [mg/kg d.w.]	
Total exposure (inhalation + dermal)		PNEC	0.28000
Maximum exposure [mg/kg x d]	135.05	PEC	0.00803
Maximum RCR	8.330	RCR	0.02868
		Soil [mg/kg d.w.]	
Additional modification outside ECETOC TRA required?	YES	PNEC	0.04700
For PROC(s)	10,11, 13	PEC	0.00000
	(see text for details)	RCR	0.00010
		Marine water [mg/L]	
		PNEC	0.00170
		PEC	0.00009
		RCR	0.05160
		Marine Sediment [mg/kg d.w.]	
		PNEC	0.02800
		PEC	0.00069
		RCR	0.02467
		Humans via the environment [mg/kg x d]	
		DNEL, gen. pop., long-term-systemic, oral	1.1
		Total daily intake via local environment	0.00013
		RCR	0.00012

In summary, all RCRs are below 1 for the environment and further refinement is not required.

For workers, the initial ECETOC TRA estimation resulted in an RCR > 1 for PROCs 10, 11 and 13.7. Therefore a refined exposure assessment with all the RMMs/OCs and PPEs communicated in the ES was conducted and is shown in Table 41.

Table 41: Refined exposure assessment and risk characterisation for ES 11 (workers; all calculated values rounded to three significant figures)

Input	PROC ->	10	11	13
Duration of activity [hours/day] (> 4 hours = default)		1-4 h	1-4 h	>4 h
Use of ventilation? (Indoors with or without LEV)		Without		
Use of respiratory protection and, if so, minimum efficiency ?		No	No	No
Substance in preparation?		5-25%	5-25%	5-25%
TRA estimate of exposures				
Inhalative Exposure Estimate (mg/m ³)		48.8	195	32.6
Dermal Exposure Estimate (mg/kg/day)		27.4	107	13.7
Total Exposure = Dermal + Inhalative (mg/kg/day)		34.4	135	18.4
TRA risk characterization				
Risk Characterisation Ratio - Inhalation		0.918	3.67	0.612
Risk Characterisation Ratio - Dermal		1.19	4.66	0.596
Risk Characterisation Ratio - Total Exposure		2.11	8.33	1.21
Advanced exposure modifiers (outside ECETOC TRA) - Dermal exposure				
1) Concentration of the substance in the product up to [#] :		25%	25%	25%
Dermal Exposure Estimate (mg/kg/day), maximum		16.4	64.3	8.22
Risk Characterisation Ratio - Dermal		0.713	2.79	0.357
2) Chemically resistant gloves (tested to type EN374) in combination with 'basic' employee training (90% efficiency)*				
Dermal Exposure Estimate (mg/kg/day)			6.43	
Risk Characterisation Ratio - Dermal			0.280	
3) Suitable gloves tested to EN374 (80% efficiency)*				
Dermal Exposure Estimate (mg/kg/day)		3.29		1.64
Risk Characterisation Ratio - Dermal		0.143		0.0714
Advanced exposure modifiers (outside ECETOC TRA) - Inhalation exposure				
Option 1: Reduce concentration to 1-5% OR Option 2: Reduce duration to 15 min-1 h (each leading to a reduction by 67%)*				
Inhalative Exposure Estimate (mg/m ³)		16.3		
Risk Characterisation Ratio - Inhalation		0.306		
Option 3: Wear a half mask respirator conforming to EN140, 149 or equivalent (90% efficiency)*				
Inhalative Exposure Estimate (mg/m ³)			19.5	
Risk Characterisation Ratio - Inhalation			0.366	
Risk Characterisation Ratio - Total Exposure		0.449¹	0.646	0.683

¹ Control of risk from inhalation exposure is also achieved by using LEV (80% reduction), adequate dilution ventilation (70% reduction) or – as a last option - half mask respirators (see Option 3).

* Assumed efficiency according to ES VOC GES;

[#] the reduction due to the low concentration of the substance in a mixture (preparation) is automatically included in ECETOC TRA *inhalation* exposure estimates, but has to be manually included for *dermal* exposure. For dermal exposure, the same reduction factors were applied as for inhalation exposure (e.g. 90% reduction for concentrations up to 1% and 40% reduction for concentrations up to 25%) as proposed in the Guidance on Information Requirements and Chemical Safety Assessment (R.14, May 2010).

