TDI: Final Exposure Scenarios in the e-SDS format

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On the next pages the TDI Exposure Scenarios (ES) in the e-SDS format are presented.

At the request of the consortia TNO clustered the eight ES in the TDI CSR into four broad clusters following the life cycle tree of TDI.

ES cluster	Life cycle stage	TDI
1	Manufacturing	ES 1: Manufacturing
2	Use as intermediate + formlation	ES 2 + ES 3
3	End uses – industrial	– Flexible Foam – Coatings – Adhesives and sealants – Elastomers, TPU, Polyamide, Polyimide & Synthetic Fibres – Other Composite Material
4	End uses – professional	– Coatings – Adhesives and sealants – Other Composite Material

Exposure Scenario 1: Manufacturing of TDI

ES Annex to the e-SDS	
Section 1	**Exposure Scenario Title**
Title	**Manufacturing of TDI**
Use Descriptor	Sector of Use: SU3, SU8, SU9
	Process Categories and Environmental Release Categories: PROC 1, PROC 2, PROC 3, PROC 4, PROC 8b, PROC 15 ERC 1, ERC 2, ERC 6c
Processes, tasks, activities covered	Covers: Industrial: – PROC 1: Use in closed process, no likelihood of exposure. (e.g. including enclosed sampling, waste collection & transfer, charging, discharging) – PROC 2: Use in closed continuous processes with occasional exposure (e.g. during sampling, maintenance, equipment cleaning, occasional interventions). – PROC 3: Use in closed batch processes (synthesis or formulation) (e.g. during sampling, maintenance, equipment breaks). – PROC 4: Use in batch and other process (synthesis) where opportunity for exposure arises (e.g. during use, sampling, maintenance, equipment breaks). – PROC 8b: Transfer of substance or preparation (charging/discharging) from/to vessels/large containers at dedicated facilities (e.g. drum filling, sampling, waste collection & transfer, charging, discharging) – PROC 15: Use as a laboratory reagent

Section 2	**Operational conditions and risk management measures**
Field for additional statements to explain scenario if required.	
Section 2.1	**Control of worker exposure**
Product characteristics	
Physical form of product	Physical state: liquid (only solid when specifically mentioned)
Concentration of substance in product	G13: Covers percentage substance in the product up to 100 % (unless stated differently).
Amounts used	Not applicable.
Frequency and duration of use	G2: Covers daily exposures up to 8 hours (unless stated differently).
Human factors not influenced by risk management	None identified.
Other Operational Conditions affecting worker exposure	G15: Assumes use at not more than 20°C above ambient temperature, unless stated differently. Elevated temperatures in the range of 55 ºC to 110 ºC for PROC 1.
Contributing Scenarios	**Risk Management Measures** *Note: list RMM standard phrases according to the control hierarchy indicated in the ECHA template: 1. Technical measures to prevent release, 2. Technical measures to prevent dispersion, 3. Organisational measures , 4. Personal protection*
CS 135: General Measures applicable to all activities	- E3: Avoid all skin contact with product, clean up contamination/spills as soon as they occur. Wear gloves (tested to EN374) if hand contamination likely, wash off any skin contamination immediately. Provide basic employee training to prevent / minimize exposures and to report any skin problems that may develop. - PPE14 PP: Use suitable eye protection and gloves. - PPE27 PP: Wear suitable coveralls to prevent exposure to the skin.

PROC 1: Use in closed process, no likelihood of exposure. (E.g. including enclosed sampling, waste collection & transfer, charging, discharging)	- CS109: With local exhaust ventilation.
PROC 2: Use in closed continuous processes with occasional exposure (e.g. during sampling, maintenance, equipment cleaning, occasional interventions).	- CS109: With local exhaust ventilation. - PPE30 PP: If above technical/organizational control measures are not feasible, then adopt following PPE: - PPE29 PP: Wear a respirator conforming to EN140 with Type A/P2 filter or better
PROC 3: Use in closed batch processes (synthesis or formulation) (e.g. during sampling, maintenance, equipment breaks).	- CS109: With local exhaust ventilation. - PPE30 PP: If above technical/organizational control measures are not feasible, then adopt following PPE: - PPE29 PP: Wear a respirator conforming to EN140 with Type A/P2 filter or better.
PROC 4: Use in batch and other process (synthesis) where opportunity for exposure arises (e.g. during use, sampling, maintenance, equipment breaks).	- CS109: With local exhaust ventilation. - PPE30 PP: If above technical/organizational control measures are not feasible, then adopt following PPE: - PPE29 PP: Wear a respirator conforming to EN140 with Type A/P2 filter or better.
PROC 8b: Transfer of substance or preparation (charging/discharging) from/to vessels/large containers at dedicated facilities (e.g. drum filling, sampling, waste collection & transfer, charging, discharging)	- CS109: With local exhaust ventilation. - PPE30 PP: If above technical/organizational control measures are not feasible, then adopt following PPE: - PPE29 PP: Wear a respirator conforming to EN140 with Type A/P2 filter or better.
PROC 15: Use as a laboratory reagent	- CS36: Use in laboratory activities. - E83: Handle in a fume cupboard or under extract ventilation. .

