

SAFETY DATA SHEET



Piperazine anhydrous, PIP

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

1.1 Product identifier

Product name : Piperazine anhydrous, PIP**Index number** : 612-057-00-4**EC number** : 203-808-3**REACH Registration number**

Registration number	Legal entity
01-2119480384-35-0001	-

CAS number : 110-85-0**Other means of identification** : -**Chemical formula** : C4-H10-N2

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

Product use : Intermediate. Chemical synthesis. Pharmaceuticals.

Identified uses
ES01: Manufacture of substance - Industrial: SU03; PROC01, PROC08a, PROC08b, PROC15; ERC01
ES02: Flaking of substance - Industrial: SU03; PROC03, PROC08b; ERC01
ES03: Use as an intermediate + Polymerisation - Industrial: SU03; PROC01, PROC08a, PROC08b, PROC15; ERC06a, ERC06c
ES04: Formulation - Industrial: SU10; PROC01, PROC08a, PROC08b, PROC15; ERC02
ES05: Use of gas-washer formulations in scrubbers - Industrial: SU03; PROC01, PROC08b; ERC07

See Annex to the Safety data sheet for additional information in the Exposure Scenario(s).

1.3 Details of the supplier of the safety data sheet

Delamine B.V.
 Barchman Wuytierslaan 10
 3818 LH Amersfoort
 Netherlands
 Telephone number: +31-334224600

e-mail address of person responsible for this SDS : sds.delamine@delamine.com

1.4 Emergency telephone number

Supplier**Telephone number** : GBK/Infotrac ID 104075 : International (001) 352 323 3500 (24 h)

SECTION 2: Hazards identification

2.1 Classification of the substance or mixture

Product definition : Mono-constituent substance**Classification according to Regulation (EC) No. 1272/2008 [CLP/GHS]**

Flam. Sol. 1, H228

Skin Corr. 1B, H314

Eye Dam. 1, H318

Resp. Sens. 1B, H334

Skin Sens. 1B, H317

Repr. 2, H361fd (Fertility and Unborn child)

The product is classified as hazardous according to Regulation (EC) 1272/2008 as amended.

SECTION 2: Hazards identification

See Section 16 for the full text of the H statements declared above.

See Section 11 for more detailed information on health effects and symptoms.

2.2 Label elements

Hazard pictograms



Signal word

: Danger

Hazard statements

: H228 - Flammable solid.
 H314 - Causes severe skin burns and eye damage.
 H334 - May cause allergy or asthma symptoms or breathing difficulties if inhaled.
 H317 - May cause an allergic skin reaction.
 H361fd - Suspected of damaging fertility. Suspected of damaging the unborn child.

Precautionary statements

Prevention

: P280 - Wear protective gloves. Wear eye or face protection. Wear protective clothing.
 P210 - Keep away from heat, hot surfaces, sparks, open flames and other ignition sources. No smoking.
 P260 - Do not breathe dust or mist.

Response

: P303 + P361 + P353 + P310 - IF ON SKIN (or hair): Take off immediately all contaminated clothing. Rinse skin with water or shower. Immediately call a POISON CENTER or physician.
 P305 + P351 + P338 + P310 - IF IN EYES: Rinse cautiously with water for several minutes. Remove contact lenses, if present and easy to do. Continue rinsing. Immediately call a POISON CENTER or physician.
 P304 + P340 - IF INHALED: Remove person to fresh air and keep comfortable for breathing.
 P342 + P311 - If experiencing respiratory symptoms: Call a POISON CENTER or doctor/physician.

Storage

: Not applicable.

Disposal

: Not applicable.

Hazardous ingredients

: piperazine

Supplemental label elements

: Not applicable.

Annex XVII - Restrictions on the manufacture, placing on the market and use of certain dangerous substances, mixtures and articles

: Not applicable.

2.3 Other hazards

Substance meets the criteria for PBT according to Regulation (EC) No. 1907/2006, Annex XIII

: No.
 P: No. B: No. T: Yes.

Substance meets the criteria for vPvB according to Regulation (EC) No. 1907/2006, Annex XIII

: No.
 vP: No. vB: No.

Other hazards which do not result in classification

: None known.

SECTION 3: Composition/information on ingredients

3.1 Substances : Mono-constituent substance

Product/ingredient name	Identifiers	%	Regulation (EC) No. 1272/2008 [CLP]	Type
piperazine	REACH #: 01-2119480384-35 EC: 203-808-3 CAS: 110-85-0 Index: 612-057-00-4	100	Flam. Sol. 1, H228 Skin Corr. 1B, H314 Eye Dam. 1, H318 Resp. Sens. 1B, H334 Skin Sens. 1B, H317 Repr. 2, H361fd (Fertility and Unborn child) See Section 16 for the full text of the H statements declared above.	[A]

There are no additional ingredients present which, within the current knowledge of the supplier, are classified and contribute to the classification of the substance and hence require reporting in this section.

Type

[A] Constituent

[B] Impurity

[C] Stabilising additive

Occupational exposure limits, if available, are listed in Section 8.

SECTION 4: First aid measures

4.1 Description of first aid measures

Eye contact

- : Get medical attention immediately. Call a poison center or physician. Immediately flush eyes with plenty of water, occasionally lifting the upper and lower eyelids. Check for and remove any contact lenses. Continue to rinse for at least 10 minutes. Chemical burns must be treated promptly by a physician.

Inhalation

- : Get medical attention immediately. Call a poison center or physician. Remove victim to fresh air and keep at rest in a position comfortable for breathing. If it is suspected that fumes are still present, the rescuer should wear an appropriate mask or self-contained breathing apparatus. If not breathing, if breathing is irregular or if respiratory arrest occurs, provide artificial respiration or oxygen by trained personnel. It may be dangerous to the person providing aid to give mouth-to-mouth resuscitation. If unconscious, place in recovery position and get medical attention immediately. Maintain an open airway. Loosen tight clothing such as a collar, tie, belt or waistband. In case of inhalation of decomposition products in a fire, symptoms may be delayed. The exposed person may need to be kept under medical surveillance for 48 hours. In the event of any complaints or symptoms, avoid further exposure.

Skin contact

- : Get medical attention immediately. Call a poison center or physician. Wash with plenty of soap and water. Remove contaminated clothing and shoes. Wash contaminated clothing thoroughly with water before removing it, or wear gloves. Continue to rinse for at least 10 minutes. Chemical burns must be treated promptly by a physician. In the event of any complaints or symptoms, avoid further exposure. Wash clothing before reuse. Clean shoes thoroughly before reuse.

Ingestion

- : Get medical attention immediately. Call a poison center or physician. Wash out mouth with water. Remove dentures if any. Remove victim to fresh air and keep at rest in a position comfortable for breathing. If material has been swallowed and the exposed person is conscious, give small quantities of water to drink. Stop if the exposed person feels sick as vomiting may be dangerous. Do not induce vomiting unless directed to do so by medical personnel. If vomiting occurs, the head should be kept low so that vomit does not enter the lungs. Chemical burns must be treated promptly by a physician. Never give anything by mouth to an unconscious person. If unconscious, place in recovery position and get medical attention immediately. Maintain an open airway. Loosen tight clothing such as a collar, tie, belt or waistband.

SECTION 4: First aid measures

Protection of first-aiders : No action shall be taken involving any personal risk or without suitable training. If it is suspected that fumes are still present, the rescuer should wear an appropriate mask or self-contained breathing apparatus. It may be dangerous to the person providing aid to give mouth-to-mouth resuscitation. Wash contaminated clothing thoroughly with water before removing it, or wear gloves.

4.2 Most important symptoms and effects, both acute and delayed**Potential acute health effects**

Eye contact : Causes serious eye damage.
Inhalation : May cause allergy or asthma symptoms or breathing difficulties if inhaled.
Skin contact : Causes severe burns. May cause an allergic skin reaction.
Ingestion : No known significant effects or critical hazards.

Over-exposure signs/symptoms

Eye contact : Adverse symptoms may include the following:
 pain
 watering
 redness

Inhalation : Adverse symptoms may include the following:
 wheezing and breathing difficulties
 asthma
 reduced foetal weight
 increase in foetal deaths
 skeletal malformations

Skin contact : Adverse symptoms may include the following:
 pain or irritation
 redness
 blistering may occur
 reduced foetal weight
 increase in foetal deaths
 skeletal malformations

Ingestion : Adverse symptoms may include the following:
 stomach pains
 reduced foetal weight
 increase in foetal deaths
 skeletal malformations

4.3 Indication of any immediate medical attention and special treatment needed

Notes to physician : In case of inhalation of decomposition products in a fire, symptoms may be delayed. The exposed person may need to be kept under medical surveillance for 48 hours.

Specific treatments : No specific treatment.

SECTION 5: Firefighting measures**5.1 Extinguishing media**

Suitable extinguishing media : Use dry chemical, CO₂, water spray (fog) or foam. Dry sand or other suitable absorbent. Use an extinguishing agent suitable for the surrounding fire.

Unsuitable extinguishing media : Do not use water jet.

5.2 Special hazards arising from the substance or mixture

Hazards from the substance or mixture : Flammable solid.

Hazardous combustion products : Decomposition products may include the following materials:
 carbon dioxide
 carbon monoxide
 nitrogen oxides

SECTION 5: Firefighting measures**5.3 Advice for firefighters**

- Special protective actions for fire-fighters** : Promptly isolate the scene by removing all persons from the vicinity of the incident if there is a fire. No action shall be taken involving any personal risk or without suitable training. Move containers from fire area if this can be done without risk. Use water spray to keep fire-exposed containers cool.
- Special protective equipment for fire-fighters** : Fire-fighters should wear appropriate protective equipment and self-contained breathing apparatus (SCBA) with a full face-piece operated in positive pressure mode. Clothing for fire-fighters (including helmets, protective boots and gloves) conforming to European standard EN 469 will provide a basic level of protection for chemical incidents.
- Additional information (Explosibility)** : Not considered to be a product presenting a risk of explosion.

SECTION 6: Accidental release measures**6.1 Personal precautions, protective equipment and emergency procedures**

- For non-emergency personnel** : No action shall be taken involving any personal risk or without suitable training. Evacuate surrounding areas. Keep unnecessary and unprotected personnel from entering. Do not touch or walk through spilt material. Shut off all ignition sources. No flares, smoking or flames in hazard area. Provide adequate ventilation. Wear appropriate respirator when ventilation is inadequate. Put on appropriate personal protective equipment.
- For emergency responders** : If specialised clothing is required to deal with the spillage, take note of any information in Section 8 on suitable and unsuitable materials. See also the information in "For non-emergency personnel".