As shown in Table, the RCRs are < 1 if the PPE for dermal and inhalation exposure communicated in the ES are considered in the estimate.

2.12. Use in oil and gas field drilling (industrial) (ES 12)

2.12.1. Human Health

2.12.1.1. Workers

Table shows the Risk Characterization Ratios (RCR) calculated by using the parameters, operational conditions and risk management measures specified in the exposure scenario in section 1.

2.12.1.2. Consumers

This exposure scenario does not address consumers.

2.12.1.3. Indirect exposure of humans via the environment

Table shows the RCR for humans via the environment in the environment section.

2.12.2. Environment

Table 42 shows the RCRs calculated by using the parameters, operational conditions and risk management measures specified in the exposure scenario in section 1.

Table 42: Risk characterisation for ES 11

Workers		Environment	
Inhalation exposure		STP [mg/L]	
DNEL [mg/m ³]	53.2	PNEC	10
Maximum exposure [mg/m ³]	27.13	PEC	0.13616
Maximum RCR	0.510	RCR	0.01362
Dermal exposure		Freshwater [mg/L]	
DNEL dermal [mg/kg x d]	23	PNEC	0.01700
Maximum exposure [mg/kg x d]	13.71	PEC	0.01463
Maximum RCR	0.596	RCR	0.86087
		Freshwater sediment [mg/kg d.w.]	
Total exposure (inhalation + dermal)		PNEC	
Maximum exposure [mg/kg x d]	15.26	PEC	0.11521
Maximum RCR	0.808	RCR	0.41148
		Soil [mg/kg d.w.]	
Additional modification outside ECETOC TRA required?	NO	PNEC	0.04700
		PEC	
For PROC 4 at temperatures up to 60°C		RCR	
		0.25552	
Inhalation exposure OCs/RMMs		Marine water [mg/L]	
Provide LEV for PROC4 [efficiency in %]	90	PNEC	0.00170
Inhalation exposure [mg/m ³]	16.28	PEC	0.00145
Inhalation RCR for PROC 4 at elevated temperatures	0.306	RCR	0.85247
Dermal exposure OCs/RMMs		Marine Sediment [mg/kg d.w.]	
Reduced exposure due to LEV (50% efficiency)		PNEC	0.02800
Dermal exposure [mg/kg x d]	0.17	PEC	0.01141
Dermal RCR for PROC 4 at elevated temperatures	0.007	RCR	0.40746
		Humans via the environment [mg/kg x d]	
Total RCR with additional OCs/RMMs		DNEL, gen. pop., long-term-systemic, oral	
		Total daily intake via local environment	
		RCR	
		0.00041	

In summary, all RCRs are below 1 and further refinement is not required.

2.13. Overall exposure (combined for all relevant emission/release sources)

2.13.1. Human health (combined for all exposure routes)

Combined exposure routes

For consumers and workers all exposure routes were already combined and the combined exposure and risk characterisation ratios were calculated (see above: Total exposure in the left columns of the tables).

Combination of uses

At the workplace more than one use is not expected to occur in parallel, as all exposure estimates assume whole shift occupation for each use.

Also, use of concentrated consumer products is expected to be an infrequent event for specific purposes, which occurs with a low frequency per year. Incidental use of two products (which differ in the intended end use) is considered highly unlikely.

Exposure of humans via the environment

In section 1 the exposure of humans via the environment on a regional scale was estimated by using ECETOC TRA to be 0.16 µg/kg bw x d. This conservative estimate is orders of magnitude below the long-term oral DNEL for the general population of 1.1 mg/kg bw x d.

2.13.2. Environment (combined for all emission sources)

The environmental exposure from all sources and for all uses on a regional scale was estimated by ECETOC TRA and was presented in section 1.