Section 2.2	Control of environmental exposure
Product characteristics	Substance is a unique structure [PrC1].
	Predominantly hydrophobic [PrC4a].
	Not biodegradable [PrC5f].
Operational conditions	Indoor/Outdoor use [OOC3].
Amounts used	
Fraction of EU tonnage used in region [A1]:	1
Regional use tonnage (tonnes/year) [A2]:	512,000
Fraction of regional tonnage used locally [A3]:	0.21
Maximum daily site tonnage (kg/day) [A4].	364,700 kg/day
Frequency and duration of use	
Type of release	Continuous release [FD2].
Emission days (days/year) [FD4]	≥ 300
Environmental factors not influenced by risk management	
Local freshwater dilution factor [EF1].	10
Local marine water dilution factor [EF2].	100
Other given operational conditions affecting environmental exposure	Used in closed systems.
	Dry processes.
Release fraction to air from process [OOC4].	$3.2 \cdot 10^{-8}$
Release fraction to wastewater from process [OOC5].	0
Release fraction to soil from process (regional only) [OOC6].	0
Risk Management Measures	

Technical conditions and measures at process level (source) to prevent release	Common practices vary across sites thus conservative process release estimates used [TCS 1].
Technical onsite conditions and measures to reduce or limit discharges, air emissions and releases to soil	Off-gases are treated by: 1. Incineration, and/or 2. Carbon absorption, and/or **3.** Caustic scrubbing.
Air:	Treat air emissions to provide a typical removal efficiency of > 99% [TCR7].
Soil:	Soil emission controls are not applicable as there is no direct release to soil [TCR4].
Organizational measures to prevent/limit release from site	Prevent discharge of un-dissolved substance to or recover from wastewater [OMS1].
Conditions and measures related to municipal sewage treatment plant	Domestic sewage treatment is not assumed [STP2].
Conditions and measures related to external treatment of waste for disposal	Not applicable.
Conditions and measures related to external recovery of waste	Not applicable.
Other environmental control measures additional to above	None.
Section 3	**Exposure Estimation**

3.1. Health

Measured data has been used to estimate worker exposure

PROC #	**Inhalation exposure – long term (mg/m^3)**	**RCR inhalation**	**Inhalation exposure – short term (mg/m^3)**	**RCR Short term**
PROC 1	0.012	0.346	0.024	0.173
PROC 2	0.012	0.346	0.024	0.173
PROC	0.030	0.857	0.060	0.429

3				
PROC 4	0.032	0.920	0.064	0.460
PROC 8b	0.019	0.549	0.038	0.274
PROC 15	0.005	0.131	0.009	0.066

3.2. Environment

Used EUSES model [EE4].

Compartment	**Predicted Environmental Concentration**	**RCR**
Air (µg/m^3)	Not relevant	
Freshwater (mg/l)	$4.14 \cdot 10^{-8}$	$3.31 \cdot 10^{-6}$
Marine water (mg/l)	$9.71 \cdot 10^{-10}$	$7.77 \cdot 10^{-7}$
Agricultural soil (mg/kg)	$1.02 \cdot 10^{-3}$	$< 1.02 \cdot 10^{-3}$
Grassland (mg/kg)	$1.03 \cdot 10^{-3}$	$< 1.03 \cdot 10^{-3}$
STP (mg/l)	Not relevant	
Secondary poisoning	Not relevant	
Humans exposed via the environment	Not relevant	

Section 4 **Guidance to check compliance with the Exposure Scenario**

4.1. Health

Guidance to DU	Predicted exposures are not expected to exceed the DN(M)EL when the Risk Management Measures/Operational Conditions outlined in Section 2 are implemented [GC 22]
	Where other Risk Management Measures/Operational Conditions are adopted, then users should ensure that risks are managed to at least equivalent levels. [GC 23]
	Further information on the assumptions contained in this Exposure Scenario can be found at: [GC 24] ISOPA interpretation on selection of Use Descriptors

4.2. Environment

Not applicable

Section 5	
Additional good practice advice beyond the REACH Chemical Safety Assessment - (Section Optional)	
Note: The measures reported in this section have not been taken into account in the exposure estimates related to the exposure scenario above. They are not subject to obligation laid down in Article 37 (4) of REACH.	
Control of Worker Exposure	
PROC 4. Open batch/continuous processes with opportunity for exposure (e.g. during use, sampling, maintenance, equipment breaks)	- E9: Put lids on containers immediately after use.
Control of environmental exposure	
None	

Exposure scenario 2: Use of TDI as Intermediate for Manufacturing other Substances and Formulating, Repackaging & Distribution

ES2 Annex to the e-SDS	
Section 1	**Exposure Scenario Title**
Title	**Use of TDI as Intermediate for Manufacturing other Substances and Formulating, Repackaging & Distribution**
Use Descriptor	Sector of Use intermediate use: SU3, SU8, SU9 Sector of use Formulating, Repackaging & Distribution: SU3, SU10
	Process Categories and Environmental Release Categories: <u>A) Use as intermediate</u> PROC 1, PROC 2, PROC 3, PROC 4, PROC 5, PROC 8b, PROC 9, PROC 15 ERC2, ERC3, ERC6a <u>B) Repackaging & Distribution</u> PROC 1, PROC 2, PROC 3, PROC 4, PROC 5, PROC 8b, PROC 9, PROC 15 ERC2, ERC3, ERC6c
Processes, tasks, activities covered	Covers: Industrial: – PROC 1: Use in closed process, no likelihood of exposure (e.g. including enclosed sampling, waste collection & transfer, charging, discharging) – PROC 2: Use in closed, continuous process with occasional controlled exposure (e.g. during sampling, maintenance, equipment cleaning, occasional interventions) – PROC 3: Use in closed batch processes (synthesis or formulation) (e.g. during sampling, maintenance, equipment breaks) – PROC 4: Use in batch and other process (synthesis) where opportunity for exposure arises (e.g. during use, sampling, maintenance, equipment breaks) – PROC 5: Mixing or blending in batch processes for formulations or preparations and articles (multistage