- 6.2 Environmental precautions** : Avoid dispersal of spilt material and runoff and contact with soil, waterways, drains and sewers. Inform the relevant authorities if the product has caused environmental pollution (sewers, waterways, soil or air).

6.3 Methods and material for containment and cleaning up

- Small spill** : Move containers from spill area. Use spark-proof tools and explosion-proof equipment. Avoid dust generation. Do not dry sweep. Vacuum dust with equipment fitted with a HEPA filter and place in a closed, labeled waste container. Place spilled material in a designated, labeled waste container. Dispose of via a licensed waste disposal contractor.
- Large spill** : Move containers from spill area. Use spark-proof tools and explosion-proof equipment. Approach the release from upwind. Prevent entry into sewers, water courses, basements or confined areas. Avoid dust generation. Do not dry sweep. Vacuum dust with equipment fitted with a HEPA filter and place in a closed, labeled waste container. Dispose of via a licensed waste disposal contractor.

- 6.4 Reference to other sections** : See Section 1 for emergency contact information.
See Section 8 for information on appropriate personal protective equipment.
See Section 13 for additional waste treatment information.

SECTION 7: Handling and storage**7.1 Precautions for safe handling**

- Protective measures** : Put on appropriate personal protective equipment (see Section 8). Persons with a history of skin sensitisation problems or asthma, allergies or chronic or recurrent respiratory disease should not be employed in any process in which this product is used. Avoid exposure - obtain special instructions before use. Avoid exposure during pregnancy. Do not handle until all safety precautions have been read and understood. Do not get in eyes or on skin or clothing. Do not ingest. Use only with adequate ventilation. Wear appropriate respirator when ventilation is inadequate. Do not enter storage areas and confined spaces unless adequately ventilated. Keep in the original container or an approved alternative made from a compatible material, kept tightly closed when not in use. Store and use away from heat, sparks, open flame or any other ignition source. Use only non-sparking tools. Empty containers

SECTION 7: Handling and storage

Advice on general occupational hygiene

retain product residue and can be hazardous. Do not reuse container.

: Eating, drinking and smoking should be prohibited in areas where this material is handled, stored and processed. Workers should wash hands and face before eating, drinking and smoking. Remove contaminated clothing and protective equipment before entering eating areas. See also Section 8 for additional information on hygiene measures.

7.2 Conditions for safe storage, including any incompatibilities

Store in accordance with local regulations. Store in a segregated and approved area. Store in original container protected from direct sunlight in a dry, cool and well-ventilated area, away from incompatible materials (see Section 10) and food and drink. Store locked up. Eliminate all ignition sources. Separate from oxidizing materials. Keep container tightly closed and sealed until ready for use. Containers that have been opened must be carefully resealed and kept upright to prevent leakage. Do not store in unlabelled containers. Use appropriate containment to avoid environmental contamination.

7.3 Specific end use(s)

Section 7. Handling and storage: The information in this section contains generic advice and guidance. The list of Identified Uses in Section 1 should be consulted for any available use-specific information provided in the Exposure Scenario(s).

SECTION 8: Exposure controls/personal protection

The list of Identified Uses in Section 1 should be consulted for any available use-specific information provided in the Exposure Scenario(s).

8.1 Control parameters

Occupational exposure limits

Product/ingredient name	Exposure limit values
piperazine	EH40/2005 WELs (United Kingdom (UK), 12/2011). Inhalation sensitiser. STEL: 0.3 mg/m ³ 15 minutes. TWA: 0.1 mg/m ³ 8 hours.

Recommended monitoring procedures : If this product contains ingredients with exposure limits, personal, workplace atmosphere or biological monitoring may be required to determine the effectiveness of the ventilation or other control measures and/or the necessity to use respiratory protective equipment. Reference should be made to monitoring standards, such as the following: European Standard EN 689 (Workplace atmospheres - Guidance for the assessment of exposure by inhalation to chemical agents for comparison with limit values and measurement strategy) European Standard EN 14042 (Workplace atmospheres - Guide for the application and use of procedures for the assessment of exposure to chemical and biological agents) European Standard EN 482 (Workplace atmospheres - General requirements for the performance of procedures for the measurement of chemical agents) Reference to national guidance documents for methods for the determination of hazardous substances will also be required.

DNELs/DMELs

Product/ingredient name	Type	Exposure	Value	Population	Effects
piperazine	DNEL	Short term Dermal	0.042 mg/kg bw/day	Workers	Systemic
	DNEL	Short term Inhalation	0.3 mg/m ³	Workers	Systemic
	DNEL	Short term Inhalation	0.3 mg/m ³	Workers	Local
	DNEL	Long term Dermal	0.014 mg/kg bw/day	Workers	Systemic
	DNEL	Long term	0.1 mg/m ³	Workers	Systemic

SECTION 8: Exposure controls/personal protection

		Inhalation			
	DNEL	Long term Inhalation	0.1 mg/m ³	Workers	Local
	DNEL	Long term Oral	1.5 mg/kg bw/day	Consumers	Systemic

PNECs

Product/ingredient name	Compartment Detail	Value	Method Detail
piperazine	Fresh water	1.25 mg/l	-
	Marine water	0.13 mg/l	-
	Intermittent release	1.25 mg/l	-
	Fresh water sediment	4.5 mg/kg dwt	-
	Fresh water sediment	0.98 mg/kg wwt	-
	Marine water sediment	0.45 mg/kg dwt	-
	Marine water sediment	0.1 mg/kg wwt	-
	Soil	11.5 mg/kg dwt	-
	Soil	8.86 mg/kg wwt	-
	Sewage Treatment Plant	54 mg/l	-
Secondary Poisoning	4.6 mg/kg	-	

8.2 Exposure controls

Appropriate engineering controls : Use only with adequate ventilation. If user operations generate dust, fumes, gas, vapour or mist, use process enclosures, local exhaust ventilation or other engineering controls to keep worker exposure to airborne contaminants below any recommended or statutory limits. The engineering controls also need to keep gas, vapour or dust concentrations below any lower explosive limits. Use explosion-proof ventilation equipment.

Individual protection measures

Hygiene measures : Wash hands, forearms and face thoroughly after handling chemical products, before eating, smoking and using the lavatory and at the end of the working period. Appropriate techniques should be used to remove potentially contaminated clothing. Contaminated work clothing should not be allowed out of the workplace. Wash contaminated clothing before reusing. Ensure that eyewash stations and safety showers are close to the workstation location.

Eye/face protection : Safety eyewear complying with an approved standard should be used when a risk assessment indicates this is necessary to avoid exposure to liquid splashes, mists, gases or dusts. If contact is possible, the following protection should be worn, unless the assessment indicates a higher degree of protection: chemical splash goggles and/or face shield. If inhalation hazards exist, a full-face respirator may be required instead.

Skin protection

Hand protection : Chemical-resistant, impervious gloves complying with an approved standard should be worn at all times when handling chemical products if a risk assessment indicates this is necessary. Considering the parameters specified by the glove manufacturer, check during use that the gloves are still retaining their protective properties. It should be noted that the time to breakthrough for any glove material may be different for different glove manufacturers. In the case of mixtures, consisting of several substances, the protection time of the gloves cannot be accurately estimated.

SECTION 8: Exposure controls/personal protection

	Recommended: Wear suitable gloves tested to EN374. > 8 hours (breakthrough time): butyl rubber (thickness ≥ 0.3 mm), nitrile rubber (thickness ≥ 0.4 mm), Chloroprene (thickness ≥ 0.65 mm).
Body protection	: Personal protective equipment for the body should be selected based on the task being performed and the risks involved and should be approved by a specialist before handling this product. When there is a risk of ignition from static electricity, wear anti-static protective clothing. For the greatest protection from static discharges, clothing should include anti-static overalls, boots and gloves. Refer to European Standard EN 1149 for further information on material and design requirements and test methods.
Other skin protection	: Appropriate footwear and any additional skin protection measures should be selected based on the task being performed and the risks involved and should be approved by a specialist before handling this product.
Respiratory protection	: Use a properly fitted, particulate filter respirator complying with an approved standard if a risk assessment indicates this is necessary. Respirator selection must be based on known or anticipated exposure levels, the hazards of the product and the safe working limits of the selected respirator.
	Recommended: Combination filtering device (DIN EN 14387), Filter type: A-P2.
Environmental exposure controls	: Emissions from ventilation or work process equipment should be checked to ensure they comply with the requirements of environmental protection legislation. In some cases, fume scrubbers, filters or engineering modifications to the process equipment will be necessary to reduce emissions to acceptable levels.

SECTION 9: Physical and chemical properties

9.1 Information on basic physical and chemical properties

Appearance

Physical state	: Solid. [Deliquescent crystals.]
Colour	: Colourless.
Odour	: Amine-like. [Slight]
Odour threshold	: Not available.
pH	: 12 [Conc. (% w/w): 1%]
Melting point/freezing point	: 106°C
Initial boiling point and boiling range	: 147°C
Flash point	: Not applicable.
Evaporation rate	: Not available.
Flammability (solid, gas)	: Highly flammable.
Upper/lower flammability or explosive limits	: Lower: 4% Upper: 14%
Vapour pressure	: 0.039 kPa [room temperature]
Vapour density	: 3 [Air = 1]
Relative density	: Not available.
Density	: 1.1 g/cm ³
Solubility(ies)	: Not available.
Solubility in water	: 150 g/l
Partition coefficient: n-octanol/ water	: -1.24
Auto-ignition temperature	: 320°C
Decomposition temperature	: Not available.
Viscosity	: Not available.
Explosive properties	: Not considered to be a product presenting a risk of explosion.
Oxidising properties	: None.

Piperazine anhydrous, PIP

SECTION 9: Physical and chemical properties**9.2 Other information**

No additional information.

