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

1.1 Product identifier

Trade name	:	Pyrolysis Gasoline
REACH Registration Number	:	01-2119489289-18-0002, 01-2119489289-18-XXXX
Substance name	:	naphtha (petroleum), light steam-cracked
EC-No.	:	265-187-5

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

Use of the Substance/Mixture	:	Manufacture, Use as an intermediate, Formulation

1.3 Details of the supplier of the safety data sheet

Manufacturer	:	Borealis Polymers Oy P.O.Box 330, FI-06101 Porvoo, Finland Telephone: +358 9 394900 Borealis AB S-444 86 Stenungsund, Sweden Telephone: +46 303 86000
Supplier	:	Borealis AG Trabrennstrasse 6-8, 1020 Vienna, Austria Telephone: +43 1 22400 0
E-mail address	:	sds@borealisgroup.com

1.4 Emergency telephone number

+1 760 476 3962 (3E), Access code: 336296

SECTION 2: Hazards identification

2.1 Classification of the substance or mixture

Classification (REGULATION (EC) No 1272/2008)

Flammable liquids, Category 2	H225: Highly flammable liquid and vapour.
Skin irritation, Category 2	H315: Causes skin irritation.

Eye irritation, Category 2	H319: Causes serious eye irritation.
Germ cell mutagenicity, Category 1B	H340: May cause genetic defects.
Carcinogenicity, Category 1A	H350: May cause cancer.
Reproductive toxicity, Category 2	H361fd: Suspected of damaging fertility. Suspected of damaging the unborn child.
Specific target organ toxicity - single exposure, Category 3, Central nervous system	H336: May cause drowsiness or dizziness.
Specific target organ toxicity - repeated exposure, Category 1	H372: Causes damage to organs through prolonged or repeated exposure.
Aspiration hazard, Category 1	H304: May be fatal if swallowed and enters airways.
Long-term (chronic) aquatic hazard, Category 2	H411: Toxic to aquatic life with long lasting effects.

2.2 Label elements

Labelling (REGULATION (EC) No 1272/2008)

Hazard pictograms :

Signal word : Danger

Hazard statements :

H225 Highly flammable liquid and vapour.
H304 May be fatal if swallowed and enters airways.
H315 Causes skin irritation.
H319 Causes serious eye irritation.
H336 May cause drowsiness or dizziness.
H340 May cause genetic defects.
H350 May cause cancer.
H361fd Suspected of damaging fertility. Suspected of damaging the unborn child.
H372 Causes damage to organs through prolonged or repeated exposure.
H411 Toxic to aquatic life with long lasting effects.

Precautionary statements :

Prevention:

P201 Obtain special instructions before use.
P210 Keep away from heat, hot surfaces, sparks, open flames and other ignition sources. No smoking.
P260 Do not breathe mist or vapours.
P273 Avoid release to the environment.
P280 Wear protective gloves/ protective clothing/ eye protection/ face protection/ hearing protection.

Response:

P301 + P310 IF SWALLOWED: Immediately call a POISON CENTER/ doctor.

P308 + P313 IF exposed or concerned: Get medical advice/ attention.
P331 Do NOT induce vomiting.
P370 + P378 In case of fire: Use dry sand, dry chemical or alcohol-resistant foam to extinguish.
P391 Collect spillage.

2.3 Other hazards

This substance/mixture contains no components considered to be either persistent, bioaccumulative and toxic (PBT), or very persistent and very bioaccumulative (vPvB) at levels of 0.1% or higher.
This substance/mixture contains no components considered to be either persistent, bioaccumulative and toxic (PBT), or very persistent and very bioaccumulative (vPvB) at levels of 0.1% or higher.

Ecological information: The substance/mixture does not contain components considered to have endocrine disrupting properties according to REACH Article 57(f) or Commission Delegated regulation (EU) 2017/2100 or Commission Regulation (EU) 2018/605 at levels of 0.1% or higher.

Toxicological information: The substance/mixture does not contain components considered to have endocrine disrupting properties according to REACH Article 57(f) or Commission Delegated regulation (EU) 2017/2100 or Commission Regulation (EU) 2018/605 at levels of 0.1% or higher.

SECTION 3: Composition/information on ingredients

The product is a complex combination of hydrocarbons obtained by the distillation of the products from a steam cracking process. It consists predominantly of unsaturated hydrocarbons having carbon numbers predominantly in the range of C4 through C11 and boiling in the range of approximately minus 20°C to 190°C (-4°F to 374°F). This stream is likely to contain 10 vol. % or more benzene.

3.1 Substances

Substance name : naphtha (petroleum), light steam-cracked

EC-No. : 265-187-5

Chemical nature : Petroleum distillates

Components

Chemical name	CAS-No. EC-No.	Concentration (% w/w)	M-Factor, SCL, ATE
Substance of unknown or variable composition, complex reaction products or biological material (UVCB) :			
Naphtha (petroleum), light steam-cracked; Low boiling point naphtha -unspecified	64742-83-2 265-187-5	<= 100	
Contains :			
benzene	71-43-2	>= 30 - < 50	

	200-753-7		
toluene	108-88-3 203-625-9	>= 8 - < 20	
n-hexane	110-54-3 203-777-6	>= 1 - < 10	specific concentration limit STOT RE 2; H373 >= 5 %
naphthalene	91-20-3 202-049-5	>= 0 - < 3	

SECTION 4: First aid measures

4.1 Description of first aid measures

General advice : Where there is potential for exposure:
Restrict access to authorised persons.
Provide specific activity training to operators to minimise exposures.
First aider needs to protect himself.
Wear respiratory protection.
Do not leave the victim unattended.
Move out of dangerous area.
Take off contaminated clothing and shoes immediately.
In case of accident or if you feel unwell, seek medical advice immediately (show the label where possible).

If inhaled : Move to fresh air.
Do not leave the victim unattended.
Keep patient warm and at rest.
Immediate medical attention is required.
If breathing is difficult, give oxygen.
No artificial respiration, mouth-to-mouth or mouth to nose. Use suitable instruments/apparatus.
If unconscious place in recovery position.

In case of skin contact : Wash off immediately with soap and plenty of water for at least 15 minutes while removing all contaminated clothes and shoes.
Wash contaminated clothing before re-use.
If skin irritation persists, call a physician.

In case of eye contact : Remove contact lenses.
In case of eye contact, remove contact lens and rinse immediately with plenty of water, also under the eyelids, for at least 15 minutes.

Protect unharmed eye.
If symptoms persist, call a physician.
If eye irritation persists, consult a specialist.

If swallowed : Do NOT induce vomiting.
If a person vomits when lying on his back, place him in the recovery position.
Immediate medical attention is required.
Clean mouth with water and drink afterwards plenty of water.
Do not give milk or alcoholic beverages.
Never give anything by mouth to an unconscious person.

4.2 Most important symptoms and effects, both acute and delayed

Symptoms : Eye contact:
Redness
Dilatation of the pupil

Skin contact:
Redness
Swelling of tissue

Inhalation:
Headache
Nausea
Cough
Breathing difficulties
discomfort in the chest
Shortness of breath

Risks : Causes eye irritation.
Causes skin irritation.
Repeated exposure may cause skin dryness or cracking.
May cause respiratory irritation.
May be fatal if swallowed and enters airways.
Causes skin irritation.
Causes serious eye irritation.
May cause drowsiness or dizziness.
May cause genetic defects.
May cause cancer.
Suspected of damaging fertility. Suspected of damaging the unborn child.
Causes damage to organs through prolonged or repeated exposure.

4.3 Indication of any immediate medical attention and special treatment needed

Treatment : In case of ingestion, the stomach should be emptied by gastric lavage under qualified medical supervision.

SECTION 5: Firefighting measures

5.1 Extinguishing media

Suitable extinguishing media	:	Dry powder Carbon dioxide (CO2) Foam Water mist
Unsuitable extinguishing media	:	High volume water jet

5.2 Special hazards arising from the substance or mixture

Specific hazards during firefighting	:	Vapours are heavier than air and may spread along floors. Flash back possible over considerable distance. Fire will produce dense black smoke containing hazardous combustion products (see section 10). Do not allow run-off from fire fighting to enter drains or water courses. Vapours may form explosive mixtures with air.

5.3 Advice for firefighters

Special protective equipment for firefighters	:	Wear self-contained breathing apparatus and protective suit.
Further information	:	Keep people away from and upwind of spill/leak. Observe the risk of explosion. Remove all sources of ignition. Use water spray to cool unopened containers.

SECTION 6: Accidental release measures

6.1 Personal precautions, protective equipment and emergency procedures

Use personal protective equipment.
Avoid inhalation of vapour or mist.
Ensure adequate ventilation, especially in confined areas.
Beware of vapours accumulating to form explosive concentrations. Vapours can accumulate in low areas.
Remove all sources of ignition.

6.2 Environmental precautions

Prevent product from entering environment and drains.
Prevent further leakage or spillage if safe to do so.
If the product contaminates rivers and lakes or drains inform respective authorities.

6.3 Methods and material for containment and cleaning up

Small amounts:
Contain spillage, soak up with non-combustible absorbent material, (e.g. sand, earth, diatomaceous earth, vermiculite) and transfer to a container for disposal according to local / national regulations (see section 13).
Large amounts:
Dam up.
Remove from surface water (e.g. by skimming or siphoning).

6.4 Reference to other sections

For personal protection see section 8., For disposal considerations see section 13.

SECTION 7: Handling and storage

7.1 Precautions for safe handling

Advice on safe handling	:	The following actions are recommended: Closed systems for handling, process and storage. To be handled by trained personnel only. Ensure adequate ventilation. Container may be opened only under exhaust ventilation hood. Avoid splashes. Do not use compressed air for filling, discharging or handling. Dispose of rinse water in accordance with local and national regulations. Avoid inhalation of vapour or mist. Ensure that eyewash stations and safety showers are close to the workstation location.
Advice on protection against fire and explosion	:	Keep product and empty container away from heat and sources of ignition. Take precautionary measures against static discharges. To avoid ignition of vapours by static electricity discharge, all metal parts of the equipment must be grounded.
Hygiene measures	:	Ensure adequate ventilation. Avoid and prevent all spillage, contact and exposure. Smoking, eating and drinking should be prohibited in the application area.

7.2 Conditions for safe storage, including any incompatibilities

Requirements for storage areas and containers	:	Keep locked up or in an area accessible only to qualified or authorised persons. Keep container tightly closed and in a well-ventilated place. Containers which are opened must be carefully resealed and kept upright to prevent leakage. Keep in properly labelled containers.
Further information on	:	Vapours may form explosive mixtures with air. Keep away

storage conditions		from sources of ignition - No smoking. Provide adequate precautions, such as electrical grounding and bonding, or inert atmospheres.
Advice on common storage	:	Keep away from incompatible materials. See chapter 10. Keep away from food, drink and animal feedingstuffs.
Packaging material	:	Suitable material: Mild steel, Stainless steel

7.3 Specific end use(s)

Specific use(s) : Reserved for industrial and professional use.

SECTION 8: Exposure controls/personal protection

8.1 Control parameters

Occupational Exposure Limits

Components	CAS-No.	Value type (Form of exposure)	Control parameters	Basis
benzene	71-43-2	TWA	0,5 ppm 1,65 mg/m3	2004/37/EC
Further information	Skin, Carcinogens or mutagens			
toluene	108-88-3	TWA	50 ppm 192 mg/m3	2006/15/EC
Further information	Indicative, Identifies the possibility of significant uptake through the skin			
		STEL	100 ppm 384 mg/m3	2006/15/EC
Further information	Indicative, Identifies the possibility of significant uptake through the skin			
n-hexane	110-54-3	TWA	20 ppm 72 mg/m3	2006/15/EC
Further information	Indicative			
naphthalene	91-20-3	TWA	10 ppm 50 mg/m3	91/322/EEC
Further information	Indicative			

Derived No Effect Level (DNEL) according to Regulation (EC) No. 1907/2006:

Substance name	End Use	Exposure routes	Potential health effects	Value
Pyrolysis Gasoline	Workers	Inhalation	Long-term systemic effects	3,25 mg/m3
		Dermal	Long-term systemic effects	23,4 mg/kg bw/day
	Consumers	Inhalation	Long-term systemic effects	3,25 µg/m³
		Oral	Long-term systemic effects	0,464 µg/kg/d

Predicted No Effect Concentration (PNEC) according to Regulation (EC) No. 1907/2006:

Substance name	Environmental Compartment	Value
Pyrolysis Gasoline		
Remarks:	The Hydrocarbon Block Method has been used to calculate environmental exposure with the Petrorisk model.	