Protection target		Regional PEC	PNEC	RCR
Water [mg/l]:	Surface water	0.001	0.017	0.06
	Sea water	0.000087	0.0017	0.05
Air [mg/m ³]:		0.00002		
Soil [mg/kg dw]:	Agricultural soil	0.00045	0.047	0.01
	Natural soil	0.0000046	0.047	0.0001
	Industrial soil	0.0000046	0.047	0.0001

All RCRs obtained are well below 1.

2.14. Qualitative risk characterisation

2.14.1. Human health risks

The substance is classified as skin and eye irritant (Skin Irrit. 2 - H315; Eye Irrit. 2 - H319). According to ECHA Guidance on Information Requirements and Chemical Safety Assessment, Part E. (Risk Characterisation), this classification corresponds to a moderate hazard. For a substance with R phrases R36/37/38, which corresponds to the classification above, this guidance proposes operational conditions and risk management measures, which should be taken into account and adapted to the specific situation.

Workplace

used on the proposals in the Guidance document the following measures are recommended:

Organisational measures

- Minimise number of staff exposed;
- Good standard of general ventilation;
- Minimisation of manual phases;
- Avoidance of contact with contaminated tools and objects;
- Regular cleaning of equipment and work area;
- Management/supervision in place to check that the RMMs in place are being used correctly and OCs followed;
- Training for staff on good practice;
- Good standard of personal hygiene.

Personal protection equipment

- Substance/task appropriate gloves;
- Skin coverage with appropriate barrier material based on potential for contact with the chemicals;
- Substance/task appropriate respirator;
- Optional face shield;
- Eye protection.

These risk management measures should be applied whenever the substance is handled at workplaces in concentrations above 10% (which is the limit for classification of mixtures for the endpoints in question according to Regulation (EC) 1272/2008 (CLP)). Risks are not completely excluded at lower concentrations, but taken into consideration the moderate hazard and the reversibility of the effects the remaining low risks are considered acceptable. Presence of any additional substance in mixtures resulting in hazards for the same endpoints and/or exaggerating the effects of the substance would lead to respective classification of the mixture at lower concentration, according to Regulation (EC) 1272/2008, and is dealt with under this regulation.

Additional respiratory protection is not considered necessary, as potential irritation effects in the respiratory tract are considered in the quantitative risk assessment (see above).

Consumers

Concentrated products destined for consumers to be diluted for various end uses may contain 2-EH in concentrations up to 25%.

For products with concentrations >10% protection against skin and eye irritation is required. The following measures should apply:

Organisational measures

- Good standard of general ventilation;
- Avoidance of contact with contaminated tools and objects;
- Regular cleaning of equipment

Personal protection measures

- Protective gloves
- Eye protection

For consumer products containing 2-EH concentrations >10% the organisational measures above should be communicated via the product label. In addition, suitable protective gloves and goggles should be provided with the product. Alternatively, the product should be designed in a way that skin and eye contact is made impossible during the dilution process.

ANNEX 1

Detailed results for exposure estimation – Workers (ECETOC TRA Tier 1)

In the following tables the detailed results of the ECEOTC TRA Tier 1 exposure estimation for each PROC per exposure scenario are presented to allow for easy traceability.

Physical state of the substance for all PROCs in all ES: liquid

ES1

Input							
Process Category (PROC)	PROC 1	PROC 2	PROC 3	PROC 4	PROC 8a	PROC 8b	PROC 15
Type of setting	industrial	industrial	industrial	industrial	industrial	industrial	industrial
Duration of activity [hours/day]	>4 hours (default)						
Use of ventilation ?	Indoors without LEV				Indoors with LEV	Indoors without LEV	
Use of respiratory protection and, if so, minimum efficiency ?	No	No	No	No	No	No	No
Substance in preparation?	No	No	No	No	No	No	No
Estimate of exposures							
Inhalative Exposure Estimate (mg/m ³)	0.0543	5.4263	16.2788	27.1313	5.4263	27.1313	27.1313
Dermal Exposure Estimate (mg/kg/day)	0.3429	1.3714	0.3429	6.8571	6.8571	6.8571	0.3429
Total Exposure = Dermal + Inhalative (mg/kg/day)	0.3506	2.1466	2.6684	10.7330	7.6323	10.7330	4.2188
Risk characterization							
Risk Characterisation Ratio - Inhalation	0.0010	0.1020	0.3060	0.5100	0.1020	0.5100	0.5100
Risk Characterisation Ratio - Dermal	0.0149	0.0596	0.0149	0.2981	0.2981	0.2981	0.0149
Risk Characterisation Ratio - Total Exposure	0.0159	0.1616	0.3209	0.8081	0.4001	0.8081	0.5249