SECTION 10: Stability and reactivity**10.1 Reactivity** : No specific test data related to reactivity available for this product or its ingredients.**10.2 Chemical stability** : The product is stable.**10.3 Possibility of hazardous reactions** : Under normal conditions of storage and use, hazardous reactions will not occur.
Under normal conditions of storage and use, hazardous polymerisation will not occur.**10.4 Conditions to avoid** : Avoid dust generation.
Keep away from heat, sparks and flame. Do not smoke.**10.5 Incompatible materials** : Reactive or incompatible with the following materials: oxidizing materials, metals, acids. Chlorinated hydrocarbon.**10.6 Hazardous decomposition products** : Under normal conditions of storage and use, hazardous decomposition products should not be produced.**SECTION 11: Toxicological information****11.1 Information on toxicological effects**Acute toxicity

Product/ingredient name	Result	Species	Dose	Exposure	Remarks
piperazine	LD50 Oral [OECD 401]	Rat - Male, Female	2600 mg/kg	-	-

Conclusion/Summary : Based on available data, the classification criteria are not met.Irritation/Corrosion

Product/ingredient name	Result	Species	Score	Exposure	Observation	Remarks
piperazine	Skin - Visible necrosis	Rabbit	-	1 hours	14 hours	-

Conclusion/Summary**Skin** : Causes severe burns.**Eyes** : Causes serious eye damage.Sensitisation

Product/ingredient name	Route of exposure	Species	Result	Remarks
piperazine	skin	Guinea pig	Sensitising	-
	Respiratory	Human	Sensitising	-

Conclusion/Summary**Skin** : May cause an allergic skin reaction.**Respiratory** : May cause allergy or asthma symptoms or breathing difficulties if inhaled.Mutagenicity

SECTION 11: Toxicological information

Product/ingredient name	Test	Experiment	Result	Remarks
piperazine	OECD 471	Experiment: In vitro Subject: Bacteria	Negative	-
	-	Experiment: In vivo Subject: Mammalian-Animal	Negative	

Conclusion/Summary : Based on available data, the classification criteria are not met.

Carcinogenicity

Conclusion/Summary : No known significant effects or critical hazards.

Reproductive toxicity

Product/ingredient name	Maternal toxicity	Fertility	Developmental toxin	Species	Dose	Exposure	Remarks
piperazine	-	Positive	-	Rat	Oral: 125 mg/kg NOAEL	-	OECD 416 test substance: CAS no. 142-64-3 (read-across)
	Positive	-	Positive	Rabbit	Oral: 42 mg/kg NOAEL	-	OECD 414 test substance: CAS no. 14538-56-5 (read-across)

Conclusion/Summary : Suspected of damaging fertility or the unborn child.

Teratogenicity

Conclusion/Summary : No known significant effects or critical hazards.

Specific target organ toxicity (single exposure)

Not available.

Specific target organ toxicity (repeated exposure)

Not available.

Aspiration hazard

Not available.

Information on likely routes of exposure : Not available.

Potential acute health effects

- Eye contact** : Causes serious eye damage.
- Inhalation** : May cause allergy or asthma symptoms or breathing difficulties if inhaled.
- Skin contact** : Causes severe burns. May cause an allergic skin reaction.
- Ingestion** : No known significant effects or critical hazards.

Symptoms related to the physical, chemical and toxicological characteristics

- Eye contact** : Adverse symptoms may include the following:
pain
watering
redness

SECTION 11: Toxicological information

- Inhalation** : Adverse symptoms may include the following:
wheezing and breathing difficulties
asthma
reduced foetal weight
increase in foetal deaths
skeletal malformations
- Skin contact** : Adverse symptoms may include the following:
pain or irritation
redness
blistering may occur
reduced foetal weight
increase in foetal deaths
skeletal malformations
- Ingestion** : Adverse symptoms may include the following:
stomach pains
reduced foetal weight
increase in foetal deaths
skeletal malformations

Delayed and immediate effects as well as chronic effects from short and long-term exposure**Short term exposure**

Potential immediate effects : Not available.

Potential delayed effects : Not available.

Long term exposure

Potential immediate effects : Not available.

Potential delayed effects : Not available.

Potential chronic health effects

Product/ingredient name	Result	Species	Dose	Exposure	Remarks
piperazine	Sub-chronic NOAEL Oral	Rat - Male, Female	627 mg/kg	90 days; 7 days per week	test substance: CAS no. 142-64-3 (read- across). Based on available data, the classification criteria are not met.

Conclusion/Summary : Based on available data, the classification criteria are not met.

General : Once sensitized, a severe allergic reaction may occur when subsequently exposed to very low levels.

Carcinogenicity : No known significant effects or critical hazards.

Mutagenicity : No known significant effects or critical hazards.

Teratogenicity : Suspected of damaging the unborn child.

Developmental effects : No known significant effects or critical hazards.

Fertility effects : Suspected of damaging fertility.

Other information : Not available.

SECTION 12: Ecological information**12.1 Toxicity**

Product/ingredient name	Result	Species	Exposure	Remarks
piperazine	Acute EC50 21 mg/l [EU C.2]	Daphnia - Daphnia magna	48 hours	-
	Acute LC50 >1800 mg/l [EU C.1]	Fish - Poecilia reticulata	96 hours	-
	Chronic NOEC >1000 mg/l [OECD 201]	Algae	72 hours	-
	Chronic NOEC 12.5 mg/l [OECD 211]	Daphnia - Daphnia magna	21 days	-

Conclusion/Summary : Based on available data, the classification criteria are not met.

12.2 Persistence and degradability

Product/ingredient name	Test	Result	Dose	Inoculum
piperazine	OECD 301F	70 % - Readily - 28 days	-	-

Conclusion/Summary : Readily biodegradable.

Product/ingredient name	Aquatic half-life	Photolysis	Biodegradability
piperazine	-	-	Readily

12.3 Bioaccumulative potential

Product/ingredient name	LogP _{ow}	BCF	Potential
piperazine	-1.24	-	low

12.4 Mobility in soil

Soil/water partition coefficient (K_{oc}) : 507 to 2233

Mobility : Low mobility in soil predicted, based on the log K_{oc} value.

12.5 Results of PBT and vPvB assessment

PBT : No.
P: No. B: No. T: Yes.

vPvB : No.
vP: No. vB: No.

12.6 Other adverse effects : No known significant effects or critical hazards.

SECTION 13: Disposal considerations

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

13.1 Waste treatment methods**Product**

Methods of disposal : The generation of waste should be avoided or minimised wherever possible. Disposal of this product, solutions and any by-products should at all times comply with the requirements of environmental protection and waste disposal legislation and any regional local authority requirements. Dispose of surplus and non-recyclable products via a licensed waste disposal contractor. Waste should not be disposed of untreated to the sewer unless fully compliant with the requirements of all authorities with jurisdiction.

SECTION 13: Disposal considerations

Hazardous waste : The classification of the product may meet the criteria for a hazardous waste. The allocation of waste identity numbers/waste descriptions must be carried out according to the EEC, specific to the industry and process.





Packaging

Methods of disposal : The generation of waste should be avoided or minimised wherever possible. Waste packaging should be recycled. Incineration or landfill should only be considered when recycling is not feasible.

Special precautions

: This material and its container must be disposed of in a safe way. Care should be taken when handling emptied containers that have not been cleaned or rinsed out. Empty containers or liners may retain some product residues. Avoid dispersal of split material and runoff and contact with soil, waterways, drains and sewers.

SECTION 14: Transport information

	ADR/RID	ADN	IMDG	IATA
14.1 UN number	UN2579	UN2579	UN2579	UN2579
14.2 UN proper shipping name	PIPERAZINE	PIPERAZINE	PIPERAZINE	Piperazine
14.3 Transport hazard class(es)	8	8	8	8
Label				
14.4 Packing group	III	III	III	III
14.5 Environmental hazards	No.	No.	Marine Pollutant: No	No.
Additional information	<p>Hazard identification number 80</p> <p>Limited quantity 5 kg</p> <p>Tunnel code (E)</p>	-	<p>Emergency schedules (EmS) F-A, S-B</p>	<p>Passenger and Cargo Aircraft Quantity limitation: 25 kg Packaging instructions: 860</p> <p>Cargo Aircraft Only Quantity limitation: 100 kg Packaging instructions: 864</p> <p>Limited Quantities - Passenger Aircraft Quantity limitation: 5 kg Packaging instructions: Y845</p> <p>Special provisions A803</p>

14.6 Special precautions for user : **Transport within user's premises:** always transport in closed containers that are upright and secure. Ensure that persons transporting the product know what to do in the event of an accident or spillage.

14.7 Transport in bulk according to Annex II of Marpol and the IBC Code : Not available.

SECTION 15: Regulatory information

15.1 Safety, health and environmental regulations/legislation specific for the substance or mixture

EU Regulation (EC) No. 1907/2006 (REACH)

Annex XIV - List of substances subject to authorisation

Annex XIV

None of the components are listed.

Substances of very high concern

None of the components are listed.

Annex XVII - Restrictions on the manufacture, placing on the market and use of certain dangerous substances, mixtures and articles : Not applicable.

Other EU regulations

Europe inventory : This material is listed or exempted.

Ozone depleting substances (1005/2009/EU)

Not listed.

Prior Informed Consent (PIC) (649/2012/EU)

Not listed.

Seveso Directive

This product is not controlled under the Seveso Directive.

National regulations

Hazchem code : 2X

International regulations

Chemical Weapon Convention List Schedules I, II & III Chemicals

Not listed.

Montreal Protocol (Annexes A, B, C, E)

Not listed.

Stockholm Convention on Persistent Organic Pollutants

Not listed.

Rotterdam Convention on Prior Informed Consent (PIC)

Not listed.

UNECE Aarhus Protocol on POPs and Heavy Metals

Not listed.

International lists

National inventory

Australia : This material is listed or exempted.

Canada : This material is listed or exempted.

China : This material is listed or exempted.

Japan : **Japan inventory (ENCS):**
This material is listed or exempted.

Japan inventory (ISHL):
This material is listed or exempted.

New Zealand : This material is listed or exempted.

Philippines : This material is listed or exempted.

Republic of Korea : This material is listed or exempted.

Taiwan : This material is listed or exempted.

United States : This material is listed or exempted.

SECTION 15: Regulatory information

15.2 Chemical safety assessment : Complete.

SECTION 16: Other information

✔ Indicates information that has changed from previously issued version.

Abbreviations and acronyms :

- ATE = Acute Toxicity Estimate
- CLP = Classification, Labelling and Packaging Regulation [Regulation (EC) No. 1272/2008]
- DMEL = Derived Minimal Effect Level
- DNEL = Derived No Effect Level
- EUH statement = CLP-specific Hazard statement
- PBT = Persistent, Bioaccumulative and Toxic
- PNEC = Predicted No Effect Concentration
- RRN = REACH Registration Number
- vPvB = Very Persistent and Very Bioaccumulative

Procedure used to derive the classification according to Regulation (EC) No. 1272/2008 [CLP/GHS]

Classification	Justification
Flam. Sol. 1, H228 Skin Corr. 1B, H314 Eye Dam. 1, H318 Resp. Sens. 1B, H334 Skin Sens. 1B, H317 Repr. 2, H361fd (Fertility and Unborn child)	Expert judgment Regulatory data On basis of test data Expert judgment Expert judgment Regulatory data

Full text of abbreviated H statements

H228	Flammable solid.
H314	Causes severe skin burns and eye damage.
H317	May cause an allergic skin reaction.
H318	Causes serious eye damage.
H334	May cause allergy or asthma symptoms or breathing difficulties if inhaled.
H361fd	Suspected of damaging fertility. Suspected of damaging the unborn child.