8.2 Exposure controls

Engineering measures

Minimise exposure using measures such as closed systems, dedicated facilities and suitable general / local exhaust ventilation.
Ensure safe systems of work or equivalent arrangements are in place to manage risks.
Regularly inspect, test and maintain all control measures.

Personal protective equipment

Eye protection : Wear goggles and if needed face-shield.
Hand protection
Material : Viton
Break through time : > 240 min

Material : Neoprene
Break through time : > 10 min

Material : thick PVC

Remarks : Wear suitable gloves:
The selected protective gloves have to satisfy the specifications of Regulation (EU) 2016/425 and the standard EN 374 derived from it. Please observe the instructions regarding permeability and breakthrough time which are provided by the supplier of the gloves. Also take into consideration the specific local conditions under which the product is used, such as the danger of cuts, abrasion, and the contact time. or

Skin and body protection : Wear suitable protective clothing and rubber boots.
Respiratory protection : In case of insufficient ventilation: Respirator with A2 or ABEK filter or self-contained breathing apparatus.
Protective measures : Provide specific activity training to operators to minimise exposures.
Consider the need for risk based health surveillance.

Environmental exposure controls

General advice : Prevent product from entering environment and drains.
Prevent further leakage or spillage if safe to do so. If the product contaminates rivers and lakes or drains inform respective authorities.

SECTION 9: Physical and chemical properties

9.1 Information on basic physical and chemical properties

Physical state	:	liquid
Colour	:	colourless, yellow, dark brown
Odour	:	aromatic
Odour Threshold	:	No data available
Melting point	:	< -25 °C
Boiling range	:	> 35 - 200 °C
Flammability	:	Highly flammable.
Upper explosion limit / Upper flammability limit	:	8,0 %(V) Benzene
Lower explosion limit / Lower flammability limit	:	1,2 %(V) Benzene
Flash point	:	< -10 °C
pH	:	No data available
Viscosity		
Viscosity, kinematic	:	0,6 - 1,5 mm²/s (20 °C)
		0,47 - 0,71 mm²/s (40 °C)
Solubility(ies)		
Water solubility	:	0,035 - 0,16 g/l
Solubility in other solvents	:	No data available
Partition coefficient: n-octanol/water	:	log Pow: 2,2 - 6,5
		log Pow: 2,1 Benzene
Vapour pressure	:	100 hPa (20 °C) Benzene
Relative density	:	ca. 0,82
Relative vapour density	:	2,7 Benzene

9.2 Other information

Self-ignition	:	> 400 °C 101,3 kPa
Surface tension	:	70,2 - 72 mN/m
Molecular weight	:	Not applicable

SECTION 10: Stability and reactivity

10.1 Reactivity

No dangerous reaction known under conditions of normal use.

10.2 Chemical stability

No decomposition if stored and applied as directed.

10.3 Possibility of hazardous reactions

Hazardous reactions : Vapours may form explosive mixture with air.

10.4 Conditions to avoid

Conditions to avoid : Observe the risk of explosion.
Keep away from heat and sources of ignition.

10.5 Incompatible materials

Materials to avoid : Reacts violently with:
Oxidizing agents
Nitric acid
sulphuric acid
Fluorine
Chlorine
Bromine
May attack many plastics, rubbers and coatings.

10.6 Hazardous decomposition products

Under fire conditions:
Carbon monoxide, carbon dioxide and unburned hydrocarbons (smoke).

SECTION 11: Toxicological information

11.1 Information on hazard classes as defined in Regulation (EC) No 1272/2008

Acute toxicity

Not classified based on available information.

Product:

Acute oral toxicity	:	LD50 (Rat): > 5.000 mg/kg Remarks: Read-across (Analogy)
Acute inhalation toxicity	:	LD50 (Rat): mg/m³ 20000 Test substance: Read-across (Analogy) Remarks: No adverse effect has been observed in acute toxicity tests.
Acute dermal toxicity	:	LD50 (Rat): > 2.000 mg/kg Remarks: Read-across (Analogy)

Skin corrosion/irritation

Causes skin irritation.

Product:

Species	:	Rabbit
Result	:	Irritating to skin.
Test substance	:	Read-across (Analogy)

Serious eye damage/eye irritation

Causes serious eye irritation.

Product:

Species	:	Rabbit
Result	:	Irritating to eyes.
Test substance	:	Read-across (Analogy)

Respiratory or skin sensitisation

Skin sensitisation

Not classified based on available information.

Respiratory sensitisation

Not classified based on available information.

Product:

Exposure routes	:	Dermal
Species	:	Guinea pig
Result	:	Does not cause skin sensitisation.
Test substance	:	Read-across (Analogy)

Germ cell mutagenicity

May cause genetic defects.

Product:

Genotoxicity in vivo	:	Test Type: In vivo micronucleus test

Species: Mouse
Cell type: Bone marrow
Application Route: Inhalation
Method: Mutagenicity (micronucleus test)
Result: positive
Remarks: Read-across (Analogy)

Germ cell mutagenicity-Assessment : May cause genetic defects.

Components:

benzene:

Genotoxicity in vitro : Test Type: Ames test
Metabolic activation: with and without metabolic activation
Method: OECD Test Guideline 471
Result: negative

: Test Type: Chromosome aberration test in vitro
Metabolic activation: with and without metabolic activation
Result: positive

Genotoxicity in vivo : Test Type: In vivo micronucleus test
Species: Mouse
Application Route: inhalation (vapour)
Method: OECD Test Guideline 474
Result: positive

Species: Human
Result: Positive results were obtained in some in vivo tests.

Carcinogenicity

May cause cancer.

Product:

Remarks : Information given is based on data on the components and the toxicology of similar products.

Carcinogenicity - Assessment : May cause cancer.

Components:

benzene:

Species : Rat, male and female
Application Route : Oral
Exposure time : 103 wks
Dose : 25 mg/kg bw/d
Frequency of Treatment : 1/d, 5 d/wk
Method : OECD Test Guideline 453

Species	:	Mouse, male and female
Application Route	:	Inhalation
Exposure time	:	2 - 16 wks
Dose	:	960 mg/m3
Frequency of Treatment	:	6 h/d, 5 d/wk

Reproductive toxicity

Suspected of damaging fertility. Suspected of damaging the unborn child.

Product:

Reproductive toxicity - Assessment	:	Suspected of damaging the unborn child.

STOT - single exposure

May cause drowsiness or dizziness.

STOT - repeated exposure

Causes damage to organs through prolonged or repeated exposure.

Aspiration toxicity

May be fatal if swallowed and enters airways.

Product:

Harmful: may cause lung damage if swallowed.

11.2 Information on other hazards

Endocrine disrupting properties

Product:

Assessment	:	The substance/mixture does not contain components considered to have endocrine disrupting properties according to REACH Article 57(f) or Commission Delegated regulation (EU) 2017/2100 or Commission Regulation (EU) 2018/605 at levels of 0.1% or higher.

Neurological effects

Product:

Components of the product may affect the nervous system.

SECTION 12: Ecological information

12.1 Toxicity

Product:

Toxicity to fish	:	LL50 (Oncorhynchus mykiss (rainbow trout)): 1,1 mg/l Exposure time: 96 h Test Type: semi-static test Method: OECD Test Guideline 203 GLP: yes Remarks: Read-across (Analogy)
Toxicity to daphnia and other aquatic invertebrates	:	EC50 (Daphnia magna (Water flea)): 1,2 mg/l Exposure time: 48 h Test Type: static test Method: OECD Test Guideline 202 GLP: yes Remarks: Read-across (Analogy)
Toxicity to algae/aquatic plants	:	EC50 (Pseudokirchneriella subcapitata (green algae)): 1,8 mg/l End point: Growth rate Exposure time: 96 h Test Type: static test Method: OECD Test Guideline 201 GLP: yes Remarks: Read-across (Analogy)
Toxicity to microorganisms	:	EL50 : 201,49 mg/l Exposure time: 72 h Test Type: Growth inhibition Method: QSAR GLP: Remarks: Read-across (Analogy)

Components:

benzene:

Toxicity to fish (Chronic toxicity)	:	LOEC: 1,6 mg/l Exposure time: 32 d Species: Pimephales promelas (fathead minnow) Test Type: flow-through test
Toxicity to daphnia and other aquatic invertebrates (Chronic toxicity)	:	NOEC: 3 mg/l Exposure time: 7 d Species: Ceriodaphnia dubia (water flea) Test Type: semi-static test

12.2 Persistence and degradability

Product:

Biodegradability : Result: Not readily biodegradable.
Biodegradation: 7,3 - 29 %
Exposure time: 28 d
Remarks: Read-across (Analogy)

Components:

benzene:

Biodegradability : Test Type: activated sludge
Result: Readily biodegradable.
Kinetic:

10 d: 88 %
28 d: 96 %
Method: OECD Test Guideline 301F

12.3 Bioaccumulative potential

Product:

Bioaccumulation : Remarks: Bioaccumulation is unlikely.
Information given is based on data on the components and the ecotoxicology of similar products.

Components:

benzene:

Bioaccumulation : Bioconcentration factor (BCF): 13
Method: QSAR
Remarks: Bioaccumulation not expected.
log Pow: 2,13

12.4 Mobility in soil

Product:

Distribution among environmental compartments : Adsorption/Soil
log Koc: 1,34 - 6,67
Method: QSAR
Remarks: Not expected to adsorb on soil.

12.5 Results of PBT and vPvB assessment

Product:

Assessment : This substance/mixture contains no components considered to be either persistent, bioaccumulative and toxic (PBT), or very persistent and very bioaccumulative (vPvB) at levels of 0.1% or higher..

: This substance/mixture contains no components considered to be either persistent, bioaccumulative and toxic (PBT), or very persistent and very bioaccumulative (vPvB) at levels of 0.1% or higher..

12.6 Endocrine disrupting properties

Product:

Assessment : The substance/mixture does not contain components considered to have endocrine disrupting properties according to REACH Article 57(f) or Commission Delegated regulation (EU) 2017/2100 or Commission Regulation (EU) 2018/605 at levels of 0.1% or higher.

12.7 Other adverse effects

Product:

Additional ecological information : Avoid release to the environment.

SECTION 13: Disposal considerations

13.1 Waste treatment methods

Product : Dispose of as hazardous waste in compliance with local and national regulations.
European waste code:
07 01 04* (other organic solvents, washing liquids and mother liquors)
Where possible recycling is preferred to disposal or incineration.

Contaminated packaging : Handle with care.
Dispose of as hazardous waste in compliance with local and national regulations.

SECTION 14: Transport information

14.1 UN number or ID number

ADR : UN 3295

IMDG : UN 3295

IATA (Cargo)	:	UN 3295

14.2 UN proper shipping name

ADR	:	HYDROCARBONS, LIQUID, N.O.S. (benzene, toluene)
IMDG	:	HYDROCARBONS, LIQUID, N.O.S. (benzene, toluene)
IATA (Cargo)	:	Hydrocarbons, liquid, n.o.s. (benzene, toluene)

14.3 Transport hazard class(es)

ADR	:	3
IMDG	:	3
IATA (Cargo)	:	3

14.4 Packing group

ADR

Packing group	:	II
Classification Code	:	F1
Hazard Identification Number	:	33
Labels	:	3
Tunnel restriction code	:	(D/E)

IMDG

Packing group	:	II
Labels	:	3
EmS Code	:	F-E, S-D

IATA (Cargo)

Packing instruction (cargo aircraft)	:	364
Packing instruction (LQ)	:	Y341
Packing group	:	II
Labels	:	Flammable Liquids

14.5 Environmental hazards

ADR

Environmentally hazardous	:	yes

IMDG

Marine pollutant	:	yes

14.6 Special precautions for user

The transport classification(s) provided herein are for informational purposes only, and solely based upon the properties of the unpackaged material as it is described within this Safety Data Sheet. Transportation classifications may vary by mode of transportation, package sizes, and variations in regional or country regulations.