	and/or significant contact) (e.g. mixing) – PROC 8b: Transfer of substance or preparation (charging/discharging) from/to vessels/large containers at dedicated facilities (e.g. drum filling, sampling, waste collection & transfer, charging, discharging) – PROC 9: Transfer of substance or preparation into small containers (e.g. dedicated filling line, including weighing) – PROC 15: Use as a laboratory reagent
Section 2	**Operational conditions and risk management measures**
Field for additional statements to explain scenario if required.	
Section 2.1	**Control of worker exposure**
Product characteristics	
Physical form of product	Physical state: liquid (only solid when specifically mentioned)
Concentration of substance in product	G13: Covers percentage substance in the product up to 100 % (unless stated differently).
Amounts used	Not applicable.
Frequency and duration of use	G2: Covers daily exposures up to 8 hours (unless stated differently).
Human factors not influenced by risk management	None identified.
Other Operational Conditions affecting worker exposure	G15: Assumes use at not more than 20°C above ambient temperature, unless stated differently. Elevated temperatures in the range of 55 ºC to 110 ºC for PROC 1 and 5.
Contributing Scenarios	**Risk Management Measures** *Note: list RMM standard phrases according to the control hierarchy indicated in the ECHA template: 1. Technical measures to prevent release, 2. Technical measures to prevent dispersion, 3. Organisational measures , 4. Personal protection*
CS 135: General Measures applicable to all activities	- E3: Avoid all skin contact with product, clean up contamination/spills as soon as they occur. Wear gloves (tested to EN374) if hand contamination likely, wash off any

	skin contamination immediately. Provide basic employee training to prevent / minimize exposures and to report any skin problems that may develop. - PPE14 PP: Use suitable eye protection and gloves. - PPE27 PP: Wear suitable coveralls to prevent exposure to the skin.
PROC 1: Use in closed process, no likelihood of exposure (e.g. including enclosed sampling, waste collection & transfer, charging, discharging)	- CS109: With local exhaust ventilation.
PROC 2: Use in closed, continuous process with occasional controlled exposure (e.g. during sampling, maintenance, equipment cleaning, occasional interventions)	- CS109: With local exhaust ventilation. - PPE30: If above technical/organizational control measures are not feasible, then adopt following PPE: - PPE29: Wear a respirator conforming to EN140 with Type A/P2 filter or better.
PROC 3: Use in closed batch processes (synthesis or formulation) (e.g. during sampling, maintenance, equipment breaks)	- CS109: With local exhaust ventilation. - PPE30 PP: If above technical/organizational control measures are not feasible, then adopt following PPE: - PPE29 PP: Wear a respirator conforming to EN140 with Type A/P2 filter or better.
PROC 4: Use in batch and other process (synthesis) where opportunity for exposure arises (e.g. during use, sampling, maintenance, equipment breaks)	- CS109: With local exhaust ventilation. - PPE30 PP: If above technical/organizational control measures are not feasible, then adopt following PPE: - PPE29 PP: Wear a respirator conforming to EN140 with Type A/P2 filter or better.

PROC 5: Mixing or blending in batch processes for formulations or preparations and articles (multistage and/or significant contact) (e.g. mixing)	- CS109: With local exhaust ventilation. - Wear a full face respirator TM3 conforming to EN147 with Type A filter or better.
PROC 8b: Transfer of substance or preparation (charging/discharging) from/to vessels/large containers at dedicated facilities (e.g. drum filling, sampling, waste collection & transfer, charging, discharging)	- CS109: With local exhaust ventilation. - PPE30 PP: If above technical/organizational control measures are not feasible, then adopt following PPE: - PPE29 PP: Wear a respirator conforming to EN140 with Type A/P2 filter or better.
PROC 9: Transfer of substance or preparation into small containers (e.g. dedicated filling line, including weighing)	- CS109: With local exhaust ventilation. - PPE30 PP: If above technical/organizational control measures are not feasible, then adopt following PPE: - PPE29 PP: Wear a respirator conforming to EN140 with Type A/P2 filter or better.
PROC 15: Use as a laboratory reagent	- CS36: Use in laboratory activities. - E83: Handle in a fume cupboard or under extract ventilation.
Section 2.2	**Control of environmental exposure**
Product characteristics	Substance is a unique structure [PrC1].
	Predominantly hydrophobic [PrC4a].
	Not biodegradable [PrC5f].
Operational conditions	Indoor/Outdoor use [OOC3].
Amounts used	
Fraction of EU tonnage used in region [A1]:	1

Regional use tonnage (tonnes/year) [A2]:	32,000
Fraction of regional tonnage used locally [A3]:	0.3125
Average local daily tonnage (kg/d) [A5]:	33,333 kg/day
Frequency and duration of use	
Type of release	Continuous release [FD2].
Emission days (days/year) [FD4]	≥ 300
Environmental factors not influenced by risk management	
Local freshwater dilution factor [EF1].	10
Local marine water dilution factor [EF2].	100
Other given operational conditions affecting environmental exposure	Used in open systems.
	Dry processes.
Release fraction to air from process [OOC4].	$3 \cdot 10^{-4}$
Release fraction to wastewater from process [OOC5].	0
Release fraction to soil from process (regional only) [OOC6].	0
Risk Management Measures	
Technical conditions and measures at process level (source) to prevent release	Common practices vary across sites thus conservative process release estimates used [TCS 1].
Technical onsite conditions and measures to reduce or limit discharges, air emissions and releases to soil	
Air:	No air emission controls required; required removal efficiency is 0% [TCR5].

Soil:	Soil emission controls are not applicable as there is no direct release to soil [TCR4].
Organizational measures to prevent/limit release from site	Prevent discharge of un-dissolved substance to or recover from wastewater [OMS1].
Conditions and measures related to municipal sewage treatment plant	Wastewater emission controls are not applicable as there is no direct release to wastewater [TCR3].
Conditions and measures related to external treatment of waste for disposal	Not applicable.
Conditions and measures related to external recovery of waste	Not applicable.
Other environmental control measures additional to above	None.