Full text of classifications [CLP/GHS]

Eye Dam. 1, H318 Flam. Sol. 1, H228 Repr. 2, H361fd	SERIOUS EYE DAMAGE/EYE IRRITATION - Category 1 FLAMMABLE SOLIDS - Category 1 REPRODUCTIVE TOXICITY (Fertility and Unborn child) - Category 2
Resp. Sens. 1B, H334 Skin Corr. 1B, H314 Skin Sens. 1B, H317	RESPIRATORY SENSITISATION - Category 1B SKIN CORROSION/IRRITATION - Category 1B SKIN SENSITISATION - Category 1B

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Notice to reader

To the best of our knowledge, the information contained herein is accurate. However, neither the above-named supplier, nor any of its subsidiaries, assumes any liability whatsoever for the accuracy or completeness of the information contained herein.

Final determination of suitability of any material is the sole responsibility of the user. All materials may present unknown hazards and should be used with caution. Although certain hazards are described herein, we cannot guarantee that these are the only hazards that exist.

Annex to the extended Safety Data Sheet (eSDS)

Industrial

Identification of the substance or mixture

Product definition : Mono-constituent substance
Product name : Piperazine anhydrous, PIP

Section 1 - Title

Short title of the exposure scenario : Manufacture of substance - Industrial.
List of use descriptors : **Identified use name: ES01:** Manufacture of substance - Industrial: SU03; PROC01, PROC08a, PROC08b, PROC15; ERC01
Process Category: PROC01, PROC08a, PROC08b, PROC15
Substance supplied to that use in form of: As such
Subsequent service life relevant for that use: No.
Environmental Release Category: ERC01
Environmental contributing scenarios : **ERC01 - Manufacture of substances**
Health Contributing scenarios : **PROC01 - Use in closed process, no likelihood of exposure**
PROC08a - Transfer of substance or preparation (charging/discharging) from/to vessels/large containers at non-dedicated facilities
PROC08b - Transfer of substance or preparation (charging/discharging) from/to vessels/large containers at dedicated facilities
PROC15 - Use as laboratory reagent

Number of the ES	: 1
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Section 2 - Exposure controls

Contributing scenario controlling environmental exposure for 1: ERC01 - Manufacture of substances

Amounts used : Amounts used: 18600 tonnes/year.
 Fraction used at main source: 100%.
 Regional use tonnage: 100%.
Frequency and duration of use : 365 days.
Environment factors not influenced by risk management : River flow rate: 18000 m³/d.
Other conditions affecting environmental exposure : Release to air from process: 0.1%.
 Release to waste water from process: 0.2%.
 Release to soil from process: 0.1%.
Technical conditions and measures at process level (source) to prevent release : Wet scrubber - gas removal (Scrubber water should be led to waste).
Technical on-site conditions and measures to reduce or limit discharges, air emissions and releases to soil : Waste water treatment: Sewage Treatment Plant.
 Incineration, Ion exchange, Efficiency of at least 88%.
Organisational measures to prevent/limit release from site : Do not allow to enter drains or watercourses. Do not allow contact with soil, surface or groundwater.
Conditions and measures related to sewage treatment plant : Discharge rate: 2000 m³/d.

Contributing scenario controlling worker exposure for 2: PROC01 - Use in closed process, no likelihood of exposure

Product characteristics	: Vapour pressure: 39 Pa.
Concentration of substance in mixture or article	: Covers percentage substance in the product up to 100%.
Physical state	: Low volatile liquid.
Frequency and duration of use/exposure	: Exposure duration per day: > 4 hours. Frequency: ≤ 240 days per year.
Human factors not influenced by risk management	: Exposed skin surface assumed: Palm of one hand (240 cm ²).
Other conditions affecting workers exposure	: Outdoor use / Indoor use.
Conditions and measures related to personal protection, hygiene and health evaluation	
Advice on general occupational hygiene	: Ensure good industrial hygiene. When using do not eat, drink or smoke. Wash hands before breaks and after work.
Personal protection	: Use suitable eye protection. Wear suitable protective clothing. Avoid contact with skin. Wear chemical-resistant gloves (tested to EN374) in combination with intensive management supervision controls. (Efficiency of at least 99%).

Contributing scenario controlling worker exposure for 3: PROC08a - Transfer of substance or preparation (charging/discharging) from/to vessels/large containers at non-dedicated facilities

Product characteristics	: Vapour pressure: 39 Pa.
Concentration of substance in mixture or article	: Covers percentage substance in the product up to 100%.
Physical state	: Low volatile liquid.
Frequency and duration of use/exposure	: Exposure duration per day: 5 min. Frequency: ≤ 240 days per year.
Human factors not influenced by risk management	: Exposed skin surface assumed: Palm of both hands (480 cm ²).
Other conditions affecting workers exposure	: Outdoor use / Indoor use.
Technical conditions and measures to control dispersion from source towards the worker	: Good standard of general ventilation. Further parameters (RISKOFDERM v2.1): Frequency: rare contact. Nature of contact: light contact. Level of automation: Manual. Application rate: 0.2 L/min. Contact time: 5 min.
Conditions and measures related to personal protection, hygiene and health evaluation	
Advice on general occupational hygiene	: Ensure good industrial hygiene. When using do not eat, drink or smoke. Wash hands before breaks and after work.
Personal protection	: Use suitable eye protection. Wear suitable protective clothing. Avoid contact with skin. Wear chemical-resistant gloves (tested to EN374) in combination with intensive management supervision controls. (Efficiency of at least 99%).

Contributing scenario controlling worker exposure for 4: PROC08b - Transfer of substance or preparation (charging/discharging) from/to vessels/large containers at dedicated facilities

Product characteristics	: Vapour pressure: 39 Pa.
Concentration of substance in mixture or article	: Covers percentage substance in the product up to 100%.
Physical state	: Low volatile liquid.

Piperazine anhydrous, PIP	Exposure Scenario: 1	Manufacture of substance - Industrial.
Frequency and duration of use/exposure	: Exposure duration per day: > 4 hours. Frequency: ≤ 240 days per year.	
Human factors not influenced by risk management	: Exposed skin surface assumed: Palm of both hands (480 cm ²).	
Other conditions affecting workers exposure	: Indoor use.	
Technical conditions and measures to control dispersion from source towards the worker	: Local exhaust ventilation - efficiency of at least 97%.	
Conditions and measures related to personal protection, hygiene and health evaluation		
Advice on general occupational hygiene	: Ensure good industrial hygiene. When using do not eat, drink or smoke. Wash hands before breaks and after work.	
Personal protection	: Use suitable eye protection. Wear suitable protective clothing. Avoid contact with skin. Wear chemical-resistant gloves (tested to EN374) in combination with intensive management supervision controls. (Efficiency of at least 99%).	
Contributing scenario controlling worker exposure for 5: PROC15 - Use as laboratory reagent		
Product characteristics	: Vapour pressure: 39 Pa.	
Concentration of substance in mixture or article	: Covers percentage substance in the product up to 100%.	
Physical state	: Low volatile liquid.	
Frequency and duration of use/exposure	: Exposure duration per day: 15 min - 1 hour. Frequency: ≤ 240 days per year.	
Human factors not influenced by risk management	: Exposed skin surface assumed: Palm of one hand (240 cm ²).	
Other conditions affecting workers exposure	: Indoor use.	
Technical conditions and measures to control dispersion from source towards the worker	: Local exhaust ventilation - efficiency of at least 90%.	
Conditions and measures related to personal protection, hygiene and health evaluation		
Advice on general occupational hygiene	: Ensure good industrial hygiene. When using do not eat, drink or smoke. Wash hands before breaks and after work.	
Personal protection	: Use suitable eye protection. Wear suitable protective clothing. Avoid contact with skin. Wear chemical-resistant gloves (tested to EN374) in combination with intensive management supervision controls. (Efficiency of at least 99%).	

Section 3 - Exposure estimation and reference to its source

Exposure estimation and reference to its source - Environment: 1: ERC01 - Manufacture of substances	
Exposure assessment (environment):	: EUSES
Exposure estimation	: Freshwater: 0.645 mg/l. Risk characterisation ratio (PEC/PNEC): 0.516.
	: Freshwater sediment: 0.505 mg/kg wwt. Risk characterisation ratio (PEC/PNEC): 0.515.
	: Marine water: 0.0645 mg/l. Risk characterisation ratio (PEC/PNEC): 0.496.
	: Marine water sediment: 0.0505 mg/kg wwt. Risk characterisation ratio (PEC/PNEC): 0.505.

Piperazine anhydrous, PIP	Exposure Scenario: 1	Manufacture of substance - Industrial.
Remark	Sewage Treatment Plant: 6.43 mg/l. Risk characterisation ratio (PEC/PNEC): 0.119. Soil: 0.00269 mg/kg wwt. Risk characterisation ratio (PEC/PNEC): 0.000304. : Based on the applied RMMs the risk towards environment is sufficiently controlled (RCR < 1).	
Exposure estimation and reference to its source - Workers: 2: PROC01 - Use in closed process, no likelihood of exposure		
Exposure assessment (human):	: ECETOC TRA v2.0 worker; modified version.	
Exposure estimation	Worker - dermal, long-term - systemic: 0.003 mg/kg bw/day. Risk characterisation ratio: 0.245. Worker - inhalative, long-term - systemic: < 0.030 mg/m ³ . Risk characterisation ratio: < 0.300. Worker - combined, long-term - systemic: < 0.545.	
Remark	: Based on the applied RMMs the risk towards humans is sufficiently controlled (RCR < 1).	
Exposure estimation and reference to its source - Workers: 3: PROC08a - Transfer of substance or preparation (charging/discharging) from/to vessels/large containers at non-dedicated facilities		
Exposure assessment (human):	Dermal: RISKOFDERM v2.1. Inhalation: ECETOC TRA v2.0 worker; modified version.	
Exposure estimation	Worker - dermal, long-term - systemic: 0.003 mg/kg bw/day. Risk characterisation ratio: 0.214. Worker - inhalative, long-term - systemic: < 0.030 mg/m ³ . Risk characterisation ratio: < 0.300. Worker - combined, long-term - systemic: < 0.514.	
Remark	: Based on the applied RMMs the risk towards humans is sufficiently controlled (RCR < 1).	
Exposure estimation and reference to its source - Workers: 4: PROC08b - Transfer of substance or preparation (charging/discharging) from/to vessels/large containers at dedicated facilities		
Exposure assessment (human):	: ECETOC TRA v2.0 worker; modified version.	
Exposure estimation	Worker - dermal, long-term - systemic: 0.007 mg/kg bw/day. Risk characterisation ratio: 0.490. Worker - inhalative, long-term - systemic: < 0.030 mg/m ³ . Risk characterisation ratio: < 0.300. Worker - combined, long-term - systemic: < 0.790.	
Remark	: Based on the applied RMMs the risk towards humans is sufficiently controlled (RCR < 1).	
Exposure estimation and reference to its source - Workers: 5: PROC15 - Use as laboratory reagent		
Exposure assessment (human):	: ECETOC TRA v2.0 worker; modified version.	