14.7 Maritime transport in bulk according to IMO instruments

Ship type	:	2
Pollution category	:	Y
Remarks	:	Product name in English:, BENZENE AND MIXTURES HAVING 10% BENZENE OR MORE (I)

SECTION 15: Regulatory information

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

REACH - Restrictions on the manufacture, placing on the market and use of certain dangerous substances, preparations and articles (Annex XVII)	:	benzene
Regulation (EC) No 649/2012 of the European Parliament and the Council concerning the export and import of dangerous chemicals	:	benzene

Seveso III: Directive 2012/18/EU of the European Parliament and of the Council on the control of major-accident hazards involving dangerous substances.

Category		Quantity 1	Quantity 2
E2	ENVIRONMENTAL HAZARDS	200 t	500 t
P5c	FLAMMABLE LIQUIDS	5.000 t	50.000 t
34	Petroleum products: (a) gasolines and naphthas, (b) kerosenes (including jet fuels), (c) gas oils (including diesel fuels, home heating oils and gas oil blending streams),(d) heavy fuel oils	2.500 t	25.000 t

Other regulations:

Europe. Directive 2004/37/EC on the protection of workers from the risks related to exposure to carcinogens or mutagens at work
Take note of Dir 94/33/EC on the protection of young people at work.
Take note of Dir 92/85/EEC on the safety and health at work of pregnant workers.

15.2 Chemical safety assessment

A Chemical Safety Assessment has been carried out for this substance.

SECTION 16: Other information

Full text of other abbreviations

2004/37/EC	:	Europe. Directive 2004/37/EC on the protection of workers from the risks related to exposure to carcinogens or mutagens at work
2006/15/EC	:	Europe. Indicative occupational exposure limit values
91/322/EEC	:	Europe. Commission Directive 91/322/EEC on establishing indicative limit values
2004/37/EC / TWA	:	Long term exposure limit
2006/15/EC / TWA	:	Limit Value - eight hours
2006/15/EC / STEL	:	Short term exposure limit
2006/15/EC / TWA	:	Limit Value - eight hours
91/322/EEC / TWA	:	Limit Value - eight hours

Further information

Other information	:	Changes since the last version are highlighted in the margin. This version replaces all previous versions. The classification corresponds to the current EC listing, but is enhanced by specialised literature data and the Company's own information.
Issuer	:	Borealis, Group Product Stewardship
Sources of key data used to compile the Safety Data Sheet	:	Chemical Safety Report, Naphtha (petroleum), light steam-cracked. Lower Olefins and Aromatics REACH Consortium, 2020 International Chemical Safety Card, Benzene (http://www.inchem.org/documents/icsc/icsc/eics0015.htm)

Disclaimer

To the best of our knowledge, the information contained herein is accurate and reliable as of the date of publication; however we do not assume any liability whatsoever for the accuracy and completeness of such information.

Borealis makes no warranties which extend beyond the description contained herein. Nothing herein shall constitute any warranty of merchantability or fitness for a particular purpose.

It is the customer's responsibility to inspect and test our products in order to satisfy itself as to the suitability of the products for the customer's particular purpose. The customer is responsible for the appropriate, safe and legal use, processing and handling of our products.

No liability can be accepted in respect of the use of Borealis' products in conjunction with other materials. The information contained herein relates exclusively to our products when not used in conjunction with any third party materials.

Annex: Exposure Scenarios

Table of Contents

ES1: Manufacture

1.1. Title section

Structured Short Title	:	Manufacture, Manufacture

Environment		
CS1	**Environment**	ERC1
Worker		
CS2	**General measures (eye irritants), General measures (skin irritants), General measures (carcinogens), General risk management measures applicable to all activities**	PROC1, PROC2, PROC3, PROC4, PROC5, PROC8a, PROC8b, PROC9, PROC14, PROC15, PROC28
CS3	**General exposures (closed systems), Indoor**	PROC1
CS4	**General exposures (closed systems), Outdoor**	PROC1
CS5	**General exposures (closed systems), Local exhaust ventilation, Indoor**	PROC2
CS6	**General exposures (closed systems), Local exhaust ventilation, Indoor**	PROC3
CS7	**General exposures (open systems), Local exhaust ventilation, Indoor**	PROC4
CS8	**General exposures (open systems), Respiratory protection, Indoor**	PROC4
CS9	**General exposures (open systems), Respiratory protection, Outdoor**	PROC4
CS10	**Process sampling, Local exhaust ventilation, Indoor**	PROC9
CS11	**Process sampling, Respiratory protection, Indoor**	PROC9
CS12	**Process sampling, Respiratory protection, Outdoor**	PROC9
CS13	**Laboratory activities, Local exhaust ventilation, Indoor**	PROC15
CS14	**Bulk transfers, Closed systems, Local exhaust ventilation, Indoor**	PROC8b
CS15	**Bulk transfers, Open systems, Local exhaust ventilation, Indoor**	PROC8b
CS16	**Bulk transfers, Open systems, Respiratory protection, Indoor**	PROC8b
CS17	**Equipment cleaning and maintenance, Local exhaust ventilation, Indoor**	PROC8a,

		PROC28
CS18	**Storage, Outdoor**	PROC1, PROC2
CS19	**Storage, Indoor**	PROC1, PROC2

1.2. Conditions of use affecting exposure

1.2.1. Control of environmental exposure: Manufacture of the substance (ERC1)

Amount used, frequency and duration of use (or from service life)		
Annual amount per site	:	767000 tonnes/year
Daily amount per site	:	2600000 kg/day
Emission days	:	300
Conditions and measures related to sewage treatment plant		
STP type	:	Municipal Sewage Treatment Plant
STP effluent	:	10.000 m³/d
Other conditions affecting environmental exposure		
Local freshwater dilution factor	:	10
Local marine water dilution factor	:	100

1.2.2. Control of worker exposure: General measures (eye irritants), General measures (skin irritants), General measures (carcinogens), General risk management measures applicable to all activities

Chemical production or refinery in closed process without likelihood of exposure or processes with equivalent containment conditions (PROC1) / Chemical production or refinery in closed continuous process with occasional controlled exposure or processes with equivalent containment conditions (PROC2) / Manufacture or formulation in the chemical industry in closed batch processes with occasional controlled exposure or processes with equivalent containment condition (PROC3) / Chemical production where opportunity for exposure arises (PROC4) / Mixing or blending in batch processes (PROC5) / Transfer of substance or mixture (charging/discharging) at non dedicated-facilities (PROC8a) / Transfer of substance or mixture (charging/discharging) at dedicated facilities (PROC8b) / Transfer of substance or mixture into small containers (dedicated filling line, including weighing) (PROC9) / Tabletting, compression, extrusion, pelettisation, granulation (PROC14) / Use as laboratory reagent (PROC15) / Manual maintenance (cleaning and repair) of machinery (PROC28)

Product (article) characteristics		
Covers percentage substance in the product up to 100 %.		
Physical form of product	:	Liquid
Amount used, frequency and duration of use (or from service life)		
Duration	:	Covers daily exposures up to 8 hours (unless stated differently).
Conditions and measures related to personal protection, hygiene and health evaluation		
General measures (eye irritants) Use suitable eye protection. Avoid direct eye contact with product, also via contamination on hands.		
General measures (skin irritants) Avoid direct skin contact with product. Identify potential areas for indirect skin contact. Wear gloves (tested to EN374) if hand contact with substance likely. Clean up contamination/spills as soon as they occur. Wash off any skin contamination immediately. Provide basic employee training to prevent / minimise exposures and to report any skin problems that may develop.		
Additional good practice advice. Obligations according to Article 37(4) of REACH do not apply		
General measures (carcinogens) Consider technical advances and process upgrades (including automation) for the elimination of releases. Minimise exposure using measures such as closed systems, dedicated facilities and suitable general/local exhaust ventilation. Drain down systems and clear transfer lines prior to breaking containment. Clean/flush equipment, where possible, prior to maintenance. Where there is potential for exposure: restrict access to authorised persons; provide specific activity training to operators to minimise exposures; wear suitable gloves and coveralls to prevent skin contamination; wear respiratory protection when its use is identified for certain contributing scenarios; clear up spills immediately and dispose of wastes safely. Ensure safe systems of work or equivalent arrangements are in place to manage risks. Regularly inspect, test and maintain all control measures. Consider the need for risk based health surveillance.		

1.2.3. Control of worker exposure: General exposures (closed systems), Indoor
Chemical production or refinery in closed process without likelihood of exposure or processes with equivalent containment conditions (PROC1)

Technical and organisational conditions and measures		
No other specific measures identified.		
Occupational Health and Safety Management System: Advanced		
Provide a good standard of general ventilation (not less than 3 to 5 air changes per hour). Inhalation - minimum efficiency of 30 %		
Conditions and measures related to personal protection, hygiene and health evaluation		
Wear chemically resistant gloves (tested to EN374) in combination with 'basic' employee training. Dermal - minimum efficiency of 90 %		
Other conditions affecting workers exposure		
Indoor or outdoor use	:	Indoor use
Temperature	:	Assumes process temperature up to 20 °C

1.2.4. Control of worker exposure: General exposures (closed systems), Outdoor
Chemical production or refinery in closed process without likelihood of exposure or processes with equivalent containment conditions (PROC1)

Technical and organisational conditions and measures		
Use in closed process No other specific measures identified.		
Occupational Health and Safety Management System: Advanced		
Conditions and measures related to personal protection, hygiene and health evaluation		
Wear chemically resistant gloves (tested to EN374) in combination with 'basic' employee training. Dermal - minimum efficiency of 90 %		
Other conditions affecting workers exposure		
Indoor or outdoor use	:	Outdoor use
Temperature	:	Assumes process temperature up to 20 °C

1.2.5. Control of worker exposure: General exposures (closed systems), Local exhaust ventilation, Indoor

Chemical production or refinery in closed continuous process with occasional controlled exposure or processes with equivalent containment conditions (PROC2)

Amount used, frequency and duration of use (or from service life)		
Duration	:	Covers use up to 4 h
Technical and organisational conditions and measures		
Handle substance within a predominantly closed system provided with extract ventilation. Occupational Health and Safety Management System: Advanced		
Provide a good standard of controlled ventilation (5 to 10 air changes per hour). Inhalation - minimum efficiency of 70 %		
Local exhaust ventilation Inhalation - minimum efficiency of 90 %		
Conditions and measures related to personal protection, hygiene and health evaluation		
Wear chemically resistant gloves (tested to EN374) in combination with 'basic' employee training. Dermal - minimum efficiency of 90 %		
Other conditions affecting workers exposure		
Indoor or outdoor use	:	Indoor
Temperature	:	Assumes process temperature up to 20 °C

1.2.6. Control of worker exposure: General exposures (closed systems), Local exhaust ventilation, Indoor
Manufacture or formulation in the chemical industry in closed batch processes with occasional controlled exposure or processes with equivalent containment condition (PROC3)

Amount used, frequency and duration of use (or from service life)		
Duration	:	Covers use up to 1 h
Technical and organisational conditions and measures		
Handle substance within a predominantly closed system provided with extract ventilation. Occupational Health and Safety Management System: Advanced		
Provide a good standard of controlled ventilation (5 to 10 air changes per hour). Inhalation - minimum efficiency of 70 %		
Local exhaust ventilation Inhalation - minimum efficiency of 90 %		

Conditions and measures related to personal protection, hygiene and health evaluation		
Wear chemically resistant gloves (tested to EN374) in combination with 'basic' employee training. Dermal - minimum efficiency of 90 %		
Other conditions affecting workers exposure		
Indoor or outdoor use	:	Indoor
Temperature	:	Assumes process temperature up to 20 °C

1.2.7. Control of worker exposure: General exposures (open systems), Local exhaust ventilation, Indoor
Chemical production where opportunity for exposure arises (PROC4)