Section 3	**Exposure Estimation**

3.1. Health

Measured data has been used to estimate worker exposure

PROC #	**Inhalation exposure – long term (mg/m^3)**	**RCR inhalation-Long term**	**Inhalation exposure – short term (mg/m^3)**	**RCR Inhalation - Short term**
PROC 1	0.012	0.346	0.024	0.173
PROC 2	0.012	0.346	0.024	0.173
PROC 3	0.030	0.857	0.060	0.429
PROC 4	0.032	0.92	0.064	0.460
PROC 5	<0.001	0.013	0.001	0.006
PROC 8b	0.019	0.549	0.038	0.274

PROC 9	0.015	0.423	0.030	0.211
PROC 15	0.005	0.131	0.009	0.066

3.2. Environment

Used EUSES model [EE4].

Compartment	**Predicted Environmental Concentration**	**Risk Characterisation Ratio**
Air (µg/m^3)	Not relevant	
Freshwater (mg/l)	$4.14 \cdot 10^{-8}$	$3.31 \cdot 10^{-6}$
Marine water (mg/l)	$9.71 \cdot 10^{-10}$	$7.77 \cdot 10^{-7}$
Agricultural soil (mg/kg)	$8.37 \cdot 10^{-3}$	$< 8.37 \cdot 10^{-3}$
Grassland (mg/kg)	0.012	< 0.012
STP (mg/l)	Not relevant	
Secondary poisoning	Not relevant	
Humans exposed via the environment	Not relevant	

Section 4	**Guidance to check compliance with the Exposure Scenario**
4.1. Health	
Guidance to DU	Predicted exposures are not expected to exceed the DN(M)EL when the Risk Management Measures/Operational Conditions outlined in Section 2 are implemented [GC 22]
	Where other Risk Management Measures/Operational Conditions are adopted, then users should ensure that risks are managed to at least equivalent levels. [GC 23]
	Further information on the assumptions contained in this Exposure Scenario can be found at: [GC 24] ISOPA interpretation on selection of Use Descriptors
4.2. Environment	
Not applicable	

Section 5	
Additional good practice advice beyond the REACH Chemical Safety Assessment - (Section Optional)	
Note: The measures reported in this section have not been taken into account in the exposure estimates related to the exposure scenario above. They are not subject to obligation laid down in Article 37 (4) of REACH.	
Control of Worker Exposure	
PROC 4: Use in batch and other process (synthesis) where opportunity for exposure arises (e.g. during use, sampling, maintenance, equipment breaks)	- E9: Put lids on containers immediately after use.
PROC 9: Transfer of substance or preparation into small containers (dedicated filling line, including weighing)	- E9: Put lids on containers immediately after use.
Control of environmental exposure	
None	

Exposure Scenario 3: Industrial use of TDI

Annex to the e-SDS	
Section 1	**Exposure Scenario Title**
Title	**Industrial use of TDI**
Use Descriptor	Sector of Use: SU3
	Process Categories: A) Industrial use for Flexible Foam PROC 1, PROC 2, PROC 3, PROC 4, PROC 5, PROC 8b, PROC 14, PROC 15, PROC 21, ERC 2, ERC 3, ERC 6c B) Industrial use for Coatings PROC 1, PROC 2, PROC 3, PROC 4, PROC 5, PROC 7, PROC 8b, PROC 9, PROC 10, PROC 13, PROC 15 ERC 2, ERC 3, ERC 5, ERC 6c C) Industrial use for Adhesives and Sealants PROC 1, PROC 2, PROC 3, PROC 4, PROC 5, PROC 7, PROC 8b, PROC 9, PROC 10, PROC 13, PROC 14, PROC 15 ERC 2, ERC 3, ERC 5, ERC 6c D) Industrial use for Elastomers, TPU, Polyamide, Polyamide & synthetic Fibres PROC 1, PROC 2, PROC 3, PROC 4, PROC 5, PROC 8b, PROC 9, PROC 15 ERC 2, ERC 3, ERC 6c E) Industrial use for composite material [e.g. Automotive /Aerospace composites, electrical parts, pipe repair] PROC 1, PROC 2, PROC 3, PROC 5, PROC 8b, PROC 13, PROC 14, PROC 15 ERC 2, ERC 3, ERC 5, ERC 6c

Processes, tasks, activities covered	– PROC 1: Use in closed process, no likelihood of exposure (e.g. including enclosed sampling, waste collection & transfer, charging, discharging, blowline injections, blender operations) – PROC 2: Use in closed, continuous process with occasional controlled exposure (e.g. automatic or manual closed moulding, sawing in cabinet, during sampling, charging, discharging, maintenance, equipment cleaning, occasional interventions) – PROC 3: Use in closed batch processes (synthesis or formulation) (e.g. closed moulding, sawing in cabinet, blending, during sampling, maintenance, equipment cleaning, occasional interventions) – PROC 4: Use in batch and other process (synthesis) where opportunity for exposure arises (e.g. open moulding, pouring on conveyor or in box, open sawing, during casting, other open uses, during sampling, maintenance, equipment cleaning, occasional interventions (at open areas)) – PROC 5: Mixing or blending in batch processes for formulations or preparations and articles (multistage and/or significant contact) – PROC 7: Industrial spraying – PROC 8b: Transfer of substance or preparation (charging/discharging) from/to vessels/large containers at dedicated facilities (e.g. sampling, waste collection & transfer, charging, discharging) – PROC 9: Transfer of substance or preparation into small containers (e.g. dedicated filling line, including weighing) – PROC 10: Roller application or brushing – PROC 13: Treatment of articles by dipping and pouring – PROC 14: Production of preparations or articles by tabletting, compression, extrusion, pelettisation