ES2

Input							
Process Category (PROC)	PROC 1	PROC 2	PROC 3	PROC 4	PROC 8a	PROC 8b	PROC 9
Type of setting	industrial	industrial	industrial	industrial	industrial	industrial	industrial
Duration of activity [hours/day]	>4 hours (default)						
Use of ventilation ?	Indoors without LEV				Indoors with LEV	Indoors without LEV	

Use of respiratory protection and, if so, minimum efficiency ?	No	No	No	No	No	No	No	No	No
Substance in preparation?	No	No	No	No	No	No	No	No	No
Estimate of exposures									
Inhalative Exposure Estimate (mg/m3)	0.0543	5.4263	16.2788	27.1313	5.4263	27.1313	27.1313	27.1313	27.1313
Dermal Exposure Estimate (mg/kg/day)	0.3429	1.3714	0.3429	6.8571	6.8571	6.8571	6.8571	6.8571	0.3429
Total Exposure = Dermal + Inhalative (mg/kg/day)	0.3506	2.1466	2.6684	10.7330	7.6323	10.7330	10.7330	10.7330	4.2188
Risk characterization									
Risk Characterisation Ratio - Inhalation	0.0010	0.1020	0.3060	0.5100	0.1020	0.5100	0.5100	0.5100	0.5100
Risk Characterisation Ratio - Dermal	0.0149	0.0596	0.0149	0.2981	0.2981	0.2981	0.2981	0.2981	0.0149
Risk Characterisation Ratio - Total Exposure	0.0159	0.1616	0.3209	0.8081	0.4001	0.8081	0.8081	0.8081	0.5249

ES3

Input										
Process Category (PROC)	PROC 1	PROC 2	PROC 3	PROC 4	PROC 5	PROC 8a	PROC 8b	PROC 9	PROC 14	PROC 15
Type of setting	industrial	industrial	industrial	industrial	industrial	industrial	industrial	industrial	industrial	industrial
Duration of activity [hours/day]	>4 hours (default)									
Use of ventilation ?	Indoors without LEV				Indoors with LEV		Indoors without LEV			
Use of respiratory protection and, if so, minimum efficiency ?	No	No	No	No	No	No	No	No	No	No
Substance in preparation?	No	No	No	No	No	No	No	No	No	No
Estimate of exposures										
Inhalative Exposure Estimate (mg/m3)	0.0543	5.4263	16.2788	27.1313	2.7131	5.4263	27.1313	27.1313	27.1313	27.1313
Dermal Exposure Estimate (mg/kg/day)	0.3429	1.3714	0.3429	6.8571	6.8571	6.8571	6.8571	6.8571	3.4286	0.3429
Total Exposure = Dermal + Inhalative (mg/kg/day)	0.3506	2.1466	2.6684	10.7330	7.2447	7.6323	10.7330	10.7330	7.3045	4.2188
Risk characterization										
Risk Characterisation Ratio - Inhalation	0.0010	0.1020	0.3060	0.5100	0.0510	0.1020	0.5100	0.5100	0.5100	0.5100
Risk Characterisation Ratio - Dermal	0.0149	0.0596	0.0149	0.2981	0.2981	0.2981	0.2981	0.2981	0.1491	0.0149
Risk Characterisation Ratio - Total Exposure	0.0159	0.1616	0.3209	0.8081	0.3491	0.4001	0.8081	0.8081	0.6591	0.5249