Amount used, frequency and duration of use (or from service life)		
Duration	:	Covers use up to 0,25 h
Technical and organisational conditions and measures		
Occupational Health and Safety Management System: Advanced Provide extract ventilation to points where emissions occur.		
Provide a good standard of controlled ventilation (5 to 10 air changes per hour). Inhalation - minimum efficiency of 70 %		
Local exhaust ventilation Inhalation - minimum efficiency of 90 %		
Conditions and measures related to personal protection, hygiene and health evaluation		
Wear chemically resistant gloves (tested to EN374) in combination with 'basic' employee training. Dermal - minimum efficiency of 90 %		
Other conditions affecting workers exposure		
Indoor or outdoor use	:	Indoor use
Temperature	:	Assumes process temperature up to 20 °C

1.2.8. Control of worker exposure: General exposures (open systems), Respiratory protection, Indoor
Chemical production where opportunity for exposure arises (PROC4)

Amount used, frequency and duration of use (or from service life)

Duration	:	Covers use up to 1 h
Technical and organisational conditions and measures		
Occupational Health and Safety Management System: Advanced		
Provide a good standard of controlled ventilation (5 to 10 air changes per hour). Inhalation - minimum efficiency of 70 %		
Conditions and measures related to personal protection, hygiene and health evaluation		
Wear chemically resistant gloves (tested to EN374) in combination with 'basic' employee training. Dermal - minimum efficiency of 90 %		
Wear suitable respiratory protection. Efficiency: APF 20 Inhalation - minimum efficiency of 95 %		
Other conditions affecting workers exposure		
Indoor or outdoor use	:	Indoor use
Temperature	:	Assumes process temperature up to 20 °C

1.2.9. Control of worker exposure: General exposures (open systems), Respiratory protection, Outdoor
Chemical production where opportunity for exposure arises (PROC4)

Amount used, frequency and duration of use (or from service life)		
Duration	:	Covers use up to 0,25 h
Technical and organisational conditions and measures		
Occupational Health and Safety Management System: Advanced		
Conditions and measures related to personal protection, hygiene and health evaluation		
Wear chemically resistant gloves (tested to EN374) in combination with 'basic' employee training. Dermal - minimum efficiency of 90 %		
Wear suitable respiratory protection. Efficiency: APF 20 Inhalation - minimum efficiency of 95 %		
Other conditions affecting workers exposure		
Indoor or outdoor use	:	Outdoor use
Temperature	:	Assumes process temperature up to 20 °C

1.2.10. Control of worker exposure: Process sampling, Local exhaust ventilation, Indoor Transfer of substance or mixture into small containers (dedicated filling line, including weighing) (PROC9)

Amount used, frequency and duration of use (or from service life)		
Duration	:	Covers use up to 0,25 h
Technical and organisational conditions and measures		
Occupational Health and Safety Management System: Advanced		
Provide a good standard of controlled ventilation (5 to 10 air changes per hour). Inhalation - minimum efficiency of 70 %		
Conditions and measures related to personal protection, hygiene and health evaluation		
Wear chemically resistant gloves (tested to EN374) in combination with 'basic' employee training. Dermal - minimum efficiency of 90 %		
Wear suitable respiratory protection. Efficiency: APF 20 Inhalation - minimum efficiency of 95 %		
Other conditions affecting workers exposure		
Indoor or outdoor use	:	Indoor use
Temperature	:	Assumes process temperature up to 20 °C

1.2.11. Control of worker exposure: Process sampling, Respiratory protection, Indoor Transfer of substance or mixture into small containers (dedicated filling line, including weighing) (PROC9)

Amount used, frequency and duration of use (or from service life)		
Duration	:	Covers use up to 0,25 h
Technical and organisational conditions and measures		
Occupational Health and Safety Management System: Advanced		
Provide a good standard of controlled ventilation (5 to 10 air changes per hour). Inhalation - minimum efficiency of 70 %		
Conditions and measures related to personal protection, hygiene and health evaluation		
Wear chemically resistant gloves (tested to EN374) in combination with 'basic' employee training. Dermal - minimum efficiency of 90 %		

Wear suitable respiratory protection. Efficiency: APF 20 Inhalation - minimum efficiency of 95 %		
Other conditions affecting workers exposure		
Indoor or outdoor use	:	Indoor use
Temperature	:	Assumes process temperature up to 20 °C

1.2.12. Control of worker exposure: Process sampling, Respiratory protection, Outdoor Transfer of substance or mixture into small containers (dedicated filling line, including weighing) (PROC9)

Product (article) characteristics		
Covers percentage substance in the product up to 25 %.		
Amount used, frequency and duration of use (or from service life)		
Duration	:	Covers use up to 0,25 h
Technical and organisational conditions and measures		
Occupational Health and Safety Management System: Advanced		
Conditions and measures related to personal protection, hygiene and health evaluation		
Wear chemically resistant gloves (tested to EN374) in combination with 'basic' employee training. Dermal - minimum efficiency of 90 %		
Wear suitable respiratory protection. Efficiency: APF 20 Inhalation - minimum efficiency of 95 %		
Other conditions affecting workers exposure		
Indoor or outdoor use	:	Outdoor use
Temperature	:	Assumes process temperature up to 20 °C

1.2.13. Control of worker exposure: Laboratory activities, Local exhaust ventilation, Indoor Use as laboratory reagent (PROC15)

Amount used, frequency and duration of use (or from service life)		
Duration	:	Covers use up to 1 h

Technical and organisational conditions and measures		
Occupational Health and Safety Management System: Advanced		
Handle in a fume cupboard or under extract ventilation. Inhalation - minimum efficiency of 90 %		
Provide a good standard of controlled ventilation (5 to 10 air changes per hour). Inhalation - minimum efficiency of 70 %		
Local exhaust ventilation Inhalation - minimum efficiency of 90 %		
Conditions and measures related to personal protection, hygiene and health evaluation		
Wear chemically resistant gloves (tested to EN374) in combination with 'basic' employee training. Dermal - minimum efficiency of 90 %		
Other conditions affecting workers exposure		
Indoor or outdoor use	:	Indoor use
Temperature	:	Assumes process temperature up to 20 °C

1.2.14. Control of worker exposure: Bulk transfers, Closed systems, Local exhaust ventilation, Indoor
Transfer of substance or mixture (charging/discharging) at dedicated facilities (PROC8b)

Amount used, frequency and duration of use (or from service life)		
Duration	:	Covers use up to 1 h
Technical and organisational conditions and measures		
Occupational Health and Safety Management System: Advanced		
Ensure material transfers are under containment or extract ventilation. Local exhaust ventilation Inhalation - minimum efficiency of 95 %		
Provide a good standard of controlled ventilation (5 to 10 air changes per hour). Inhalation - minimum efficiency of 70 %		
Conditions and measures related to personal protection, hygiene and health evaluation		
Wear chemically resistant gloves (tested to EN374) in combination with specific activity training. Dermal - minimum efficiency of 95 %		
Other conditions affecting workers exposure		

Indoor or outdoor use	:	Indoor use
Temperature	:	Assumes process temperature up to 20 °C

1.2.15. Control of worker exposure: Bulk transfers, Open systems, Local exhaust ventilation, Indoor
Transfer of substance or mixture (charging/discharging) at dedicated facilities (PROC8b)

Amount used, frequency and duration of use (or from service life)		
Duration	:	Covers use up to 1 h
Technical and organisational conditions and measures		
Occupational Health and Safety Management System: Advanced		
Ensure material transfers are under containment or extract ventilation. Local exhaust ventilation Inhalation - minimum efficiency of 95 %		
Provide a good standard of controlled ventilation (5 to 10 air changes per hour). Inhalation - minimum efficiency of 70 %		
Conditions and measures related to personal protection, hygiene and health evaluation		
Wear chemically resistant gloves (tested to EN374) in combination with specific activity training. Dermal - minimum efficiency of 95 %		
Other conditions affecting workers exposure		
Indoor or outdoor use	:	Indoor use
Temperature	:	Assumes process temperature up to 20 °C

1.2.16. Control of worker exposure: Bulk transfers, Open systems, Respiratory protection, Indoor
Transfer of substance or mixture (charging/discharging) at dedicated facilities (PROC8b)

Amount used, frequency and duration of use (or from service life)		
Duration	:	Covers use up to 0,25 h
Technical and organisational conditions and measures		
Occupational Health and Safety Management System: Advanced		
Conditions and measures related to personal protection, hygiene and health evaluation		
Wear chemically resistant gloves (tested to EN374) in combination with specific activity training.		

Dermal - minimum efficiency of 95 %		
Wear suitable respiratory protection. Efficiency: APF 20 Inhalation - minimum efficiency of 95 %		
Other conditions affecting workers exposure		
Indoor or outdoor use	:	Outdoor use
Temperature	:	Assumes process temperature up to 20 °C

1.2.17. Control of worker exposure: Equipment cleaning and maintenance, Local exhaust ventilation, Indoor
Transfer of substance or mixture (charging/discharging) at non dedicated-facilities (PROC8a) / Manual maintenance (cleaning and repair) of machinery (PROC28)

Amount used, frequency and duration of use (or from service life)		
Duration	:	Covers use up to 1 h
Technical and organisational conditions and measures		
Occupational Health and Safety Management System: Advanced		
Local exhaust ventilation Inhalation - minimum efficiency of 90 %		
Provide a good standard of general ventilation (not less than 3 to 5 air changes per hour). Inhalation - minimum efficiency of 30 %		
Conditions and measures related to personal protection, hygiene and health evaluation		
Wear chemically resistant gloves (tested to EN374) in combination with specific activity training. Dermal - minimum efficiency of 95 %		
Wear suitable respiratory protection. Efficiency: APF 10 Inhalation - minimum efficiency of 90 %		
Other conditions affecting workers exposure		
Indoor or outdoor use	:	Indoor use
Temperature	:	Assumes process temperature up to 20 °C

1.2.18. Control of worker exposure: Storage, Outdoor

Chemical production or refinery in closed process without likelihood of exposure or processes with equivalent containment conditions (PROC1) / Chemical production or refinery in closed continuous process with occasional controlled exposure or processes with equivalent containment conditions (PROC2)

Technical and organisational conditions and measures		
Occupational Health and Safety Management System: Advanced		
Store substance within a closed system.		
Conditions and measures related to personal protection, hygiene and health evaluation		
Wear chemically resistant gloves (tested to EN374) in combination with 'basic' employee training. Dermal - minimum efficiency of 90 %		
Other conditions affecting workers exposure		
Indoor or outdoor use	:	Outdoor use
Temperature	:	Assumes process temperature up to 20 °C

1.2.19. Control of worker exposure: Storage, Indoor
Chemical production or refinery in closed process without likelihood of exposure or processes with equivalent containment conditions (PROC1) / Chemical production or refinery in closed continuous process with occasional controlled exposure or processes with equivalent containment conditions (PROC2)

Amount used, frequency and duration of use (or from service life)		
Duration	:	Covers use up to 1 h
Technical and organisational conditions and measures		
Occupational Health and Safety Management System: Advanced		
Store substance within a closed system.		
Provide a good standard of general ventilation (not less than 3 to 5 air changes per hour). Inhalation - minimum efficiency of 30 %		
Local exhaust ventilation Inhalation - minimum efficiency of 90 %		
Conditions and measures related to personal protection, hygiene and health evaluation		
Wear chemically resistant gloves (tested to EN374) in combination with 'basic' employee training. Dermal - minimum efficiency of 90 %		

Other conditions affecting workers exposure		
Indoor or outdoor use	:	Indoor use
Temperature	:	Assumes process temperature up to 20 °C

1.3. Exposure estimation and reference to its source

1.3.1. Environmental release and exposure: Manufacture of the substance (ERC1)

Compartment	Exposure level	RCR
Freshwater	0,21 mg/L	0,69
Marine water	0,021 mg/L	0,069
Freshwater sediment	0,96 mg/kg wet weight	0,91
Marine sediment	0,096 mg/kg wet weight	0,091
Agricultural soil	0,013 mg/kg wet weight	0,037

1.3.3. Worker exposure: Chemical production or refinery in closed process without likelihood of exposure or processes with equivalent containment conditions (PROC1)

Exposure route	Health effect	Exposure indicator	Exposure level	RCR	Remarks
inhalative	systemic	long-term	0,023 mg/m³	0,012	Benzene
inhalative	systemic	short-term	0,091 mg/m³		Benzene
dermal	systemic	long-term	0,0034 mg/kg bw/day		Benzene
dermal	local	long-term	0,00099 mg/cm2		Benzene
dermal	local	short-term	0,00099 mg/cm2		Benzene
combined routes	systemic	long-term		0,012	

Additional information on exposure estimation
Available hazard data do not enable the derivation of a DNEL for dermal irritant effects. Available hazard data do not enable the derivation of a DNEL for eye irritant effects. Risk management measures are based on qualitative risk characterisation. Predicted exposures are not expected to exceed the DN(M)EL when the risk management measures/operational conditions outlined in section 2 are implemented.