	– PROC 15: Use as laboratory reagent – PROC 21: Low energy manipulation of substances bound in materials and/or articles (e.g. demoulding, trimming, repairing, cutting)
Section 2	**Operational conditions and risk management measures**
Field for additional statements to explain scenario if required.	
Section 2.1	**Control of worker exposure**
Product characteristics	
Physical form of product	Physical state: liquid (only solid when specifically mentioned)
Concentration of substance in product	G13: Covers percentage substance in the product up to 100 % (unless stated differently). Exceptions: PROC 7 and PROC 10 small scale up to 60%, PROC 10 large scale, up to 0.6%, PROC 14 up to 85% and PROC 21 up to 1%.
Amounts used	Not applicable.
Frequency and duration of use	G2: Covers daily exposures up to 8 hours (unless stated differently).
Human factors not influenced by risk management	None identified.
Other Operational Conditions affecting worker exposure	G15: Assumes use at not more than 20°C above ambient temperature, unless stated differently. Elevated temperatures in the range of 55 ºC to 110 ºC for PROC 1 and 5 and 14
Contributing Scenarios	**Risk Management Measures** *Note: list RMM standard phrases according to the control hierarchy indicated in the ECHA template: 1. Technical measures to prevent release, 2. Technical measures to prevent dispersion, 3. Organizational measures , 4. Personal protection*
CS 135: General Measures applicable to all activities	- E3: Avoid all skin contact with product, clean up contamination/spills as soon as they occur. Wear gloves (tested to EN374) if hand contamination likely, wash off any skin contamination immediately. Provide basic employee training to prevent / minimize exposures and

	to report any skin problems that may develop. - PPE14 PP: Use suitable eye protection and gloves - PPE27 PP: Wear suitable coveralls to prevent exposure to the skin.
PROC 1: Use in closed process, no likelihood of exposure (e.g. including enclosed sampling, waste collection & transfer, charging, discharging, blowline injections, blender operations)	- CS109: With local exhaust ventilation.
PROC 2: Use in closed, continuous process with occasional controlled exposure (e.g. automatic or manual closed moulding, sawing in cabinet, during sampling, charging, discharging, maintenance, equipment cleaning, occasional interventions)	- CS109: With local exhaust ventilation. - PPE30 PP: If above technical/organizational control measures are not feasible, then adopt following PPE: - PPE29 PP: Wear a respirator conforming to EN140 with Type A/P2 filter or better.
PROC 3: Use in closed batch processes (synthesis or formulation) (e.g. closed moulding, sawing in cabinet, blending, during sampling, maintenance, equipment cleaning, occasional interventions)	- CS109: With local exhaust ventilation. - PPE30 PP: If above technical/organizational control measures are not feasible, then adopt following PPE: - PPE29 PP: Wear a respirator conforming to EN140 with Type A/P2 filter or better.

PROC 4: Use in batch and other process (synthesis) where opportunity for exposure arises (e.g. open moulding, pouring on conveyor or in box, open sawing, during casting, other open uses, during sampling, maintenance, equipment cleaning, occasional interventions (at open areas))	- CS109: With local exhaust ventilation. - PPE30 PP: If above technical/organizational control measures are not feasible, then adopt following PPE: - PPE29 PP: Wear a respirator conforming to EN140 with Type A/P2 filter or better.
PROC 5: Mixing or blending in batch processes for formulations or preparations and articles (multistage and/or significant contact)	- CS109: With local exhaust ventilation. - Wear a full face respirator TM3 conforming to EN147 with Type A-2 filter or better.
PROC 7: Industrial spraying	- CS109: With local exhaust ventilation. - Wear a full face respirator TM3 conforming to EN147 with Type A-2 filter or better. - Limit the substance content in the product to 60%
PROC 8b: Transfer of substance or preparation (charging/discharging) from/to vessels/large containers at dedicated facilities (e.g. sampling, waste collection & transfer, charging, discharging)	- CS109: With local exhaust ventilation. - PPE30 PP: If above technical/organizational control measures are not feasible, then adopt following PPE: - PPE29 PP: Wear a respirator conforming to EN140 with Type A/P2 filter or better.
PROC 9: Transfer of substance or preparation into small containers (e.g. dedicated filling line, including weighing)	- CS109: With local exhaust ventilation. - PPE30 PP: If above technical/organizational control measures are not feasible, then adopt following PPE: - PPE29 PP: Wear a respirator conforming to EN140 with Type A/P2 filter or better.

PROC 10: Roller application or brushing Roller application or brushing – small scale (≤10 m^2)	- CS109: With local exhaust ventilation. - PPE30 PP: If above technical/organizational control measures are not feasible, then adopt following PPE: - PPE29 PP: Wear a respirator conforming to EN140 with Type A/P2 filter or better. - Limit the substance content in the product to 60%
PROC 10: Roller application or brushing Roller application or brushing – large scale (> 10 m^2)	- if the treated surface area (in m^2) > 0.6 times the volume of the room (in m^3): E40: Provide a good standard of controlled ventilation (10 to 15 air changes per hour) - if the treated surface area (in m^2) ≤ 0.6 times the volume of the room (in m^3): E1: Provide a good standard of general ventilation. Natural ventilation is from doors, windows etc. Controlled ventilation means air is supplied or removed by a powered fan / E11: Provide a good standard of general ventilation (not less than 3 to 5 air changes per hour) - PPE30 PP: If above technical/organizational control measures are not feasible, then adopt following PPE: - PPE29 PP: Wear a respirator conforming to EN140 with Type A/P2 filter or better. - Limit the substance content in the product to 0.6%
PROC 13: Treatment of articles by dipping and pouring	- CS109: With local exhaust ventilation. - Wear a full face respirator TM3 conforming to EN147 with Type A-2 filter or better.