ES4

Input														
Process Category (PROC)	PROC 1	PROC 2	PROC 3	PROC 4	PROC 5	PROC 7	PROC 8a	PROC 8b	PROC 9	PROC 10	PROC 13	PROC 14	PROC 15	
Type of setting	industrial	industrial	industrial	industrial	industrial	industrial	industrial	industrial	industrial	industrial	industrial	industrial	industrial	
Duration of activity [hours/day]	>4 hours (default)													
Use of ventilation ?	Indoors without LEV				Indoors with LEV				Indoors without LEV		Indoors with LEV		Indoors without LEV	
Use of respiratory protection and, if so, minimum efficiency ?	No	No	No	No	No	No	No	No	No	No	No	No	No	
Substance in preparation?	>25%	>25%	>25%	>25%	>25%	>25%	>25%	>25%	>25%	>25%	>25%	>25%	>25%	
Estimate of exposures														
Inhalative Exposure Estimate (mg/m ³)	0.0543	5.4263	16.2788	27.1313	2.7131	27.1313	5.4263	27.1313	27.1313	5.4263	5.4263	27.1313	27.1313	
Dermal Exposure Estimate (mg/kg/day)	0.3429	1.3714	0.3429	6.8571	6.8571	21.4286	6.8571	6.8571	6.8571	13.7143	6.8571	3.4286	0.3429	
Total Exposure = Dermal + Inhalative (mg/kg/day)	0.3506	2.1466	2.6684	10.7330	7.2447	25.3045	7.6323	10.7330	10.7330	14.4895	7.6323	7.3045	4.2188	
Risk characterization														
Risk Characterisation Ratio - Inhalation	0.0010	0.1020	0.3060	0.5100	0.0510	0.5100	0.1020	0.5100	0.5100	0.1020	0.1020	0.5100	0.5100	
Risk Characterisation Ratio - Dermal	0.0149	0.0596	0.0149	0.2981	0.2981	0.9317	0.2981	0.2981	0.2981	0.5963	0.2981	0.1491	0.0149	
Risk Characterisation Ratio - Total Exposure	0.0159	0.1616	0.3209	0.8081	0.3491	1.4417	0.4001	0.8081	0.8081	0.6983	0.4001	0.6591	0.5249	

ES5

Input												
Process Category (PROC)	PROC 1	PROC 2	PROC 3	PROC 4	PROC 5	PROC 8a	PROC 8b	PROC 10	PROC 11	PROC 13	PROC 15	PROC 19
Type of setting	professional											
Duration of activity [hours/day]	>4 hours (default)								15 mins to 1 hour	>4 hours (default)		15 mins to 1 hour
Use of ventilation ?	Indoors without LEV			Indoors with LEV							Indoors without LEV	
Use of respiratory protection and, if so, minimum efficiency ?	No	No	No	No	No	No	No	No	No	No	No	No
Substance in preparation?	>25%	>25%	>25%	>25%	>25%	>25%	>25%	>25%	>25%	>25%	>25%	>25%
Estimate of exposures												
Inhalative Exposure Estimate (mg/m ³)	0.0543	27.1313	16.2788	10.8525	10.8525	27.1313	5.4263	27.1313	21.7050	10.8525	27.1313	27.1313
Dermal Exposure Estimate (mg/kg/day)	0.3429	1.3714	0.3429	3.4286	6.8571	6.8571	3.4286	13.7143	53.5714	6.8571	0.3429	141.4286
Total Exposure = Dermal + Inhalative (mg/kg/day)	0.3506	5.2473	2.6684	4.9789	8.4075	10.7330	4.2038	17.5902	56.6721	8.4075	4.2188	145.3045
Risk characterization												
Risk Characterisation Ratio - Inhalation	0.0010	0.5100	0.3060	0.2040	0.2040	0.5100	0.1020	0.5100	0.4080	0.2040	0.5100	0.5100
Risk Characterisation Ratio - Dermal	0.0149	0.0596	0.0149	0.1491	0.2981	0.2981	0.1491	0.5963	2.3292	0.2981	0.0149	6.1491
Risk Characterisation Ratio - Total Exposure	0.0159	0.5696	0.3209	0.3531	0.5021	0.8081	0.2511	1.1063	2.7372	0.5021	0.5249	6.6591