1.3.4. Worker exposure: Chemical production or refinery in closed process without likelihood of exposure or processes with equivalent containment conditions (PROC1)

Exposure route	Health effect	Exposure indicator	Exposure level	RCR	Remarks
inhalative	systemic	long-term	0,023 mg/m³	0,012	Benzene
inhalative	systemic	short-term	0,091 mg/m³		Benzene
dermal	systemic	long-term	0,0034 mg/kg bw/day		Benzene
dermal	local	long-term	0,00099 mg/cm2		Benzene
dermal	local	short-term	0,00099 mg/cm2		Benzene
combined routes	systemic	long-term		0,012	

Additional information on exposure estimation
Available hazard data do not enable the derivation of a DNEL for dermal irritant effects. Available hazard data do not enable the derivation of a DNEL for eye irritant effects. Risk management measures are based on qualitative risk characterisation. Predicted exposures are not expected to exceed the DN(M)EL when the risk management measures/operational conditions outlined in section 2 are implemented.

1.3.5. Worker exposure: Chemical production or refinery in closed continuous process with occasional controlled exposure or processes with equivalent containment conditions (PROC2)

Exposure route	Health effect	Exposure indicator	Exposure level	RCR	Remarks
inhalative	systemic	long-term	1,465 mg/m³	0,771	Benzene
inhalative	systemic	short-term	9,764 mg/m³		Benzene
dermal	systemic	long-term	0,082 mg/kg bw/day	0,087	Benzene
dermal	local	long-term	0,012 mg/cm2		Benzene
dermal	local	short-term	0,012 mg/cm2		Benzene
combined routes	systemic	long-term		0,112	

Additional information on exposure estimation
Available hazard data do not enable the derivation of a DNEL for dermal irritant effects. Available hazard data do not enable the derivation of a DNEL for eye irritant effects. Risk management measures are based on qualitative risk characterisation. Predicted exposures are not expected to exceed the DN(M)EL when the risk management measures/operational conditions outlined in section 2 are implemented.

1.3.6. Worker exposure: Manufacture or formulation in the chemical industry in closed batch processes with occasional controlled exposure or processes with equivalent containment condition (PROC3)

Exposure route	Health effect	Exposure indicator	Exposure level	RCR	Remarks
inhalative	systemic	long-term	0,976 mg/m³	0,514	Benzene
inhalative	systemic	short-term	19,52 mg/m³		Benzene
dermal	systemic	long-term	0,014 mg/kg bw/day	0,044	Benzene
dermal	local	long-term	0,004 mg/cm2		Benzene
dermal	local	short-term	0,004 mg/cm2		Benzene
combined routes	systemic	long-term		0,069	

Additional information on exposure estimation
Available hazard data do not enable the derivation of a DNEL for dermal irritant effects. Available hazard data do not enable the derivation of a DNEL for eye irritant effects. Risk management measures are based on qualitative risk characterisation. Predicted exposures are not expected to exceed the DN(M)EL when the risk management measures/operational conditions outlined in section 2 are implemented.

1.3.7. Worker exposure: Chemical production where opportunity for exposure arises (PROC4)

Exposure route	Health effect	Exposure indicator	Exposure level	RCR	Remarks
inhalative	systemic	long-term	0,976 mg/m³	0,514	Benzene
inhalative	systemic	short-term	39,05 mg/m³		Benzene
dermal	systemic	long-term	0,069 mg/kg bw/day	0,433	Benzene
dermal	local	long-term	0,01 mg/cm2		Benzene
dermal	local	short-term	0,01 mg/cm2		Benzene
combined routes	systemic	long-term		0,455	

Additional information on exposure estimation
Available hazard data do not enable the derivation of a DNEL for dermal irritant effects. Available hazard data do not enable the derivation of a DNEL for eye irritant effects. Risk management measures are based on qualitative risk characterisation. Predicted exposures are not expected to exceed the DN(M)EL when the risk management measures/operational conditions outlined in section 2 are implemented.

1.3.8. Worker exposure: Chemical production where opportunity for exposure arises (PROC4)

Exposure route	Health effect	Exposure indicator	Exposure level	RCR	Remarks
inhalative	systemic	long-term	0,976 mg/m³	0,514	Benzene
inhalative	systemic	short-term	19,52 mg/m³		Benzene
dermal	systemic	long-term	0,137 mg/kg bw/day	0,433	Benzene
dermal	local	long-term	0,02 mg/cm2		Benzene
dermal	local	short-term	0,02 mg/cm2		Benzene
combined routes	systemic	long-term		0,455	

Additional information on exposure estimation
Available hazard data do not enable the derivation of a DNEL for dermal irritant effects. Available hazard data do not enable the derivation of a DNEL for eye irritant effects. Risk management measures are based on qualitative risk characterisation. Predicted exposures are not expected to exceed the DN(M)EL when the risk management measures/operational conditions outlined in section 2 are implemented.

1.3.9. Worker exposure: Chemical production where opportunity for exposure arises (PROC4)

Exposure route	Health effect	Exposure indicator	Exposure level	RCR	Remarks
inhalative	systemic	long-term	1,139 mg/m³	0,6	Benzene
inhalative	systemic	short-term	45,56 mg/m³		Benzene
dermal	systemic	long-term	0,069 mg/kg bw/day	0,433	Benzene
dermal	local	long-term	0,01 mg/cm2		Benzene
dermal	local	short-term	0,01 mg/cm2		Benzene
combined routes	systemic	long-term		0,458	

Additional information on exposure estimation
Available hazard data do not enable the derivation of a DNEL for dermal irritant effects. Available hazard data do not enable the derivation of a DNEL for eye irritant effects. Risk management measures are based on qualitative risk characterisation. Predicted exposures are not expected to exceed the DN(M)EL when the risk management measures/operational conditions outlined in section 2 are implemented.

1.3.10. Worker exposure: Transfer of substance or mixture into small containers (dedicated filling line, including weighing) (PROC9)

Exposure route	Health effect	Exposure indicator	Exposure level	RCR	Remarks
inhalative	systemic	long-term	0,976 mg/m³	0,514	Benzene
inhalative	systemic	short-term	39,05 mg/m³		Benzene
dermal	systemic	long-term	0,069 mg/kg bw/day	0,433	Benzene
dermal	local	long-term	0,01 mg/cm2		Benzene
dermal	local	short-term	0,01 mg/cm2		Benzene
combined routes	systemic	long-term		0,444	

Additional information on exposure estimation
Available hazard data do not enable the derivation of a DNEL for dermal irritant effects. Available hazard data do not enable the derivation of a DNEL for eye irritant effects. Risk management measures are based on qualitative risk characterisation. Predicted exposures are not expected to exceed the DN(M)EL when the risk management measures/operational conditions outlined in section 2 are implemented.

1.3.11. Worker exposure: Transfer of substance or mixture into small containers (dedicated filling line, including weighing) (PROC9)

Exposure route	Health effect	Exposure indicator	Exposure level	RCR	Remarks
inhalative	systemic	long-term	0,976 mg/m³	0,514	Benzene
inhalative	systemic	short-term	39,05 mg/m³		Benzene
dermal	systemic	long-term	0,069 mg/kg bw/day	0,433	Benzene
dermal	local	long-term	0,01 mg/cm2		Benzene
dermal	local	short-term	0,01 mg/cm2		Benzene
combined routes	systemic	long-term		0,444	

Additional information on exposure estimation
Available hazard data do not enable the derivation of a DNEL for dermal irritant effects. Available hazard data do not enable the derivation of a DNEL for eye irritant effects. Risk management measures are based on qualitative risk characterisation. Predicted exposures are not expected to exceed the DN(M)EL when the risk management measures/operational conditions outlined in section 2 are implemented.

1.3.12. Worker exposure: Transfer of substance or mixture into small containers (dedicated filling line, including weighing) (PROC9)

Exposure route	Health effect	Exposure indicator	Exposure level	RCR	Remarks
inhalative	systemic	long-term	1,367 mg/m³	0,719	Benzene
inhalative	systemic	short-term	54,67 mg/m³		Benzene
dermal	systemic	long-term	0,041 mg/kg bw/day	0,26	Benzene
dermal	local	long-term	0,006 mg/cm2		Benzene
dermal	local	short-term	0,006 mg/cm2		Benzene
combined routes	systemic	long-term		0,275	

Additional information on exposure estimation
Available hazard data do not enable the derivation of a DNEL for dermal irritant effects. Available hazard data do not enable the derivation of a DNEL for eye irritant effects. Risk management measures are based on qualitative risk characterisation. Predicted exposures are not expected to exceed the DN(M)EL when the risk management measures/operational conditions outlined in section 2 are implemented.

1.3.13. Worker exposure: Use as laboratory reagent (PROC15)

Exposure route	Health effect	Exposure indicator	Exposure level	RCR	Remarks
inhalative	systemic	long-term	0,976 mg/m³	0,514	Benzene
inhalative	systemic	short-term	19,52 mg/m³		Benzene
dermal	systemic	long-term	0,0068 mg/kg bw/day	0,021	Benzene
dermal	local	long-term	0,0020 mg/cm2		Benzene
dermal	local	short-term	0,0020 mg/cm2		Benzene
combined routes	systemic	long-term		0,064	

Additional information on exposure estimation
Available hazard data do not enable the derivation of a DNEL for dermal irritant effects. Available hazard data do not enable the derivation of a DNEL for eye irritant effects. Risk management measures are based on qualitative risk characterisation. Predicted exposures are not expected to exceed the DN(M)EL when the risk management measures/operational conditions outlined in section 2 are implemented.

1.3.14. Worker exposure: Transfer of substance or mixture (charging/discharging) at dedicated facilities (PROC8b)

Exposure route	Health effect	Exposure indicator	Exposure level	RCR	Remarks
inhalative	systemic	long-term	1,465 mg/m³	0,771	Benzene
inhalative	systemic	short-term	29,29 mg/m³		Benzene
dermal	systemic	long-term	0,137 mg/kg bw/day	0,433	Benzene
dermal	local	long-term	0,01 mg/cm2		Benzene
dermal	local	short-term	0,01 mg/cm2		Benzene
combined routes	systemic	long-term		0,454	

Additional information on exposure estimation
Available hazard data do not enable the derivation of a DNEL for dermal irritant effects. Available hazard data do not enable the derivation of a DNEL for eye irritant effects. Risk management measures are based on qualitative risk characterisation. Predicted exposures are not expected to exceed the DN(M)EL when the risk management measures/operational conditions outlined in section 2 are implemented.

1.3.15. Worker exposure: Transfer of substance or mixture (charging/discharging) at dedicated facilities (PROC8b)

Exposure route	Health effect	Exposure indicator	Exposure level	RCR	Remarks
inhalative	systemic	long-term	1,465 mg/m³	0,771	Benzene
inhalative	systemic	short-term	29,29 mg/m³		Benzene
dermal	systemic	long-term	0,137 mg/kg bw/day	0,433	Benzene
dermal	local	long-term	0,01 mg/cm2		Benzene
dermal	local	short-term	0,01 mg/cm2		Benzene
combined routes	systemic	long-term		0,454	

Additional information on exposure estimation
Available hazard data do not enable the derivation of a DNEL for dermal irritant effects. Available hazard data do not enable the derivation of a DNEL for eye irritant effects. Risk management measures are based on qualitative risk characterisation. Predicted exposures are not expected to exceed the DN(M)EL when the risk management measures/operational conditions outlined in section 2 are implemented.