PROC 14: Production of preparations or articles by tabletting, compression, extrusion, pelettisation		- CS109: With local exhaust ventilation. - Wear a full face respirator TM3 conforming to EN147 with Type A filter or better. Or - demonstrate, e.g. by workplace monitoring, that exposures are below the relevant worker DNEL values for acute and long-term. (for ES E) - Limit the substance content in the product to 85%.
PROC 15: Use as laboratory reagent		- CS36: Use in laboratory activities. - E83: Handle in a fume cupboard or under extract ventilation.
PROC 21: Low energy manipulation of substances bound in materials and/or articles (e.g. demoulding, trimming, repairing, cutting)		- CS109: With local exhaust ventilation. - PPE22 PP: Wear a respirator conforming to EN140 with Type A-2 filter or better. - OC16: Limit the substance content in the product to 1 %.
Section 2.2		**Control of environmental exposure**
Product characteristics		Substance is a unique structure [PrC1].
		Predominantly hydrophobic [PrC4a].
		Not biodegradable [PrC5f].
Operational conditions		Indoor/Outdoor use [OOC3].
Amounts used		
Fraction of EU tonnage used in region [A1]:		1
Regional use tonnage (tonnes/year) [A2]:	All industrial uses of TDI except	32.000
	Industrial use of TDI containing Flexible foam	448,000

Fraction of regional tonnage used locally [A3]:	All industrial uses of TDI except	0.3125
	Industrial use of TDI containing Flexible foam	0.0223
Maximum daily site tonnage (kg/day) [A4].		33,333 kg/day
Frequency and duration of use		
Type of release		Continuous release [FD2].
Emission days (days/year) [FD4]		≥ 300
Environmental factors not influenced by risk management		
Local freshwater dilution factor [EF1].		10
Local marine water dilution factor [EF2].		100
Other given operational conditions affecting environmental exposure		Used in open systems.
		Dry processes.
Release fraction to air from process [OOC4].	All industrial uses of TDI except	$3 \cdot 10^{-4}$
	Industrial use of TDI containing Flexible foam	$9.0 \cdot 10^{-5}$
Release fraction to wastewater from process [OOC5].		0
Release fraction to soil from process (regional only) [OOC6].		0
Risk Management Measures		

Technical conditions and measures at process level (source) to prevent release	Common practices vary across sites thus conservative process release estimates used [TCS 1].
Technical onsite conditions and measures to reduce or limit discharges, air emissions and releases to soil	
Air:	No air emission controls required; required removal efficiency is 0% [TCR5].
Soil:	Soil emission controls are not applicable as there is no direct release to soil [TCR4].
Organizational measures to prevent/limit release from site	Prevent discharge of un-dissolved substance to or recover from wastewater [OMS1].].
Conditions and measures related to municipal sewage treatment plant	Wastewater emission controls are not applicable as there is no direct release to wastewater [TCR3].
Conditions and measures related to external treatment of waste for disposal	Not applicable.
Conditions and measures related to external recovery of waste	Not applicable.
Other environmental control measures additional to above	None.
Section 3	**Exposure Estimation**
3.1. Health	
Measured data has been used to estimate worker exposure	

PROC #	**Inhalation exposure – long term (mg/m^3)**	**RCR inhalation Long term**	**Inhalation exposure – short term (mg/m^3)**	**RCR Inhalation Long term**
PROC 1	0.012	0.346	0.024	0.173
PROC 2	0.012	0.346	0.024	0.173
PROC 3	0.030	0.857	0.060	0.429
PROC 4	0.032	0.920	0.064	0.460
PROC 5	<0.001	0.013	0.001	0.006
PROC 7	0.022	0.622	0.044	0.311

PROC 8b	0.019	0.549	0.038	0.274
PROC 9	0.015	0.423	0.030	0.211
PROC 10 – small scale (≤10 m^2)	0.033	0.954	0.067	0.477
PROC 10 – large scale (> 10 m^2)	0.035	0.997	0.0698	0.499
PROC 13	0.007	0.207	0.015	0.104
PROC 14	0.001	0.026	0.002	0.013
PROC 15	0.005	0.131	0.009	0.066
PROC 21	0.004	0.113	0.008	0.057

3.2. Environment		
Used EUSES model [EE4].		
Compartment	**Predicted Environmental Concentration**	**Risk Characterisation Ratio**
Air (µg/m^3)	Not relevant	
Freshwater (mg/l)	$4.14 \cdot 10^{-8}$	$3.31 \cdot 10^{-6}$
Marine water (mg/l)	$9.71 \cdot 10^{-10}$	$7.77 \cdot 10^{-7}$
Agricultural soil (mg/kg)	0.026*	< 0.026
Grassland (mg/kg)	0.037*	< 0.037
STP (mg/l)	Not relevant	
Secondary poisoning	Not relevant	
Humans exposed via the environment	Not relevant	
Section 4	**Guidance to check compliance with the Exposure Scenario**	
4.1. Health		
Guidance to DU	Predicted exposures are not expected to exceed the DN(M)EL when the Risk Management Measures/Operational Conditions outlined in Section 2	

* These values are for all uses, except Industrial use of TDI containing Flexible foam. For this use, the PECs in agricultural soil and grassland are $8.37 \cdot 10^{-2}$ and 0.012 mg/kg, respectively.