Piperazine anhydrous, PIP	Exposure Scenario: 1	Manufacture of substance - Industrial.
Exposure estimation	<p>Worker - dermal, long-term - systemic: 0.0003 mg/kg bw/day. Risk characterisation ratio: 0.024.</p> <p>Worker - inhalative, long-term - systemic: < 0.030 mg/m³. Risk characterisation ratio: < 0.300.</p> <p>Worker - combined, long-term - systemic: < 0.324.</p>	
Remark	: Based on the applied RMMs the risk towards humans is sufficiently controlled (RCR < 1).	

Section 4 - Guidance to DU to evaluate whether he works inside the boundaries set by the ES

General	: The immediate downstream user is required to evaluate whether the operational conditions and risk management measures described in the exposure scenario fit to his use. If other OC/RMM are adopted, the user has to ensure that risks are managed to at least equivalent levels. The risk assessment methods/tools given in section 3 may be used for this evaluation.
Environment	: Guidance is based on assumed operating conditions which may not be applicable to all sites; thus, scaling may be necessary to define appropriate site-specific risk management measures.

Annex to the extended Safety Data Sheet (eSDS)

Industrial

Identification of the substance or mixture

Product definition : Mono-constituent substance
Product name : Piperazine anhydrous, PIP

Section 1 - Title

Short title of the exposure scenario : Flaking of substance - Industrial.
List of use descriptors : **Identified use name: ES02:** Flaking of substance - Industrial: SU03; PROC03, PROC08b; ERC01
Process Category: PROC03, PROC08b
Substance supplied to that use in form of: As such
Subsequent service life relevant for that use: No.
Environmental Release Category: ERC01
Environmental contributing scenarios : **ERC01 - Manufacture of substances**
Health Contributing scenarios : **PROC03 - Use in closed batch process (synthesis or formulation)**
PROC08b - Transfer of substance or preparation (charging/discharging) from/to vessels/large containers at dedicated facilities

Number of the ES	: 2
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Section 2 - Exposure controls

Contributing scenario controlling environmental exposure for 1: ERC01 - Manufacture of substances

Amounts used	: Amounts used: 18600 tonnes/year. Fraction used at main source: 100%. Regional use tonnage: 100%.
Frequency and duration of use	: 365 days.
Environment factors not influenced by risk management	: River flow rate: 18000 m ³ /d.
Other conditions affecting environmental exposure	: Release to air from process: 0.1%. Release to waste water from process: 0.2%. Release to soil from process: 0.1%.
Technical conditions and measures at process level (source) to prevent release	: Wet scrubber - gas removal (Scrubber water should be led to waste).
Technical on-site conditions and measures to reduce or limit discharges, air emissions and releases to soil	: Waste water treatment: Sewage Treatment Plant. Incineration, Ion exchange, Efficiency of at least 88%.
Organisational measures to prevent/limit release from site	: Do not allow to enter drains or watercourses. Do not allow contact with soil, surface or groundwater.
Conditions and measures related to sewage treatment plant	: Discharge rate: 2000 m ³ /d.

Contributing scenario controlling worker exposure for 2: PROC03 - Use in closed batch process (synthesis or formulation)

Product characteristics	: Vapour pressure: 39 Pa.
Concentration of substance in mixture or article	: Covers percentage substance in the product up to 100%.
Physical state	: Solid, medium dustiness.
Frequency and duration of use/exposure	: Exposure duration per day: > 4 hours. Frequency: ≤ 240 days per year.
Human factors not influenced by risk management	: Exposed skin surface assumed: Palm of one hand (240 cm ²).
Other conditions affecting workers exposure	: Indoor use.
Technical conditions and measures to control dispersion from source towards the worker	: Local exhaust ventilation - efficiency of at least 90%.

Conditions and measures related to personal protection, hygiene and health evaluation

Advice on general occupational hygiene	: Ensure good industrial hygiene. When using do not eat, drink or smoke. Wash hands before breaks and after work.
Personal protection	: Use suitable eye protection. Wear suitable protective clothing. Avoid contact with skin. Wear chemical-resistant gloves (tested to EN374) in combination with intensive management supervision controls. (Efficiency of at least 99%).

Contributing scenario controlling worker exposure for 3: PROC08b - Transfer of substance or preparation (charging/discharging) from/to vessels/large containers at dedicated facilities

Product characteristics	: Vapour pressure: 39 Pa.
Concentration of substance in mixture or article	: Covers percentage substance in the product up to 100%.
Physical state	: Solid, medium dustiness.
Frequency and duration of use/exposure	: Exposure duration per day: > 4 hours. Frequency: ≤ 240 days per year.
Human factors not influenced by risk management	: Exposed skin surface assumed: Palm of both hands (480 cm ²).
Other conditions affecting workers exposure	: Indoor use.
Technical conditions and measures to control dispersion from source towards the worker	: Local exhaust ventilation - efficiency of at least 95%.

Conditions and measures related to personal protection, hygiene and health evaluation

Advice on general occupational hygiene	: Ensure good industrial hygiene. When using do not eat, drink or smoke. Wash hands before breaks and after work.
Personal protection	: Use suitable eye protection. Wear suitable protective clothing. Avoid contact with skin. Wear chemical-resistant gloves (tested to EN374) in combination with intensive management supervision controls. (Efficiency of at least 99%).

Section 3 - Exposure estimation and reference to its source

Exposure estimation and reference to its source - Environment: 1: ERC01 - Manufacture of substances

Exposure assessment (environment): : EUSES

Exposure estimation : Freshwater: 0.645 mg/l.
Risk characterisation ratio (PEC/PNEC): 0.516.

Freshwater sediment: 0.505 mg/kg wwt.
Risk characterisation ratio (PEC/PNEC): 0.515.

Marine water: 0.0645 mg/l.
Risk characterisation ratio (PEC/PNEC): 0.496.

Marine water sediment: 0.0505 mg/kg wwt.
Risk characterisation ratio (PEC/PNEC): 0.505.

Sewage Treatment Plant: 6.43 mg/l.
Risk characterisation ratio (PEC/PNEC): 0.119.

Soil: 0.00269 mg/kg wwt.
Risk characterisation ratio (PEC/PNEC): 0.000304.

Remark : Based on the applied RMMs the risk towards environment is sufficiently controlled (RCR < 1).

Exposure estimation and reference to its source - Workers: 2: PROC03 - Use in closed batch process (synthesis or formulation)

Exposure assessment (human): : ECETOC TRA v2.0 worker; modified version.

Exposure estimation : **Worker - dermal, long-term - systemic:** 0.0003 mg/kg bw/day.
Risk characterisation ratio: 0.024.

Worker - inhalative, long-term - systemic: < 0.020 mg/m³.
Risk characterisation ratio: < 0.200.

Worker - combined, long-term - systemic: < 0.224.

Remark : Based on the applied RMMs the risk towards humans is sufficiently controlled (RCR < 1).

Exposure estimation and reference to its source - Workers: 3: PROC08b - Transfer of substance or preparation (charging/discharging) from/to vessels/large containers at dedicated facilities

Exposure assessment (human): : ECETOC TRA v2.0 worker; modified version.

Exposure estimation : **Worker - dermal, long-term - systemic:** 0.007 mg/kg bw/day.
Risk characterisation ratio: 0.49.

Worker - inhalative, long-term - systemic: < 0.020 mg/m³.
Risk characterisation ratio: < 0.200.

Worker - combined, long-term - systemic: < 0.690.

Remark : Based on the applied RMMs the risk towards humans is sufficiently controlled (RCR < 1).

Section 4 - Guidance to DU to evaluate whether he works inside the boundaries set by the ES

General

: The immediate downstream user is required to evaluate whether the operational conditions and risk management measures described in the exposure scenario fit to his use. If other OC/RMM are adopted, the user has to ensure that risks are managed to at least equivalent levels. The risk assessment methods/tools given in section 3 may be used for this evaluation.

Environment

: Guidance is based on assumed operating conditions which may not be applicable to all sites; thus, scaling may be necessary to define appropriate site-specific risk management measures.

Annex to the extended Safety Data Sheet (eSDS)

Industrial

Identification of the substance or mixture

Product definition : Mono-constituent substance
Product name : Piperazine anhydrous, PIP

Section 1 - Title

Short title of the exposure scenario : Use as an intermediate + Polymerisation - Industrial.

List of use descriptors : **Identified use name: ES03:** Use as an intermediate + Polymerisation - Industrial: SU03; PROC01, PROC08a, PROC08b, PROC15; ERC06a, ERC06c
Process Category: PROC01, PROC08a, PROC08b, PROC15
Substance supplied to that use in form of: As such
Subsequent service life relevant for that use: No.
Environmental Release Category: ERC06a, ERC06c

Environmental contributing scenarios : **ERC06a - Industrial use resulting in manufacture of another substance (use of intermediates)**
ERC06c - Industrial use of monomers for manufacture of thermoplastics

Health Contributing scenarios : **PROC01 - Use in closed process, no likelihood of exposure**
PROC08a - Transfer of substance or preparation (charging/discharging) from/to vessels/large containers at non-dedicated facilities
PROC08b - Transfer of substance or preparation (charging/discharging) from/to vessels/large containers at dedicated facilities
PROC15 - Use as laboratory reagent

Number of the ES	: 3
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Section 2 - Exposure controls

Contributing scenario controlling environmental exposure for 1: ERC06a - Industrial use resulting in manufacture of another substance (use of intermediates)

Amounts used : Amounts used: 15000 tonnes/year.
 Fraction used at main source: 20%.
 Regional use tonnage: 100%.

Frequency and duration of use : 220 days.

Environment factors not influenced by risk management : River flow rate: 18000 m³/d.