1.3.16. Worker exposure: Transfer of substance or mixture (charging/discharging) at dedicated facilities (PROC8b)

Exposure route	Health effect	Exposure indicator	Exposure level	RCR	Remarks
inhalative	systemic	long-term	1,709 mg/m³	0,899	Benzene
inhalative	systemic	short-term	68,34 mg/m³		Benzene
dermal	systemic	long-term	0,069 mg/kg bw/day	0,433	Benzene
dermal	local	long-term	0,005 mg/cm2		Benzene
dermal	local	short-term	0,005 mg/cm2		Benzene
combined routes	systemic	long-term		0,454	

Additional information on exposure estimation
Available hazard data do not enable the derivation of a DNEL for dermal irritant effects. Available hazard data do not enable the derivation of a DNEL for eye irritant effects. Risk management measures are based on qualitative risk characterisation. Predicted exposures are not expected to exceed the DN(M)EL when the risk management measures/operational conditions outlined in section 2 are implemented.

1.3.17. Worker exposure: Transfer of substance or mixture (charging/discharging) at non dedicated-facilities (PROC8a) / Manual maintenance (cleaning and repair) of machinery (PROC28)

Exposure route	Health effect	Exposure indicator	Exposure level	RCR	Remarks
inhalative	systemic	long-term	1,139 mg/m³	0,6	Benzene
inhalative	systemic	short-term	22,78 mg/m³		Benzene
dermal	systemic	long-term	0,137 mg/kg bw/day	0,433	Benzene
dermal	local	long-term	0,01 mg/cm2		Benzene
dermal	local	short-term	0,01 mg/cm2		Benzene
combined routes	systemic	long-term		0,453	

Additional information on exposure estimation
Available hazard data do not enable the derivation of a DNEL for dermal irritant effects. Available hazard data do not enable the derivation of a DNEL for eye irritant effects. Risk management measures are based on qualitative risk characterisation. Predicted exposures are not expected to exceed the DN(M)EL when the risk management measures/operational conditions outlined in section 2 are implemented.

1.3.18. Worker exposure: Chemical production or refinery in closed process without likelihood of exposure or processes with equivalent containment conditions (PROC1) / Chemical production or

refinery in closed continuous process with occasional controlled exposure or processes with equivalent containment conditions (PROC2)

Exposure route	Health effect	Exposure indicator	Exposure level	RCR	Remarks
inhalative	systemic	long-term	0,023 mg/m³	0,012	Benzene
inhalative	systemic	short-term	0,091 mg/m³		Benzene
dermal	systemic	long-term	0,0034 mg/kg bw/day	< 0,01	Benzene
dermal	local	long-term	0,0010 mg/cm2		Benzene
dermal	local	short-term	0,0010 mg/cm2		Benzene
combined routes	systemic	long-term		0,012	

Additional information on exposure estimation
Available hazard data do not enable the derivation of a DNEL for dermal irritant effects. Available hazard data do not enable the derivation of a DNEL for eye irritant effects. Risk management measures are based on qualitative risk characterisation. Predicted exposures are not expected to exceed the DN(M)EL when the risk management measures/operational conditions outlined in section 2 are implemented.

1.3.19. Worker exposure: Chemical production or refinery in closed process without likelihood of exposure or processes with equivalent containment conditions (PROC1) / Chemical production or refinery in closed continuous process with occasional controlled exposure or processes with equivalent containment conditions (PROC2)

Exposure route	Health effect	Exposure indicator	Exposure level	RCR	Remarks
inhalative	systemic	long-term	1,139 mg/m³	0,6	Benzene
inhalative	systemic	short-term	22,78 mg/m³		Benzene
dermal	systemic	long-term	0,027 mg/kg bw/day	0,087	Benzene
dermal	local	long-term	0,004 mg/cm2		Benzene
dermal	local	short-term	0,004 mg/cm2		Benzene
combined routes	systemic	long-term		0,107	

Additional information on exposure estimation
Available hazard data do not enable the derivation of a DNEL for dermal irritant effects. Available hazard data do not enable the derivation of a DNEL for eye irritant effects. Risk management measures are based on qualitative risk characterisation. Predicted exposures are not expected to exceed the DN(M)EL when the risk management

measures/operational conditions outlined in section 2 are implemented.

1.4. Guidance to DU to evaluate whether he works inside the boundaries set by the ES

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.

ES2: Formulation & (re)packing of substances and mixtures

2.1. Title section

Structured Short Title	:	Formulation or re-packing, Formulation & (re)packing of substances and mixtures

Environment		
CS1	**Formulation & (re)packing of substances and mixtures**	ERC2
Worker		
CS2	**General measures (eye irritants), General measures (skin irritants), General measures (carcinogens), General risk management measures applicable to all activities**	PROC1, PROC2, PROC3, PROC4, PROC5, PROC8a, PROC8b, PROC9, PROC14, PROC15, PROC28
CS3	**General exposures (closed systems), Indoor**	PROC1
CS4	**General exposures (closed systems), Outdoor**	PROC1
CS5	**General exposures (closed systems), Use in contained systems, With sample collection, Local exhaust ventilation, Indoor**	PROC2
CS6	**General exposures (closed systems), Local exhaust ventilation, Indoor**	PROC3
CS7	**General exposures (open systems), Local exhaust ventilation, Indoor**	PROC4
CS8	**General exposures (open systems), Respiratory protection, Indoor**	PROC4
CS9	**Batch processes at elevated temperatures, Use in contained batch processes, Local exhaust ventilation, Indoor**	PROC3
CS10	**Batch processes at elevated temperatures, Use in contained batch processes, Respiratory protection, Indoor**	PROC3
CS11	**Process sampling, Indoor**	PROC9
CS12	**Laboratory activities, Local exhaust ventilation, Indoor**	PROC15
CS13	**Bulk transfers, Dedicated facility, Local exhaust ventilation, Indoor**	PROC8b
CS14	**Bulk transfers, Dedicated facility, Respiratory protection, Indoor**	PROC8b

CS15	**Mixing operations (open systems), Local exhaust ventilation, Indoor**	PROC5
CS16	**Manual, Transfer from/pouring from containers, Non-dedicated facility, Respiratory protection, Indoor**	PROC8a
CS17	**Drum/batch transfers, Dedicated facility, Local exhaust ventilation, Indoor**	PROC8b
CS18	**Drum/batch transfers, Dedicated facility, Respiratory protection, Indoor**	PROC8b
CS19	**Production or preparation or articles by tabletting, compression, extrusion or pelletisation, Local exhaust ventilation, Indoor**	PROC14
CS20	**Drum and small package filling, Indoor**	PROC9
CS21	**Drum and small package filling, Respiratory protection, Indoor**	PROC9
CS22	**Equipment cleaning and maintenance, Respiratory protection, Indoor**	PROC8a, PROC28
CS23	**Storage, Outdoor**	PROC1, PROC2
CS24	**Storage, Indoor**	PROC1, PROC2

2.2. Conditions of use affecting exposure

2.2.1. Control of environmental exposure: Formulation into mixture (ERC2)

Amount used, frequency and duration of use (or from service life)		
Annual amount per site	:	650000 tonnes/year
Daily amount per site	:	2200000 kg/day
Emission days	:	300
Conditions and measures related to sewage treatment plant		
STP type	:	Municipal Sewage Treatment Plant
STP effluent	:	10.000 m³/d
Other conditions affecting environmental exposure		
Local freshwater dilution factor	:	10
Local marine water dilution factor	:	100

2.2.2. Control of worker exposure: General measures (eye irritants), General measures (skin irritants), General measures (carcinogens), General risk management measures applicable to all activities
Chemical production or refinery in closed process without likelihood of exposure or processes with equivalent containment conditions (PROC1) / Chemical production or refinery in closed continuous process with occasional controlled exposure or processes with equivalent containment conditions (PROC2) / Manufacture or formulation in the chemical industry in closed batch processes with occasional controlled exposure or processes with equivalent containment condition (PROC3) / Chemical production where opportunity for exposure arises (PROC4) / Mixing or blending in batch processes (PROC5) / Transfer of substance or mixture (charging/discharging) at non dedicated-facilities (PROC8a) / Transfer of substance or mixture (charging/discharging) at dedicated facilities (PROC8b) / Transfer of substance or mixture into small containers (dedicated filling line, including weighing) (PROC9) / Tabletting, compression, extrusion, pelettisation, granulation (PROC14) / Use as laboratory reagent (PROC15) / Manual maintenance (cleaning and repair) of machinery (PROC28)

Product (article) characteristics		
Covers percentage substance in the product up to 100 %.		
Physical form of product	:	Liquid
Amount used, frequency and duration of use (or from service life)		
Duration	:	Covers daily exposures up to 8 hours (unless stated differently).
Conditions and measures related to personal protection, hygiene and health evaluation		
General measures (eye irritants) Use suitable eye protection. Avoid direct eye contact with product, also via contamination on hands.		
General measures (skin irritants) Avoid direct skin contact with product. Identify potential areas for indirect skin contact. Wear gloves (tested to EN374) if hand contact with substance likely. Clean up contamination/spills as soon as they occur. Wash off any skin contamination immediately. Provide basic employee training to prevent / minimise exposures and to report any skin problems that may develop.		
Additional good practice advice. Obligations according to Article 37(4) of REACH do not apply		
General measures (carcinogens) Consider technical advances and process upgrades (including automation) for the elimination of releases. Minimise exposure using measures such as closed systems, dedicated facilities and suitable general/local exhaust ventilation. Drain down systems and clear transfer lines prior to breaking containment. Clean/flush equipment, where possible, prior to maintenance. Where there is potential for exposure: restrict access to authorised persons; provide specific activity training to operators to minimise exposures; wear suitable gloves and coveralls to prevent skin contamination; wear respiratory protection when its use is identified for certain contributing scenarios; clear up spills immediately and dispose of		

wastes safely. Ensure safe systems of work or equivalent arrangements are in place to manage risks. Regularly inspect, test and maintain all control measures. Consider the need for risk based health surveillance.

2.2.3. Control of worker exposure: General exposures (closed systems), Indoor
Chemical production or refinery in closed process without likelihood of exposure or processes with equivalent containment conditions (PROC1)

Technical and organisational conditions and measures		
No other specific measures identified.		
Occupational Health and Safety Management System: Advanced		
Provide a good standard of general ventilation (not less than 3 to 5 air changes per hour). Inhalation - minimum efficiency of 30 %		
Conditions and measures related to personal protection, hygiene and health evaluation		
Wear chemically resistant gloves (tested to EN374) in combination with 'basic' employee training. Dermal - minimum efficiency of 90 %		
Other conditions affecting workers exposure		
Indoor or outdoor use	:	Indoor use
Temperature	:	Assumes process temperature up to 20 °C

2.2.4. Control of worker exposure: General exposures (closed systems), Outdoor
Chemical production or refinery in closed process without likelihood of exposure or processes with equivalent containment conditions (PROC1)

Technical and organisational conditions and measures		
Use in closed process No other specific measures identified.		
Occupational Health and Safety Management System: Advanced		
Conditions and measures related to personal protection, hygiene and health evaluation		
Wear chemically resistant gloves (tested to EN374) in combination with 'basic' employee training. Dermal - minimum efficiency of 90 %		
Other conditions affecting workers exposure		
Indoor or outdoor use	:	Outdoor use
Temperature	:	Assumes process temperature up to 20 °C

2.2.5. Control of worker exposure: General exposures (closed systems), Use in contained systems, With sample collection, Local exhaust ventilation, Indoor
Chemical production or refinery in closed continuous process with occasional controlled exposure or processes with equivalent containment conditions (PROC2)

Amount used, frequency and duration of use (or from service life)		
Duration	:	Covers use up to 4 h
Technical and organisational conditions and measures		
Use in closed, continuous process with occasional controlled exposure Occupational Health and Safety Management System: Advanced		
Provide a good standard of controlled ventilation (5 to 10 air changes per hour). Inhalation - minimum efficiency of 70 %		
Handle substance within a predominantly closed system provided with extract ventilation. Local exhaust ventilation Inhalation - minimum efficiency of 90 %		
Conditions and measures related to personal protection, hygiene and health evaluation		
Wear chemically resistant gloves (tested to EN374) in combination with 'basic' employee training. Dermal - minimum efficiency of 90 %		
Other conditions affecting workers exposure		
Indoor or outdoor use	:	Indoor
Temperature	:	Assumes process temperature up to 20 °C

2.2.6. Control of worker exposure: General exposures (closed systems), Local exhaust ventilation, Indoor
Manufacture or formulation in the chemical industry in closed batch processes with occasional controlled exposure or processes with equivalent containment condition (PROC3)

Amount used, frequency and duration of use (or from service life)		
Duration	:	Covers use up to 1 h
Technical and organisational conditions and measures		
Handle substance within a predominantly closed system provided with extract ventilation. Occupational Health and Safety Management System: Advanced		
Provide a good standard of controlled ventilation (5 to 10 air changes per hour).		