ES6

Input			
Process Category (PROC)	PROC 5	PROC 8a	PROC 8b
Type of setting	professional	professional	professional
Duration of activity [hours/day]	1 - 4 hours	15 mins to 1 hour	1 - 4 hours
Use of ventilation ?	Indoors without LEV	Indoors without LEV	Indoors without LEV
Use of respiratory protection and, if so, minimum efficiency ?	No	No	No
Substance in preparation?	5-25%	5-25%	5-25%
Estimate of exposures			
Inhalative Exposure Estimate (mg/m3)	19.5345	16.2788	19.5345
Dermal Exposure Estimate (mg/kg/day)	13.7143	13.7143	6.8571
Total Exposure = Dermal + Inhalative (mg/kg/day)	16.5049	16.0398	9.6478
Risk characterization			
Risk Characterisation Ratio - Inhalation	0.3672	0.3060	0.3672
Risk Characterisation Ratio - Dermal	0.5963	0.5963	0.2981
Risk Characterisation Ratio - Total Exposure	0.9635	0.9023	0.6653

ES7**Consumer exposure scenario – Worker exposure not relevant ES8**

Input		
Process Category (PROC)	PROC 10	PROC 15
Type of setting	industrial	industrial
Duration of activity [hours/day]	15 mins to 1 hour	>4 hours (default)
Use of ventilation ?	Indoors without LEV	Indoors without LEV
Use of respiratory protection and, if so, minimum efficiency ?	No	No
Substance in preparation?	No	No
Estimate of exposures		
Inhalative Exposure Estimate (mg/m ³)	10.8525	27.1313
Dermal Exposure Estimate (mg/kg/day)	27.4286	0.3429
Total Exposure = Dermal + Inhalative (mg/kg/day)	28.9789	4.2188
Risk characterization		
Risk Characterisation Ratio - Inhalation	0.2040	0.5100
Risk Characterisation Ratio - Dermal	1.1925	0.0149
Risk Characterisation Ratio - Total Exposure	1.3965	0.5249

ES9

Input								
Process Category (PROC)	PROC 1	PROC 2	PROC 3	PROC 4	PROC 8a	PROC 8b	PROC 9	PROC 20
Type of setting	industrial	industrial	industrial	industrial	industrial	industrial	industrial	industrial
Duration of activity [hours/day]	>4 hours (default)				1 - 4 hours	>4 hours (default)		
Use of ventilation ?	Indoors without LEV							
Use of respiratory protection and, if so, minimum efficiency ?	No	No	No	No	No	No	No	No
Substance in preparation?	5-25%	5-25%	5-25%	5-25%	5-25%	5-25%	5-25%	5-25%
Estimate of exposures								
Inhalative Exposure Estimate (mg/m3)	0.0326	3.2558	9.7673	16.2788	19.5345	16.2788	16.2788	#WERT!
Dermal Exposure Estimate (mg/kg/day)	0.3429	1.3714	0.3429	6.8571	13.7143	6.8571	6.8571	1.7143
Total Exposure = Dermal + Inhalative (mg/kg/day)	0.3475	1.8365	1.7382	9.1827	16.5049	9.1827	9.1827	1.7143
Risk characterization								
Risk Characterisation Ratio - Inhalation	0.0006	0.0612	0.1836	0.3060	0.3672	0.3060	0.3060	industrial covered by PROC 2
Risk Characterisation Ratio - Dermal	0.0149	0.0596	0.0149	0.2981	0.5963	0.2981	0.2981	0.0745
Risk Characterisation Ratio - Total Exposure	0.0155	0.1208	0.1985	0.6041	0.9635	0.6041	0.6041	industrial covered by PROC 2 /0.07453