Other conditions affecting environmental exposure : Release to air from process: 0.01%.
 Release to waste water from process: 0.7%.
 Release to soil from process: 0.01%.
 SPERC: Intermediate. (EU Emission Scenario Documents)

Technical conditions and measures at process level (source) to prevent release : Wet scrubber - gas removal (Scrubber water should be led to waste).

Technical on-site conditions and measures to reduce or limit discharges, air emissions and releases to soil : Waste water treatment: Sewage Treatment Plant.

Organisational measures to prevent/limit release from site : Do not allow to enter drains or watercourses. Do not allow contact with soil, surface or groundwater.

Conditions and measures related to sewage treatment plant : Municipal Sewage Treatment Plant: Discharge rate: 2000 m³/d.

Contributing scenario controlling environmental exposure for 2: ERC06c - Industrial use of monomers for manufacture of thermoplastics

Amounts used	: Amounts used: 15000 tonnes/year. Fraction used at main source: 20%. Regional use tonnage: 100%.
Frequency and duration of use	: 220 days.
Environment factors not influenced by risk management	: River flow rate: 18000 m ³ /d.
Other conditions affecting environmental exposure	: Release to air from process: 0.01%. Release to waste water from process: 0.7%. Release to soil from process: 0.01%. SPERC: Intermediate. (EU Emission Scenario Documents)
Technical conditions and measures at process level (source) to prevent release	: Wet scrubber - gas removal (Scrubber water should be led to waste).
Technical on-site conditions and measures to reduce or limit discharges, air emissions and releases to soil	: Waste water treatment: Sewage Treatment Plant.
Organisational measures to prevent/limit release from site	: Do not allow to enter drains or watercourses. Do not allow contact with soil, surface or groundwater.
Conditions and measures related to sewage treatment plant	: Municipal Sewage Treatment Plant: Discharge rate: 2000 m ³ /d.

Contributing scenario controlling worker exposure for 3: PROC01 - Use in closed process, no likelihood of exposure

Product characteristics	: Vapour pressure: 39 Pa.
Concentration of substance in mixture or article	: Covers percentage substance in the product up to 100%.
Physical state	: Solid in solution (water, Low volatile liquid), or Flakes. (Solid, medium dustiness).
Frequency and duration of use/exposure	: Exposure duration per day: > 4 hours. Frequency: ≤ 240 days per year.
Human factors not influenced by risk management	: Exposed skin surface assumed: Palm of one hand (240 cm ²).
Other conditions affecting workers exposure	: Indoor use.
Technical conditions and measures at process level (source) to prevent release	: Use in closed process.
Technical conditions and measures to control dispersion from source towards the worker	: Local exhaust ventilation - efficiency of at least 90%.
Conditions and measures related to personal protection, hygiene and health evaluation	
Advice on general occupational hygiene	: Ensure good industrial hygiene. When using do not eat, drink or smoke. Wash hands before breaks and after work.
Personal protection	: Use suitable eye protection. Wear suitable protective clothing. Avoid contact with skin. Wear chemical-resistant gloves (tested to EN374) in combination with intensive management supervision controls. (Efficiency of at least 99%).

Contributing scenario controlling worker exposure for 4: PROC08a - Transfer of substance or preparation (charging/discharging) from/to vessels/large containers at non-dedicated facilities

Product characteristics	: Vapour pressure: 39 Pa.
Concentration of substance in mixture or article	: Covers percentage substance in the product up to 100%.
Physical state	: Low volatile liquid.
Frequency and duration of use/exposure	: Exposure duration per day: < 15 min. Frequency: ≤ 240 days per year.
Human factors not influenced by risk management	: Exposed skin surface assumed: Palm of both hands (480 cm ²).
Other conditions affecting workers exposure	: Outdoor use / Indoor use.
Technical conditions and measures to control dispersion from source towards the worker	: Local exhaust ventilation - efficiency of at least 90%. Further parameters (RISKOFDERM v2.1): Frequency: rare contact. Nature of contact: light contact. Level of automation: Manual. Application rate: 0.2 L/min. Contact time: 5 min.

Conditions and measures related to personal protection, hygiene and health evaluation

Advice on general occupational hygiene	: Ensure good industrial hygiene. When using do not eat, drink or smoke. Wash hands before breaks and after work.
Personal protection	: Use suitable eye protection. Wear suitable protective clothing. Avoid contact with skin. Wear chemical-resistant gloves (tested to EN374) in combination with intensive management supervision controls. (Efficiency of at least 99%).
Respiratory protection	: Wear respiratory protection. (Efficiency of at least 95%).

Contributing scenario controlling worker exposure for 5: PROC08b - Transfer of substance or preparation (charging/discharging) from/to vessels/large containers at dedicated facilities

Product characteristics	: Vapour pressure: 39 Pa.
Concentration of substance in mixture or article	: Covers percentage substance in the product up to 100%.
Physical state	: Low volatile liquid.
Frequency and duration of use/exposure	: Exposure duration per day: < 8 hours. Frequency: ≤ 240 days per year.
Human factors not influenced by risk management	: Exposed skin surface assumed: Palm of both hands (480 cm ²).
Other conditions affecting workers exposure	: Indoor use. Room size: Assumes large workrooms. (ART)
Technical conditions and measures at process level (source) to prevent release	: Containment: Open process, Effectiveness of containment: Medium (99%). (ART) Transfer of liquid products - falling liquids, Splash loading. (ART) Transferring 100 - 1000 L/min. (ART)
Technical conditions and measures to control dispersion from source towards the worker	: Mechanical ventilation giving at least 1 ach (air changes per hour). (ART) Further parameters (RISKOFDERM v2.1): Frequency: rare contact. Nature of contact: light contact. Level of automation: Automated task / Semi-automated task. Application rate: 0.002 L/min. Contact time: 10 min.

Conditions and measures related to personal protection, hygiene and health evaluation

Advice on general occupational hygiene	: Ensure good industrial hygiene. When using do not eat, drink or smoke. Wash hands before breaks and after work.
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Piperazine anhydrous, PIP	Exposure Scenario: 3	Use as an intermediate + Polymerisation - Industrial.
Personal protection	: Use suitable eye protection. Wear suitable protective clothing. Avoid contact with skin. Wear chemical-resistant gloves (tested to EN374) in combination with intensive management supervision controls. (Efficiency of at least 99%).	
Contributing scenario controlling worker exposure for 6: PROC15 - Use as laboratory reagent		
Product characteristics	: Vapour pressure: 39 Pa.	
Concentration of substance in mixture or article	: Covers percentage substance in the product up to 100%.	
Physical state	: Low volatile liquid.	
Frequency and duration of use/exposure	: Exposure duration per day: 15 min - 1 hour. Frequency: ≤ 240 days per year.	
Human factors not influenced by risk management	: Exposed skin surface assumed: Palm of one hand (240 cm ²).	
Other conditions affecting workers exposure	: Indoor use.	
Technical conditions and measures to control dispersion from source towards the worker	: Local exhaust ventilation - efficiency of at least 90%.	
Conditions and measures related to personal protection, hygiene and health evaluation		
Advice on general occupational hygiene	: Ensure good industrial hygiene. When using do not eat, drink or smoke. Wash hands before breaks and after work.	
Personal protection	: Use suitable eye protection. Wear suitable protective clothing. Avoid contact with skin. Wear chemical-resistant gloves (tested to EN374) in combination with intensive management supervision controls. (Efficiency of at least 99%).	

Section 3 - Exposure estimation and reference to its source

Exposure estimation and reference to its source - Environment: 1: ERC06a - Industrial use resulting in manufacture of another substance (use of intermediates)	
Exposure assessment (environment):	: EUSES
Exposure estimation	: Freshwater: 0.604 mg/l. Risk characterisation ratio (PEC/PNEC): 0.483. Freshwater sediment: 0.473 mg/kg wwt. Risk characterisation ratio (PEC/PNEC): 0.483. Marine water: 0.0604 mg/l. Risk characterisation ratio (PEC/PNEC): 0.465. Marine water sediment: 0.0473 mg/kg wwt. Risk characterisation ratio (PEC/PNEC): 0.473. Sewage Treatment Plant: 6.05 mg/l. Risk characterisation ratio (PEC/PNEC): 0.112. Soil: 0.0000558 mg/kg wwt. Risk characterisation ratio (PEC/PNEC): 0.00000630.
Remark	: Based on the applied RMMs the risk towards environment is sufficiently controlled (RCR < 1).

Exposure estimation and reference to its source - Environment: 2: ERC06c - Industrial use of monomers for manufacture of thermoplastics

Exposure assessment (environment): : EUSES

Exposure estimation : Freshwater: 0.604 mg/l.
Risk characterisation ratio (PEC/PNEC): 0.483.

Freshwater sediment: 0.473 mg/kg wwt.
Risk characterisation ratio (PEC/PNEC): 0.483.

Marine water: 0.0604 mg/l.
Risk characterisation ratio (PEC/PNEC): 0.465.

Marine water sediment: 0.0473 mg/kg wwt.
Risk characterisation ratio (PEC/PNEC): 0.473.

Sewage Treatment Plant: 6.05 mg/l.
Risk characterisation ratio (PEC/PNEC): 0.112.

Soil: 0.0000558 mg/kg wwt.
Risk characterisation ratio (PEC/PNEC): 0.00000630.

Remark : Based on the applied RMMs the risk towards environment is sufficiently controlled (RCR < 1).

Exposure estimation and reference to its source - Workers: 3: PROC01 - Use in closed process, no likelihood of exposure

Exposure assessment (human): : ECETOC TRA v2.0 worker; modified version

Exposure estimation : **Worker - dermal, long-term - systemic:** 0.0003 mg/kg bw/day.
Risk characterisation ratio: 0.024.

Worker - inhalative, long-term - systemic: 0.035mg/m³.
Risk characterisation ratio: 0.358.

Worker - combined, long-term - systemic: 0.382.

Remark : Based on the applied RMMs the risk towards humans is sufficiently controlled (RCR < 1).

Exposure estimation and reference to its source - Workers: 4: PROC08a - Transfer of substance or preparation (charging/discharging) from/to vessels/large containers at non-dedicated facilities

Exposure assessment (human): : Dermal: RISKOFDERM v2.1.
Inhalation: ECETOC TRA v2.0 worker; modified version.

Exposure estimation : **Worker - dermal, long-term - systemic:** 0.0013 mg/kg bw/day.
Risk characterisation ratio: 0.098.

Worker - inhalative, long-term - systemic: 0.0448 mg/m³.
Risk characterisation ratio: 0.448.

Worker - combined, long-term - systemic: 0.546.