Inhalation - minimum efficiency of 70 %		
Local exhaust ventilation Inhalation - minimum efficiency of 90 %		
Conditions and measures related to personal protection, hygiene and health evaluation		
Wear chemically resistant gloves (tested to EN374) in combination with 'basic' employee training. Dermal - minimum efficiency of 90 %		
Other conditions affecting workers exposure		
Indoor or outdoor use	:	Indoor
Temperature	:	Assumes process temperature up to 20 °C

2.2.7. Control of worker exposure: General exposures (open systems), Local exhaust ventilation, Indoor
Chemical production where opportunity for exposure arises (PROC4)

Amount used, frequency and duration of use (or from service life)		
Duration	:	Covers use up to 0,25 h
Technical and organisational conditions and measures		
Occupational Health and Safety Management System: Advanced Provide extract ventilation to points where emissions occur.		
Provide a good standard of controlled ventilation (5 to 10 air changes per hour). Inhalation - minimum efficiency of 70 %		
Local exhaust ventilation Inhalation - minimum efficiency of 90 %		
Conditions and measures related to personal protection, hygiene and health evaluation		
Wear chemically resistant gloves (tested to EN374) in combination with 'basic' employee training. Dermal - minimum efficiency of 90 %		
Other conditions affecting workers exposure		
Indoor or outdoor use	:	Indoor use
Temperature	:	Assumes process temperature up to 20 °C

2.2.8. Control of worker exposure: General exposures (open systems), Respiratory protection, Indoor
Chemical production where opportunity for exposure arises (PROC4)

Amount used, frequency and duration of use (or from service life)		
Duration	:	Covers use up to 1 h
Technical and organisational conditions and measures		
Occupational Health and Safety Management System: Advanced		
Provide a good standard of controlled ventilation (5 to 10 air changes per hour). Inhalation - minimum efficiency of 70 %		
Conditions and measures related to personal protection, hygiene and health evaluation		
Wear chemically resistant gloves (tested to EN374) in combination with 'basic' employee training. Dermal - minimum efficiency of 90 %		
Wear suitable respiratory protection. Efficiency: APF 20 Inhalation - minimum efficiency of 95 %		
Other conditions affecting workers exposure		
Indoor or outdoor use	:	Indoor use
Temperature	:	Assumes process temperature up to 20 °C

2.2.9. Control of worker exposure: Batch processes at elevated temperatures, Use in contained batch processes, Local exhaust ventilation, Indoor
Manufacture or formulation in the chemical industry in closed batch processes with occasional controlled exposure or processes with equivalent containment condition (PROC3)

Amount used, frequency and duration of use (or from service life)		
Duration	:	Covers use up to 1 h
Technical and organisational conditions and measures		
Closed batch process with occasional controlled exposure Formulate in enclosed or ventilated mixing vessels. Ensure material transfers are under containment or extract ventilation.		
Occupational Health and Safety Management System: Advanced		
Provide a good standard of controlled ventilation (5 to 10 air changes per hour). Inhalation - minimum efficiency of 70 %		
Local exhaust ventilation Inhalation - minimum efficiency of 90 %		

Conditions and measures related to personal protection, hygiene and health evaluation		
Wear chemically resistant gloves (tested to EN374) in combination with 'basic' employee training. Dermal - minimum efficiency of 90 %		
Other conditions affecting workers exposure		
Indoor or outdoor use	:	Indoor use
Temperature	:	Assumes process temperature up to 20 °C

2.2.10. Control of worker exposure: Batch processes at elevated temperatures, Use in contained batch processes, Respiratory protection, Indoor
Manufacture or formulation in the chemical industry in closed batch processes with occasional controlled exposure or processes with equivalent containment condition (PROC3)

Amount used, frequency and duration of use (or from service life)		
Duration	:	Covers use up to 1 h
Technical and organisational conditions and measures		
Closed batch process with occasional controlled exposure		
Occupational Health and Safety Management System: Advanced		
Provide a good standard of controlled ventilation (5 to 10 air changes per hour). Inhalation - minimum efficiency of 70 %		
Conditions and measures related to personal protection, hygiene and health evaluation		
Wear chemically resistant gloves (tested to EN374) in combination with 'basic' employee training. Dermal - minimum efficiency of 90 %		
Wear suitable respiratory protection. Efficiency: APF 10 Inhalation - minimum efficiency of 90 %		
Other conditions affecting workers exposure		
Indoor or outdoor use	:	Indoor use
Temperature	:	Assumes process temperature up to 20 °C

2.2.11. Control of worker exposure: Process sampling, Indoor
Transfer of substance or mixture into small containers (dedicated filling line, including weighing) (PROC9)

Amount used, frequency and duration of use (or from service life)		
Duration	:	Covers use up to 0,25 h
Technical and organisational conditions and measures		
Occupational Health and Safety Management System: Advanced		
Provide a good standard of controlled ventilation (5 to 10 air changes per hour). Inhalation - minimum efficiency of 70 %		
Conditions and measures related to personal protection, hygiene and health evaluation		
Wear chemically resistant gloves (tested to EN374) in combination with 'basic' employee training. Dermal - minimum efficiency of 90 %		
Wear suitable respiratory protection. Efficiency: APF 20 Inhalation - minimum efficiency of 95 %		
Other conditions affecting workers exposure		
Indoor or outdoor use	:	Indoor use
Temperature	:	Assumes process temperature up to 20 °C

2.2.12. Control of worker exposure: Laboratory activities, Local exhaust ventilation, Indoor Use as laboratory reagent (PROC15)

Amount used, frequency and duration of use (or from service life)		
Duration	:	Covers use up to 1 h
Technical and organisational conditions and measures		
Occupational Health and Safety Management System: Advanced		
Handle in a fume cupboard or under extract ventilation. Local exhaust ventilation Inhalation - minimum efficiency of 90 %		
Provide a good standard of controlled ventilation (5 to 10 air changes per hour). Inhalation - minimum efficiency of 70 %		
Conditions and measures related to personal protection, hygiene and health evaluation		
Wear chemically resistant gloves (tested to EN374) in combination with 'basic' employee training. Dermal - minimum efficiency of 90 %		

Other conditions affecting workers exposure		
Indoor or outdoor use	:	Indoor use
Temperature	:	Assumes process temperature up to 20 °C

2.2.13. Control of worker exposure: Bulk transfers, Dedicated facility, Local exhaust ventilation, Indoor
Transfer of substance or mixture (charging/discharging) at dedicated facilities (PROC8b)

Amount used, frequency and duration of use (or from service life)		
Duration	:	Covers use up to 1 h
Technical and organisational conditions and measures		
Occupational Health and Safety Management System: Advanced		
Ensure material transfers are under containment or extract ventilation. Local exhaust ventilation Inhalation - minimum efficiency of 95 %		
Provide a good standard of controlled ventilation (5 to 10 air changes per hour). Inhalation - minimum efficiency of 70 %		
Conditions and measures related to personal protection, hygiene and health evaluation		
Wear chemically resistant gloves (tested to EN374) in combination with specific activity training. Dermal - minimum efficiency of 95 %		
Other conditions affecting workers exposure		
Indoor or outdoor use	:	Indoor use
Temperature	:	Assumes process temperature up to 20 °C

2.2.14. Control of worker exposure: Bulk transfers, Dedicated facility, Respiratory protection, Indoor
Transfer of substance or mixture (charging/discharging) at dedicated facilities (PROC8b)

Amount used, frequency and duration of use (or from service life)		
Duration	:	Covers use up to 1 h
Technical and organisational conditions and measures		
Occupational Health and Safety Management System: Advanced		

Provide a good standard of controlled ventilation (5 to 10 air changes per hour). Inhalation - minimum efficiency of 70 %		
Conditions and measures related to personal protection, hygiene and health evaluation		
Wear chemically resistant gloves (tested to EN374) in combination with specific activity training. Dermal - minimum efficiency of 95 %		
Respiratory protection Efficiency: APF 20 Inhalation - minimum efficiency of 95 %		
Other conditions affecting workers exposure		
Indoor or outdoor use	:	Indoor use
Temperature	:	Assumes process temperature up to 20 °C

2.2.15. Control of worker exposure: Mixing operations (open systems), Local exhaust ventilation, Indoor
Mixing or blending in batch processes (PROC5)

Amount used, frequency and duration of use (or from service life)		
Duration	:	Covers use up to 4 h
Technical and organisational conditions and measures		
Occupational Health and Safety Management System: Advanced		
Provide a good standard of controlled ventilation (5 to 10 air changes per hour). Inhalation - minimum efficiency of 70 %		
Conditions and measures related to personal protection, hygiene and health evaluation		
Wear chemically resistant gloves (tested to EN374) in combination with specific activity training. Dermal - minimum efficiency of 95 %		
Respiratory protection Efficiency: APF 10 Inhalation - minimum efficiency of 90 %		
Other conditions affecting workers exposure		
Indoor or outdoor use	:	Indoor use
Temperature	:	Assumes process temperature up to 20 °C

2.2.16. Control of worker exposure: Manual, Transfer from/pouring from containers, Non-dedicated facility, Respiratory protection, Indoor

Transfer of substance or mixture (charging/discharging) at non dedicated-facilities (PROC8a)

Amount used, frequency and duration of use (or from service life)		
Duration	:	Covers use up to 1 h
Technical and organisational conditions and measures		
Occupational Health and Safety Management System: Advanced		
Provide a good standard of general ventilation (not less than 3 to 5 air changes per hour). Inhalation - minimum efficiency of 30 %		
Local exhaust ventilation Provide extract ventilation to points where emissions occur. Inhalation - minimum efficiency of 90 %		
Conditions and measures related to personal protection, hygiene and health evaluation		
Wear chemically resistant gloves (tested to EN374) in combination with specific activity training. Dermal - minimum efficiency of 95 %		
Respiratory protection Efficiency: APF 10 Inhalation - minimum efficiency of 90 %		
Other conditions affecting workers exposure		
Indoor or outdoor use	:	Indoor use
Temperature	:	Assumes process temperature up to 20 °C

2.2.17. Control of worker exposure: Drum/batch transfers, Dedicated facility, Local exhaust ventilation, Indoor
Transfer of substance or mixture (charging/discharging) at dedicated facilities (PROC8b)

Amount used, frequency and duration of use (or from service life)		
Duration	:	Covers use up to 1 h
Technical and organisational conditions and measures		
Occupational Health and Safety Management System: Advanced		
Provide a good standard of controlled ventilation (5 to 10 air changes per hour). Inhalation - minimum efficiency of 70 %		
Local exhaust ventilation Provide extract ventilation to points where emissions occur. Inhalation - minimum efficiency of 95 %		

Conditions and measures related to personal protection, hygiene and health evaluation		
Wear chemically resistant gloves (tested to EN374) in combination with specific activity training. Dermal - minimum efficiency of 95 %		
Other conditions affecting workers exposure		
Indoor or outdoor use	:	Indoor use
Temperature	:	Assumes process temperature up to 20 °C

2.2.18. Control of worker exposure: Drum/batch transfers, Dedicated facility, Respiratory protection, Indoor
Transfer of substance or mixture (charging/discharging) at dedicated facilities (PROC8b)