ES10

Input						
Process Category (PROC)	PROC 1	PROC 2	PROC 3	PROC 8a	PROC 9	PROC 20
Type of setting	professional	professional	professional	professional	professional	professional
Duration of activity [hours/day]	>4 hours (default)	>4 hours (default)	>4 hours (default)	15 mins to 1 hour	>4 hours (default)	>4 hours (default)
Use of ventilation ?	Indoors without LEV					
Use of respiratory protection and, if so, minimum efficiency ?	No	No	No	No	No	No
Substance in preparation?	5-25%	5-25%	5-25%	5-25%	5-25%	5-25%
Estimate of exposures						
Inhalative Exposure Estimate (mg/m3)	0.0326	16.2788	9.7673	16.2788	32.5575	16.2788
Dermal Exposure Estimate (mg/kg/day)	0.3429	1.3714	0.3429	13.7143	6.8571	1.7143
Total Exposure = Dermal + Inhalative (mg/kg/day)	0.3475	3.6970	1.7382	16.0398	11.5082	4.0398
Risk characterization						
Risk Characterisation Ratio - Inhalation	0.0006	0.3060	0.1836	0.3060	0.6120	0.3060
Risk Characterisation Ratio - Dermal	0.0149	0.0596	0.0149	0.5963	0.2981	0.0745
Risk Characterisation Ratio - Total Exposure	0.0155	0.3656	0.1985	0.9023	0.9101	0.3805

ES11

Input								
Process Category (PROC)	PROC 2	PROC 3	PROC 4	PROC 8a	PROC 8b	PROC 10	PROC 11	PROC 13
Type of setting	professional	professional	professional	professional	professional	professional	professional	professional
Duration of activity [hours/day]	>4 hours (default)			15 mins to 1 hour	1 - 4 hours	1 - 4 hours	1 - 4 hours	>4 hours (default)
Use of ventilation ?	Indoors without LEV							
Use of respiratory protection and, if so, minimum efficiency ?	No	No	No	No	No	No	No	No
Substance in preparation?	5-25%	5-25%	5-25%	5-25%	5-25%	5-25%	5-25%	5-25%
Estimate of exposures								
Inhalative Exposure Estimate (mg/m ³)	16.2788	9.7673	32.5575	16.2788	19.5345	48.8363	195.3450	32.5575
Dermal Exposure Estimate (mg/kg/day)	1.3714	0.3429	6.8571	13.7143	6.8571	27.4286	107.1429	13.7143
Total Exposure = Dermal + Inhalative (mg/kg/day)	3.6970	1.7382	11.5082	16.0398	9.6478	34.4052	135.0493	18.3654
Risk characterization								
Risk Characterisation Ratio - Inhalation	0.3060	0.1836	0.6120	0.3060	0.3672	0.9180	3.6719	0.6120
Risk Characterisation Ratio - Dermal	0.0596	0.0149	0.2981	0.5963	0.2981	1.1925	4.6584	0.5963
Risk Characterisation Ratio - Total Exposure	0.3656	0.1985	0.9101	0.9023	0.6653	2.1105	8.3303	1.2083

ES12

Input						
Process Category (PROC)	PROC 1	PROC 2	PROC 3	PROC 4	PROC 8a	PROC 8b
Type of setting	industrial	industrial	industrial	industrial	industrial	industrial
Duration of activity [hours/day]	>4 hours (default)				15 mins to 1 hour	>4 hours (default)
Use of ventilation ?	Indoors without LEV					
Use of respiratory protection and, if so, minimum efficiency ?	No	No	No	No	No	No
Substance in preparation?	>25%	>25%	>25%	>25%	>25%	>25%
Estimate of exposures						
Inhalative Exposure Estimate (mg/m ³)	0.0543	5.4263	16.2788	27.1313	10.8525	27.1313
Dermal Exposure Estimate (mg/kg/day)	0.3429	1.3714	0.3429	6.8571	13.7143	6.8571
Total Exposure = Dermal + Inhalative (mg/kg/day)	0.3506	2.1466	2.6684	10.7330	15.2646	10.7330
Risk characterization						
Risk Characterisation Ratio - Inhalation	0.0010	0.1020	0.3060	0.5100	0.2040	0.5100
Risk Characterisation Ratio - Dermal	0.0149	0.0596	0.0149	0.2981	0.5963	0.2981
Risk Characterisation Ratio - Total Exposure	0.0159	0.1616	0.3209	0.8081	0.8003	0.8081