	are implemented [GC 22]
	Where other Risk Management Measures/Operational Conditions are adopted, then users should ensure that risks are managed to at least equivalent levels. [GC 23]
	Further information on the assumptions contained in this Exposure Scenario can be found at: [GC 24] ISOPA interpretation on selection of Use Descriptors
4.2. Environment	
Not relevant	
Section 5	
Additional good practice advice beyond the REACH Chemical Safety Assessment - (Section Optional)	
Note: The measures reported in this section have not been taken into account in the exposure estimates related to the exposure scenario above. They are not subject to obligation laid down in Article 37 (4) of REACH.	
Control of Worker Exposure	
PROC 4: Use in batch and other process (synthesis) where opportunity for exposure arises (e.g. open moulding, pouring on conveyor or in box, open sawing, during casting, other open uses, during sampling, maintenance, equipment cleaning, occasional interventions (at open areas))	- E9: Put lids on containers immediately after use.
PROC 9: Transfer of substance or preparation into small containers (dedicated filling line, including weighing)	- E9: Put lids on containers immediately after use.
Control of environmental exposure	
None	

Exposure Scenario 4: Professional use of TDI

Annex to the e-SDS	
Section 1	**Exposure Scenario Title**
Title	**Professional use of TDI**
Use Descriptor	Sector of Use: SU22
	Process Categories and Environmental Release Categories: <u>A) Professional use for Coatings</u> PROC 5, PROC 8a, PROC 10 ERC 8c, ERC 8f <u>B) Professional use for Adhesives and Sealants</u> PROC 4, PROC 5, PROC 8a, PROC 10 ERC 8c, ERC 8f <u>C) Professional use for composite material</u> PROC 2, PROC 3, PROC 5, PROC 8a, PROC 14 ERC 8c, ERC 8f
Processes, tasks, activities covered	– PROC 2: Use in closed, continuous process with occasional controlled exposure (e.g. during sampling, sawing, maintenance, equipment cleaning, occasional interventions) – PROC 3: Use in closed batch processes (synthesis or formulation) (e.g. during sampling, maintenance, equipment cleaning, occasional interventions) – PROC 4: Use in batch and other process (synthesis) where opportunity for exposure arises (e.g. during use, maintenance/cleaning/incidental interventions) – PROC 5: Mixing or blending in batch processes for formulations or preparations and articles (multistage and/or significant contact) – PROC 8a: Transfer of substance or preparation

	(charging/discharging) from/to vessels/large containers at non-dedicated facilities (e.g. sampling, waste collection & transfer, charging, discharging) – PROC 10: Roller application or brushing (e.g. One Component Foam use) – PROC 14: Production of preparations or articles by tabletting, compression, extrusion, pelettisation
Section 2	**Operational conditions and risk management measures**
Field for additional statements to explain scenario if required.	
Section 2.1	**Control of worker exposure**
Product characteristics	
Physical form of product	Physical state: liquid (only solid when specifically mentioned)
Concentration of substance in product	G13: Covers percentage substance in the product up to 100 % (unless stated differently). Exceptions: PROC 10 small scale up to 60%, PROC 10 large scale, up to 0.6%, PROC 14 up to 85%.
Amounts used	Not applicable.
Frequency and duration of use	G2: Covers daily exposures up to 8 hours (unless stated differently).
Human factors not influenced by risk management	None identified.
Other Operational Conditions affecting worker exposure	G15: Assumes use at not more than 20°C above ambient temperature, unless stated differently. Elevated temperatures in the range of 55 ºC to 110 ºC for PROC 5 and 14.
Contributing Scenarios	**Risk Management Measures** *Note: list RMM standard phrases according to the control hierarchy indicated in the ECHA template: 1. Technical measures to prevent release, 2. Technical measures to prevent dispersion, 3. Organisational measures , 4. Personal protection*

CS 135: General Measures applicable to all activities	- E3: Avoid all skin contact with product, clean up contamination/spills as soon as they occur. Wear gloves (tested to EN374) if hand contamination likely, wash off any skin contamination immediately. Provide basic employee training to prevent / minimize exposures and to report any skin problems that may develop. - PPE14 PP: Use suitable eye protection and gloves[1]. - PPE27 PP: Wear suitable coveralls to prevent exposure to the skin.
PROC 2: Use in closed, continuous process with occasional controlled exposure (e.g. during sampling, sawing, maintenance, equipment cleaning, occasional interventions)	- CS109: With local exhaust ventilation. - PPE30 PP: If above technical/organizational control measures are not feasible, then adopt following PPE: - PPE29 PP: Wear a respirator conforming to EN140 with Type A/P2 filter or better.
PROC 3: Use in closed batch processes (synthesis or formulation) (e.g. during sampling, maintenance, equipment cleaning, occasional interventions)	- CS109: With local exhaust ventilation. - PPE30 PP: If above technical/organizational control measures are not feasible, then adopt following PPE: - PPE29 PP: Wear a respirator conforming to EN140 with Type A/P2 filter or better.
PROC 4: Use in batch and other process (synthesis) where opportunity for exposure arises (e.g. during use, maintenance/cleaning/incidental interventions)	- CS109: With local exhaust ventilation.

PROC 5: Mixing or blending in batch processes for formulations or preparations and articles (multistage and/or significant contact)	- CS109: With local exhaust ventilation. - Wear a full face respirator TM3 conforming to EN147 with Type A-2 filter or better.
PROC 8a: Transfer of substance or preparation (charging/discharging) from/to vessels/large containers at non-dedicated facilities (e.g. sampling, waste collection & transfer, charging, discharging)	- CS109: With local exhaust ventilation. - Wear a full face respirator TM3 conforming to EN147 with Type A-2 filter or better.
PROC 10: Roller application or brushing (e.g. One Component Foam use) – small scale (≤ 10 m^2)	- CS109: With local exhaust ventilation. - Limit the substance content in the product to 60%.
PROC 10: Roller application or brushing (e.g. One Component Foam use) – large scale (> 10 m^2)	- *if the treated surface area (in m^2) > 0.6 times the volume of the room (in m^3):* E40: Provide a good standard of controlled ventilation (10 to 15 air changes per hour) - *if the treated surface area (in m^2) ≤ 0.6 times the volume of the room (in m^3):* E1: Provide a good standard of general ventilation. Natural ventilation is from doors, windows etc. Controlled ventilation means air is supplied or removed by a powered fan / E11: Provide a good standard of general ventilation (not less than 3 to 5 air changes per hour) - PPE30 PP: If above technical/organizational control measures are not feasible, then adopt following PPE: - PPE29 PP: Wear a respirator conforming to EN140 with Type A/P2 filter or better. - Limit the substance content in the product to 0.6%.