Remark : Based on the applied RMMs the risk towards humans is sufficiently controlled (RCR < 1).

Piperazine anhydrous, PIP	Exposure Scenario: 3	Use as an intermediate + Polymerisation - Industrial.
Exposure estimation and reference to its source - Workers: 5: PROC08b - Transfer of substance or preparation (charging/discharging) from/to vessels/large containers at dedicated facilities		
Exposure assessment (human):	: Dermal: RISKOFDERM v2.1. Inhalation: ART v1.0 (90th percentile 8 hour TWA).	
Exposure estimation	: Worker - dermal, long-term - systemic: 0.004mg/kg bw/day. Risk characterisation ratio: 0.286.	
	: Worker - inhalative, long-term - systemic: 0.047 mg/m ³ . Risk characterisation ratio: 0.47.	
	: Worker - combined, long-term - systemic: 0.756.	
Remark	: Based on the applied RMMs the risk towards humans is sufficiently controlled (RCR < 1).	
Exposure estimation and reference to its source - Workers: 6: PROC15 - Use as laboratory reagent		
Exposure assessment (human):	: Dermal: ECETOC TRA v2.0 worker; modified version. Inhalation: measured data.	
Exposure estimation	: Worker - dermal, long-term - systemic: 0.0003 mg/kg bw/day. Risk characterisation ratio: 0.024.	
	: Worker - inhalative, long-term - systemic (measured data/external): < 0.030 mg/m ³ . Risk characterisation ratio: < 0.300.	
	: Worker - combined, long-term - systemic: < 0.324.	
Remark	: Based on the applied RMMs the risk towards humans is sufficiently controlled (RCR < 1).	

Section 4 - Guidance to DU to evaluate whether he works inside the boundaries set by the ES

General	: The immediate downstream user is required to evaluate whether the operational conditions and risk management measures described in the exposure scenario fit to his use. If other OC/RMM are adopted, the user has to ensure that risks are managed to at least equivalent levels. The risk assessment methods/tools given in section 3 may be used for this evaluation.
Environment	: Guidance is based on assumed operating conditions which may not be applicable to all sites; thus, scaling may be necessary to define appropriate site-specific risk management measures. Further details on scaling and control technologies are provided in SpERC factsheet (http://cefic.org/en/reach-for-industries-libraries.html).

Annex to the extended Safety Data Sheet (eSDS)

Industrial

Identification of the substance or mixture

Product definition : Mono-constituent substance
Product name : Piperazine anhydrous, PIP

Section 1 - Title

Short title of the exposure scenario : Formulation - Industrial.

List of use descriptors : **Identified use name: ES04:** Formulation - Industrial: SU10; PROC01, PROC08a, PROC08b, PROC15; ERC02
Process Category: PROC01, PROC08a, PROC08b, PROC15
Substance supplied to that use in form of: As such
Subsequent service life relevant for that use: No.
Environmental Release Category: ERC02

Environmental contributing scenarios : **ERC02 - Formulation of preparations**

Health Contributing scenarios : **PROC01 - Use in closed process, no likelihood of exposure**
PROC08a - Transfer of substance or preparation (charging/discharging) from/to vessels/large containers at non-dedicated facilities
PROC08b - Transfer of substance or preparation (charging/discharging) from/to vessels/large containers at dedicated facilities
PROC15 - Use as laboratory reagent

Number of the ES	: 4
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Section 2 - Exposure controls

Contributing scenario controlling environmental exposure for 1: ERC02 - Formulation of preparations

Amounts used	: Amounts used: 1600 tonnes/year. Fraction used at main source: 100%. Regional use tonnage: 100%.
Frequency and duration of use	: 220 days.
Environment factors not influenced by risk management	: River flow rate: 18000 m ³ /d.
Other conditions affecting environmental exposure	: Release to air from process: 2.5%. Release to waste water from process: 2%. Release to soil from process: 0.01%.
Technical on-site conditions and measures to reduce or limit discharges, air emissions and releases to soil	: Waste water treatment: Sewage Treatment Plant.
Organisational measures to prevent/limit release from site	: Do not allow to enter drains or watercourses. Do not allow contact with soil, surface or groundwater.
Conditions and measures related to sewage treatment plant	: Municipal Sewage Treatment Plant: Discharge rate: 2000 m ³ /d.

Contributing scenario controlling worker exposure for 2: PROC01 - Use in closed process, no likelihood of exposure

Product characteristics	: Vapour pressure: 39 Pa.
Concentration of substance in mixture or article	: Covers percentage substance in the product up to 100%.
Physical state	: Solid in solution (water, Low volatile liquid), or Flakes. (Solid, medium dustiness).
Frequency and duration of use/exposure	: Exposure duration per day: > 4 hours. Frequency: ≤ 240 days per year.
Human factors not influenced by risk management	: Exposed skin surface assumed: Palm of one hand (240 cm ²).
Other conditions affecting workers exposure	: Indoor use.
Technical conditions and measures at process level (source) to prevent release	: Use in closed process.
Technical conditions and measures to control dispersion from source towards the worker	: Local exhaust ventilation - efficiency of at least 90%.
Conditions and measures related to personal protection, hygiene and health evaluation	
Advice on general occupational hygiene	: Ensure good industrial hygiene. When using do not eat, drink or smoke. Wash hands before breaks and after work.
Personal protection	: Use suitable eye protection. Wear suitable protective clothing. Avoid contact with skin. Wear chemical-resistant gloves (tested to EN374) in combination with intensive management supervision controls. (Efficiency of at least 99%).

Contributing scenario controlling worker exposure for 3: PROC08a - Transfer of substance or preparation (charging/discharging) from/to vessels/large containers at non-dedicated facilities

Product characteristics	: Vapour pressure: 39 Pa.
Concentration of substance in mixture or article	: Covers percentage substance in the product up to 100%.
Physical state	: Low volatile liquid.
Frequency and duration of use/exposure	: Exposure duration per day: < 15 min. Frequency: ≤ 240 days per year.
Human factors not influenced by risk management	: Exposed skin surface assumed: Palm of both hands (480 cm ²).
Other conditions affecting workers exposure	: Outdoor use / Indoor use.
Technical conditions and measures to control dispersion from source towards the worker	: Local exhaust ventilation - efficiency of at least 90%. Further parameters (RISKOFDERM v2.1): Frequency: rare contact. Nature of contact: light contact. Level of automation: Manual. Application rate: 0.2 L/min. Contact time: 5 min.
Conditions and measures related to personal protection, hygiene and health evaluation	
Advice on general occupational hygiene	: Ensure good industrial hygiene. When using do not eat, drink or smoke. Wash hands before breaks and after work.
Personal protection	: Use suitable eye protection. Wear suitable protective clothing. Avoid contact with skin. Wear chemical-resistant gloves (tested to EN374) in combination with intensive management supervision controls. (Efficiency of at least 99%).
Respiratory protection	: Wear respiratory protection. (Efficiency of at least 95%).

Contributing scenario controlling worker exposure for 4: PROC08b - Transfer of substance or preparation (charging/discharging) from/to vessels/large containers at dedicated facilities

Product characteristics	: Vapour pressure: 39 Pa.
Concentration of substance in mixture or article	: Covers percentage substance in the product up to 100%.
Physical state	: Low volatile liquid.
Frequency and duration of use/exposure	: Exposure duration per day: < 8 hours. Frequency: ≤ 240 days per year.
Human factors not influenced by risk management	: Exposed skin surface assumed: Palm of both hands (480 cm ²).
Other conditions affecting workers exposure	: Indoor use. Room size: Assumes large workrooms. (ART)
Technical conditions and measures at process level (source) to prevent release	: Containment: Open process, Effectiveness of containment: Medium (99%). (ART) Transfer of liquid products - falling liquids, Splash loading. (ART) Transferring 100 - 1000 L/min. (ART)
Technical conditions and measures to control dispersion from source towards the worker	: Mechanical ventilation giving at least 1 ach (air changes per hour). (ART) Further parameters (RISKOFDERM v2.1): Frequency: rare contact. Nature of contact: light contact. Level of automation: Automated task / Semi-automated task. Application rate: 0.002 L/min. Contact time: 10 min.

Conditions and measures related to personal protection, hygiene and health evaluation

Advice on general occupational hygiene	: Ensure good industrial hygiene. When using do not eat, drink or smoke. Wash hands before breaks and after work.
Personal protection	: Use suitable eye protection. Wear suitable protective clothing. Avoid contact with skin. Wear chemical-resistant gloves (tested to EN374) in combination with intensive management supervision controls. (Efficiency of at least 99%).

Contributing scenario controlling worker exposure for 5: PROC15 - Use as laboratory reagent

Product characteristics	: Vapour pressure: 39 Pa.
Concentration of substance in mixture or article	: Covers percentage substance in the product up to 100%.
Physical state	: Low volatile liquid.
Frequency and duration of use/exposure	: Exposure duration per day: 15 min - 1 hour. Frequency: ≤ 240 days per year.
Human factors not influenced by risk management	: Exposed skin surface assumed: Palm of one hand (240 cm ²).
Other conditions affecting workers exposure	: Indoor use.
Technical conditions and measures to control dispersion from source towards the worker	: Local exhaust ventilation - efficiency of at least 90%.

Conditions and measures related to personal protection, hygiene and health evaluation

Advice on general occupational hygiene	: Ensure good industrial hygiene. When using do not eat, drink or smoke. Wash hands before breaks and after work.
Personal protection	: Use suitable eye protection. Wear suitable protective clothing. Avoid contact with skin. Wear chemical-resistant gloves (tested to EN374) in combination with intensive management supervision controls. (Efficiency of at least 99%).

Section 3 - Exposure estimation and reference to its source

Exposure estimation and reference to its source - Environment: 1: ERC02 - Formulation of preparations

Exposure assessment (environment): : EUSES

Exposure estimation : Freshwater: 0.921 mg/l.
Risk characterisation ratio (PEC/PNEC): 0.737.

Freshwater sediment: 0.720 mg/kg wwt.
Risk characterisation ratio (PEC/PNEC): 0.735.

Marine water: 0.0921 mg/l.
Risk characterisation ratio (PEC/PNEC): 0.708.

Marine water sediment: 0.0720 mg/kg wwt.
Risk characterisation ratio (PEC/PNEC): 0.720.

Sewage Treatment Plant: 9.18 mg/l.
Risk characterisation ratio (PEC/PNEC): 0.170.

Soil: 0.00579 mg/kg wwt.
Risk characterisation ratio (PEC/PNEC): 0.000653.

Remark : Based on the applied RMMs the risk towards environment is sufficiently controlled (RCR < 1).