PROC 14. Tabletting, compression, extrusion, pelettisation.	- CS109: With local exhaust ventilation. - Wear a full face respirator TM3 conforming to EN147 with Type A-2 filter or better. Or - demonstrate, e.g. by workplace monitoring, that exposures are below the relevant worker DNEL values for acute and long-term. (for ES C) - Limit the substance content in the product to 85%.

Section 2.2	Control of environmental exposure
Product characteristics	Substance is a unique structure [PrC1].
	Predominantly hydrophobic [PrC4a].
	Not biodegradable [PrC5f].
Operational conditions	Indoor/Outdoor use [OOC3].
Amounts used	
Fraction of EU tonnage used in region [A1]:	1
Regional use tonnage (tonnes/year) [A2]:	32,000
Fraction of regional tonnage used locally [A3]:	$2.0 \cdot 10^{-3}$
Maximum daily site tonnage (kg/day) [A4].	175 kg/day
Frequency and duration of use	
Type of release	Dispersive use [FD2].
Emission days (days/year) [FD4]	365
Environmental factors not influenced by risk management	
Local freshwater dilution factor [EF1].	10
Local marine water dilution factor [EF2].	100
Other given operational conditions affecting environmental exposure	Used in open systems.
	Dry processes.
Release fraction to air from process [OOC4].	0.15
Release fraction to wastewater from process [OOC5].	0.01
Release fraction to soil from process (regional only) [OOC6].	$5.0 \cdot 10^{-3}$
Risk Management Measures	
Technical conditions and measures at process level (source) to prevent release	Common practices vary across sites thus conservative process release estimates used [TCS 1].

Technical onsite conditions and measures to reduce or limit discharges, air emissions and releases to soil	
Air:	No air emission controls required; required removal efficiency is 0% [TCR5].
Soil:	Soil emission controls are not applicable as there is no direct release to soil [TCR4].
Organizational measures to prevent/limit release from site	Prevent discharge of undissolved substance to or recover from wastewater [OMS1].].
Conditions and measures related to municipal sewage treatment plant	Estimated substance removal from wastewater via domestic sewage treatment is 11% [STP3].
	Assumed domestic sewage treatment plant flow is 2000 m3/d [STP5].
Conditions and measures related to external treatment of waste for disposal	Not applicable.
Conditions and measures related to external recovery of waste	Not applicable.
Other environmental control measures additional to above	None.
Section 3	**Exposure Estimation**
3.1. Health	
Measured data has been used to estimate worker exposure	

PROC #	**Inhalation exposure – long term (mg/m^3)**	**RCR inhalation long term**	**Inhalation exposure – short term (mg/m^3)**	**RCR inhalation short term**
PROC 2	0.012	0.346	0.024	0.173
PROC 3	0.030	0.857	0.060	0.429
PROC 4	0.032	0.92	0.064	0.460
PROC 5	<0.001	0.013	0.001	0.006
PROC 8a	0.007	0.207	0.015	0.104
PROC 10 – small scale ($\leq 10m^2$)	0.033	0.954	0.067	0.477
PROC 10 – large scale ($> 10m^2$)	0.035	0.997	0.070	0.499

PROC 14	0.001	0.026	0.02	0.013

3.2. Environment		
Used EUSES model [EE4].		
Compartment	**Predicted Environmental Concentration**	**Risk Characterisation Ratio**
Air (µg/m^3)	Not relevant	
Freshwater (mg/l)	$5.75 \cdot 10^{-7}$	$4.60 \cdot 10^{-5}$
Marine water (mg/l)	$8.75 \cdot 10^{-4}$	0.700
Agricultural soil (mg/kg)	$1.00 \cdot 10^{-3}$	$< 1.00 \cdot 10^{-3}$
Grassland (mg/kg)	$1.01 \cdot 10^{-3}$	$< 1.01 \cdot 10^{-3}$
STP (mg/l)	Not relevant	
Secondary poisoning	Not relevant	
Humans exposed via the environment	Not relevant	
Section 4	**Guidance to check compliance with the Exposure Scenario**	
4.1. Health		
Guidance to DU	Predicted exposures are not expected to exceed the DN(M)EL when the Risk Management Measures/Operational Conditions outlined in Section 2 are implemented [GC 22]	
	Where other Risk Management Measures/Operational Conditions are adopted, then users should ensure that risks are managed to at least equivalent levels. [GC 23]	
	Further information on the assumptions contained in this Exposure Scenario can be found at: [GC 24] ISOPA interpretation on selection of Use Descriptors	
4.2. Environment		
Not applicable		
Section 5		
Additional good practice advice beyond the REACH Chemical Safety Assessment - (Section Optional)		
Note: The measures reported in this section have not been taken into account in the exposure estimates related to the exposure scenario above. They are not subject to		

obligation laid down in Article 37 (4) of REACH.	
Control of Worker Exposure	
PROC 4: Use in batch and other process (synthesis) where opportunity for exposure arises (e.g. during use, maintenance/cleaning/ incidental interventions)	- E9: Put lids on containers immediately after use.
PROC 8a: Transfer of substance or preparation (charging/discharging) from/to vessels/large containers at non-dedicated facilities (e.g. sampling, waste collection & transfer, charging, discharging	- E9: Put lids on containers immediately after use.
Control of environmental exposure	
None	