Exposure estimation and reference to its source - Workers: 2: PROC01 - Use in closed process, no likelihood of exposure

Exposure assessment (human): : ECETOC TRA v2.0 worker; modified version

Exposure estimation : **Worker - dermal, long-term - systemic:** 0.0003 mg/kg bw/day.
Risk characterisation ratio: 0.024.

Worker - inhalative, long-term - systemic: 0.035mg/m³.
Risk characterisation ratio: 0.358.

Worker - combined, long-term - systemic: 0.382.

Remark : Based on the applied RMMs the risk towards humans is sufficiently controlled (RCR < 1).

Exposure estimation and reference to its source - Workers: 3: PROC08a - Transfer of substance or preparation (charging/discharging) from/to vessels/large containers at non-dedicated facilities

Exposure assessment (human): : Dermal: RISKOFDERM v2.1.
Inhalation: ECETOC TRA v2.0 worker; modified version.

Exposure estimation : **Worker - dermal, long-term - systemic:** 0.0013 mg/kg bw/day.
Risk characterisation ratio: 0.098.

Worker - inhalative, long-term - systemic: 0.0448 mg/m³.
Risk characterisation ratio: 0.448.

Worker - combined, long-term - systemic: 0.546.

Remark : Based on the applied RMMs the risk towards humans is sufficiently controlled (RCR < 1).

Exposure estimation and reference to its source - Workers: 4: PROC08b - Transfer of substance or preparation (charging/discharging) from/to vessels/large containers at dedicated facilities

Exposure assessment (human): : Dermal: RISKOFDERM v2.1.
Inhalation: ART v1.0 (90th percentile 8 hour TWA).

Exposure estimation : **Worker - dermal, long-term - systemic:** 0.004mg/kg bw/day.
Risk characterisation ratio: 0.286.

Worker - inhalative, long-term - systemic: 0.047 mg/m³.
Risk characterisation ratio: 0.47.

Worker - combined, long-term - systemic: 0.756.

Remark : Based on the applied RMMs the risk towards humans is sufficiently controlled (RCR < 1).

Exposure estimation and reference to its source - Workers: 5: PROC15 - Use as laboratory reagent

Exposure assessment (human): : Dermal: ECETOC TRA v2.0 worker; modified version.
Inhalation: measured data.

Exposure estimation : **Worker - dermal, long-term - systemic:** 0.0003 mg/kg bw/day.
Risk characterisation ratio: 0.024.

Worker - inhalative, long-term - systemic (measured data/external): < 0.030 mg/m³.
Risk characterisation ratio: < 0.300.

Worker - combined, long-term - systemic: < 0.324.

Remark : Based on the applied RMMs the risk towards humans is sufficiently controlled (RCR < 1).

Section 4 - Guidance to DU to evaluate whether he works inside the boundaries set by the ES

General	: The immediate downstream user is required to evaluate whether the operational conditions and risk management measures described in the exposure scenario fit to his use. If other OC/RMM are adopted, the user has to ensure that risks are managed to at least equivalent levels. The risk assessment methods/tools given in section 3 may be used for this evaluation.
Environment	: Guidance is based on assumed operating conditions which may not be applicable to all sites; thus, scaling may be necessary to define appropriate site-specific risk management measures.

Annex to the extended Safety Data Sheet (eSDS)

Industrial

Identification of the substance or mixture

Product definition : Mono-constituent substance
Product name : Piperazine anhydrous, PIP

Section 1 - Title

Short title of the exposure scenario : Use of gas-washer formulations in scrubbers - Industrial.
List of use descriptors : **Identified use name: ES05:** Use of gas-washer formulations in scrubbers - Industrial: SU03; PROC01, PROC08b; ERC07
Process Category: PROC01, PROC08b
Substance supplied to that use in form of: In a mixture
Subsequent service life relevant for that use: No.
Environmental Release Category: ERC07
Environmental contributing scenarios : **ERC07 - Industrial use of substances in closed systems**
Health Contributing scenarios : **PROC01 - Use in closed process, no likelihood of exposure**
PROC08b - Transfer of substance or preparation (charging/discharging) from/to vessels/large containers at dedicated facilities

Number of the ES	: 5
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Section 2 - Exposure controls

Contributing scenario controlling environmental exposure for 1: ERC07 - Industrial use of substances in closed systems

Amounts used	: Amounts used: 2000 tonnes/year. Fraction used at main source: 100%. Regional use tonnage: 100%.
Frequency and duration of use	: 35 days.
Environment factors not influenced by risk management	: River flow rate: 18000 m ³ /d.
Other conditions affecting environmental exposure	: Release to air from process: 0.1%. Release to waste water from process: 100%. Release to soil from process: 0%.
Technical on-site conditions and measures to reduce or limit discharges, air emissions and releases to soil	: Waste water treatment: Sewage Treatment Plant. (Efficiency of at least 88%). Incineration (Efficiency of at least 99.8%).
Organisational measures to prevent/limit release from site	: Do not allow to enter drains or watercourses. Do not allow contact with soil, surface or groundwater.
Conditions and measures related to sewage treatment plant	: Municipal Sewage Treatment Plant: Discharge rate: 2000 m ³ /d.

Contributing scenario controlling worker exposure for 2: PROC01 - Use in closed process, no likelihood of exposure

Product characteristics	: Vapour pressure: 39 Pa.
Concentration of substance in mixture or article	: Covers concentrations up to 60%.
Physical state	: Medium volatile liquid, liquid preparations.
Frequency and duration of use/exposure	: Exposure duration per day: > 4 hours. Frequency: ≤ 240 days per year.
Other conditions affecting workers exposure	: Outdoor use / Indoor use.
Technical conditions and measures at process level (source) to prevent release	: Use in closed process.
Conditions and measures related to personal protection, hygiene and health evaluation	
Advice on general occupational hygiene	: Ensure good industrial hygiene. When using do not eat, drink or smoke. Wash hands before breaks and after work.
Personal protection	: Use suitable eye protection. Wear suitable protective clothing. Avoid contact with skin. Wear chemical-resistant gloves (tested to EN374) in combination with intensive management supervision controls. (Efficiency of at least 99%).

Contributing scenario controlling worker exposure for 3: PROC08b - Transfer of substance or preparation (charging/discharging) from/to vessels/large containers at dedicated facilities

Product characteristics	: Vapour pressure: 39 Pa.
Concentration of substance in mixture or article	: Covers percentage substance in the product up to 100%.
Physical state	: Medium volatile liquid, liquid preparations.
Frequency and duration of use/exposure	: Exposure duration per day: < 8 hours. Frequency: ≤ 240 days per year.
Human factors not influenced by risk management	: Exposed skin surface assumed: Palm of both hands (480 cm ²).
Other conditions affecting workers exposure	: Indoor use. Room size: Assumes large workrooms. (ART)
Technical conditions and measures at process level (source) to prevent release	: Containment: Open process, Effectiveness of containment: Medium (99%). (ART) Transfer of liquid products - falling liquids, Splash loading. (ART) Transferring 100 - 1000 L/min. (ART)
Technical conditions and measures to control dispersion from source towards the worker	: Mechanical ventilation giving at least 1 ach (air changes per hour). (ART) Further parameters (RISKOFDERM v2.1): Frequency: rare contact. Nature of contact: light contact. Level of automation: Automated task / Semi-automated task. Application rate: 0.002 L/min. Contact time: 10 min.
Conditions and measures related to personal protection, hygiene and health evaluation	
Advice on general occupational hygiene	: Ensure good industrial hygiene. When using do not eat, drink or smoke. Wash hands before breaks and after work.
Personal protection	: Use suitable eye protection. Wear suitable protective clothing. Avoid contact with skin. Wear chemical-resistant gloves (tested to EN374) in combination with intensive management supervision controls. (Efficiency of at least 99%).

Section 3 - Exposure estimation and reference to its source

Exposure estimation and reference to its source - Environment: 1: ERC07 - Industrial use of substances in closed systems

Exposure assessment (environment): : EUSES

Exposure estimation : Freshwater: 0.690 mg/l.
Risk characterisation ratio (PEC/PNEC): 0.552.

Freshwater sediment: 0.540 mg/kg wwt.
Risk characterisation ratio (PEC/PNEC): 0.551.

Marine water: 0.0690 mg/l.
Risk characterisation ratio (PEC/PNEC): 0.551.

Marine water sediment: 0.0540 mg/kg wwt.
Risk characterisation ratio (PEC/PNEC): 0.540.

Sewage Treatment Plant: 6.83 mg/l.
Risk characterisation ratio (PEC/PNEC): 0.127.

Soil: 0.000345 mg/kg wwt.
Risk characterisation ratio (PEC/PNEC): 0.0000389.

Remark : Based on the applied RMMs the risk towards environment is sufficiently controlled (RCR < 1).

Exposure estimation and reference to its source - Workers: 2: PROC01 - Use in closed process, no likelihood of exposure

Exposure assessment (human): : ECETOC TRA v2.0 worker; modified version

Exposure estimation : **Worker - dermal, long-term - systemic:** 0.002 mg/kg bw/day.
Risk characterisation ratio: 0.147.

Worker - inhalative, long-term - systemic: 0.015mg/m³.
Risk characterisation ratio: 0.150.

Worker - combined, long-term - systemic: 0.297.

Remark : Based on the applied RMMs the risk towards humans is sufficiently controlled (RCR < 1).

Exposure estimation and reference to its source - Workers: 3: PROC08b - Transfer of substance or preparation (charging/discharging) from/to vessels/large containers at dedicated facilities

Exposure assessment (human): : Dermal: RISKOFDERM v2.1.
Inhalation: ART v1.0 (90th percentile 8 hour TWA).

Exposure estimation : **Worker - dermal, long-term - systemic:** 0.004mg/kg bw/day.
Risk characterisation ratio: 0.286.

Worker - inhalative, long-term - systemic: 0.047 mg/m³.
Risk characterisation ratio: 0.47.

Worker - combined, long-term - systemic: 0.756.

Remark : Based on the applied RMMs the risk towards humans is sufficiently controlled (RCR < 1).

Section 4 - Guidance to DU to evaluate whether he works inside the boundaries set by the ES

General

: The immediate downstream user is required to evaluate whether the operational conditions and risk management measures described in the exposure scenario fit to his use. If other OC/RMM are adopted, the user has to ensure that risks are managed to at least equivalent levels. The risk assessment methods/tools given in section 3 may be used for this evaluation.

Environment

: Guidance is based on assumed operating conditions which may not be applicable to all sites; thus, scaling may be necessary to define appropriate site-specific risk management measures.