Amount used, frequency and duration of use (or from service life)		
Duration	:	Covers use up to 4 h
Technical and organisational conditions and measures		
Occupational Health and Safety Management System: Advanced		
Provide a good standard of general ventilation (not less than 3 to 5 air changes per hour). Inhalation - minimum efficiency of 30 %		
Local exhaust ventilation Inhalation - minimum efficiency of 95 %		
Conditions and measures related to personal protection, hygiene and health evaluation		
Wear chemically resistant gloves (tested to EN374) in combination with specific activity training. Dermal - minimum efficiency of 95 %		
Respiratory protection Efficiency: APF 10 Inhalation - minimum efficiency of 90 %		
Other conditions affecting workers exposure		
Indoor or outdoor use	:	Indoor use
Temperature	:	Assumes process temperature up to 20 °C

2.2.19. Control of worker exposure: Production or preparation or articles by tabletting, compression, extrusion or pelletisation, Local exhaust ventilation, Indoor
Production of preparations or articles by tabletting, compression, extrusion, pelletisation (PROC14)

Amount used, frequency and duration of use (or from service life)		
Duration	:	Covers use up to 4 h
Technical and organisational conditions and measures		
Occupational Health and Safety Management System: Advanced		
Provide a good standard of controlled ventilation (5 to 10 air changes per hour). Inhalation - minimum efficiency of 70 %		
Local exhaust ventilation Handle substance within a predominantly closed system provided with extract ventilation. Inhalation - minimum efficiency of 90 %		
Conditions and measures related to personal protection, hygiene and health evaluation		
Wear chemically resistant gloves (tested to EN374) in combination with 'basic' employee training. Dermal - minimum efficiency of 90 %		
Respiratory protection Efficiency: APF 10 Inhalation - minimum efficiency of 90 %		
Other conditions affecting workers exposure		
Indoor or outdoor use	:	Indoor use
Temperature	:	Assumes process temperature up to 20 °C

2.2.20. Control of worker exposure: Drum and small package filling, Indoor
Transfer of substance or mixture into small containers (dedicated filling line, including weighing) (PROC9)

Amount used, frequency and duration of use (or from service life)		
Duration	:	Covers use up to 1 h
Technical and organisational conditions and measures		
Occupational Health and Safety Management System: Advanced		
Provide a good standard of controlled ventilation (5 to 10 air changes per hour). Inhalation - minimum efficiency of 70 %		
Local exhaust ventilation Inhalation - minimum efficiency of 90 %		
Conditions and measures related to personal protection, hygiene and health evaluation		

Wear chemically resistant gloves (tested to EN374) in combination with 'basic' employee training. Dermal - minimum efficiency of 90 %		
Respiratory protection Efficiency: APF 10 Inhalation - minimum efficiency of 90 %		
Other conditions affecting workers exposure		
Indoor or outdoor use	:	Indoor use
Temperature	:	Assumes process temperature up to 20 °C

2.2.21. Control of worker exposure: Drum and small package filling, Respiratory protection, Indoor Transfer of substance or mixture into small containers (dedicated filling line, including weighing) (PROC9)

Amount used, frequency and duration of use (or from service life)		
Duration	:	Covers use up to 1 h
Technical and organisational conditions and measures		
Occupational Health and Safety Management System: Advanced		
Provide a good standard of general ventilation (not less than 3 to 5 air changes per hour). Inhalation - minimum efficiency of 30 %		
Local exhaust ventilation Inhalation - minimum efficiency of 90 %		
Conditions and measures related to personal protection, hygiene and health evaluation		
Wear chemically resistant gloves (tested to EN374) in combination with 'basic' employee training. Dermal - minimum efficiency of 90 %		
Respiratory protection Efficiency: APF 10 Inhalation - minimum efficiency of 90 %		
Other conditions affecting workers exposure		
Indoor or outdoor use	:	Indoor use
Temperature	:	Assumes process temperature up to 20 °C

2.2.22. Control of worker exposure: Equipment cleaning and maintenance, Respiratory protection, Indoor
Transfer of substance or mixture (charging/discharging) at non dedicated-facilities (PROC8a) / Manual maintenance (cleaning and repair) of machinery (PROC28)

Amount used, frequency and duration of use (or from service life)		
Duration	:	Covers use up to 1 h
Technical and organisational conditions and measures		
Occupational Health and Safety Management System: Advanced		
Provide a good standard of general ventilation (not less than 3 to 5 air changes per hour). Inhalation - minimum efficiency of 30 %		
Local exhaust ventilation Drain down and flush system prior to equipment break-in or maintenance. Inhalation - minimum efficiency of 90 %		
Conditions and measures related to personal protection, hygiene and health evaluation		
Wear chemically resistant gloves (tested to EN374) in combination with 'basic' employee training. Dermal - minimum efficiency of 90 %		
Respiratory protection Efficiency: APF 10 Inhalation - minimum efficiency of 90 %		
Other conditions affecting workers exposure		
Indoor or outdoor use	:	Indoor use
Temperature	:	Assumes process temperature up to 20 °C

2.2.23. Control of worker exposure: Storage, Outdoor
Chemical production or refinery in closed process without likelihood of exposure or processes with equivalent containment conditions (PROC1) / Chemical production or refinery in closed continuous process with occasional controlled exposure or processes with equivalent containment conditions (PROC2)

Technical and organisational conditions and measures		
Occupational Health and Safety Management System: Advanced		
Conditions and measures related to personal protection, hygiene and health evaluation		
Wear chemically resistant gloves (tested to EN374) in combination with 'basic' employee training. Dermal - minimum efficiency of 90 %		
Other conditions affecting workers exposure		
Indoor or outdoor use	:	Outdoor use
Temperature	:	Assumes process temperature up to 20 °C

2.2.24. Control of worker exposure: Storage, Indoor
Chemical production or refinery in closed process without likelihood of exposure or processes with equivalent containment conditions (PROC1) / Chemical production or refinery in closed continuous process with occasional controlled exposure or processes with equivalent containment conditions (PROC2)

Amount used, frequency and duration of use (or from service life)		
Duration	:	Covers use up to 0,25 h
Technical and organisational conditions and measures		
Use in closed, continuous process with occasional controlled exposure Occupational Health and Safety Management System: Advanced		
Provide a good standard of general ventilation (not less than 3 to 5 air changes per hour). Inhalation - minimum efficiency of 30 %		
Local exhaust ventilation Inhalation - minimum efficiency of 90 %		
Conditions and measures related to personal protection, hygiene and health evaluation		
Wear chemically resistant gloves (tested to EN374) in combination with 'basic' employee training. Dermal - minimum efficiency of 90 %		
Other conditions affecting workers exposure		
Indoor or outdoor use	:	Indoor use
Temperature	:	Assumes process temperature up to 20 °C

2.3. Exposure estimation and reference to its source

2.3.1. Environmental release and exposure: Formulation into mixture (ERC2)

Compartment	Exposure level	RCR
Freshwater	0,21 mg/L	0,69
Marine water	0,021 mg/L	0,069
Freshwater sediment	0,96 mg/kg wet weight	0,91
Marine sediment	0,096 mg/kg wet weight	0,091
Agricultural soil	0,0055 mg/kg wet weight	0,016

2.3.3. Worker exposure: Chemical production or refinery in closed process without likelihood of exposure or processes with equivalent containment conditions (PROC1)

Exposure route	Health effect	Exposure indicator	Exposure level	RCR	Remarks
inhalative	systemic	long-term	0,023 mg/m³	0,012	Benzene
inhalative	systemic	short-term	0,091 mg/m³		Benzene
dermal	systemic	long-term	0,0034 mg/kg bw/day		Benzene
dermal	local	long-term	0,00099 mg/cm2		Benzene
dermal	local	short-term	0,00099 mg/cm2		Benzene
combined routes	systemic	long-term		0,012	

Additional information on exposure estimation
Available hazard data do not enable the derivation of a DNEL for dermal irritant effects. Available hazard data do not enable the derivation of a DNEL for eye irritant effects. Risk management measures are based on qualitative risk characterisation. Predicted exposures are not expected to exceed the DN(M)EL when the risk management measures/operational conditions outlined in section 2 are implemented.

2.3.4. Worker exposure: Chemical production or refinery in closed process without likelihood of exposure or processes with equivalent containment conditions (PROC1)

Exposure route	Health effect	Exposure indicator	Exposure level	RCR	Remarks
inhalative	systemic	long-term	0,023 mg/m³	0,012	Benzene
inhalative	systemic	short-term	0,091 mg/m³		Benzene
dermal	systemic	long-term	0,0034 mg/kg bw/day		Benzene
dermal	local	long-term	0,00099 mg/cm2		Benzene
dermal	local	short-term	0,00099 mg/cm2		Benzene
combined routes	systemic	long-term		0,012	

Additional information on exposure estimation
Available hazard data do not enable the derivation of a DNEL for dermal irritant effects. Available hazard data do not enable the derivation of a DNEL for eye irritant effects. Risk management measures are based on qualitative risk characterisation. Predicted exposures are not expected to exceed the DN(M)EL when the risk management measures/operational conditions outlined in section 2 are implemented.

2.3.5. Worker exposure: Chemical production or refinery in closed continuous process with occasional controlled exposure or processes with equivalent containment conditions (PROC2)

Exposure route	Health effect	Exposure indicator	Exposure level	RCR	Remarks
inhalative	systemic	long-term	1,465 mg/m³	0,771	Benzene
inhalative	systemic	short-term	9,764 mg/m³		Benzene
dermal	systemic	long-term	0,082 mg/kg bw/day	0,087	Benzene
dermal	local	long-term	0,012 mg/cm2		Benzene
dermal	local	short-term	0,012 mg/cm2		Benzene
combined routes	systemic	long-term		0,112	

Additional information on exposure estimation
Available hazard data do not enable the derivation of a DNEL for dermal irritant effects. Available hazard data do not enable the derivation of a DNEL for eye irritant effects. Risk management measures are based on qualitative risk characterisation. Predicted exposures are not expected to exceed the DN(M)EL when the risk management measures/operational conditions outlined in section 2 are implemented.

2.3.6. Worker exposure: Manufacture or formulation in the chemical industry in closed batch processes with occasional controlled exposure or processes with equivalent containment condition (PROC3)

Exposure route	Health effect	Exposure indicator	Exposure level	RCR	Remarks
inhalative	systemic	long-term	0,976 mg/m³	0,514	Benzene
inhalative	systemic	short-term	19,52 mg/m³		Benzene
dermal	systemic	long-term	0,014 mg/kg bw/day	0,044	Benzene
dermal	local	long-term	0,004 mg/cm2		Benzene
dermal	local	short-term	0,004 mg/cm2		Benzene
combined routes	systemic	long-term		0,069	

Additional information on exposure estimation
Available hazard data do not enable the derivation of a DNEL for dermal irritant effects. Available hazard data do not enable the derivation of a DNEL for eye irritant effects. Risk management measures are based on qualitative risk characterisation. Predicted exposures are not expected to exceed the DN(M)EL when the risk management

measures/operational conditions outlined in section 2 are implemented.

2.3.7. Worker exposure: Chemical production where opportunity for exposure arises (PROC4)

Exposure route	Health effect	Exposure indicator	Exposure level	RCR	Remarks
inhalative	systemic	long-term	0,976 mg/m³	0,514	Benzene
inhalative	systemic	short-term	39,05 mg/m³		Benzene
dermal	systemic	long-term	0,069 mg/kg bw/day	0,433	Benzene
dermal	local	long-term	0,01 mg/cm2		Benzene
dermal	local	short-term	0,01 mg/cm2		Benzene
combined routes	systemic	long-term		0,455	

Additional information on exposure estimation
Available hazard data do not enable the derivation of a DNEL for dermal irritant effects. Available hazard data do not enable the derivation of a DNEL for eye irritant effects. Risk management measures are based on qualitative risk characterisation. Predicted exposures are not expected to exceed the DN(M)EL when the risk management measures/operational conditions outlined in section 2 are implemented.

2.3.8. Worker exposure: Chemical production where opportunity for exposure arises (PROC4)

Exposure route	Health effect	Exposure indicator	Exposure level	RCR	Remarks
inhalative	systemic	long-term	0,976 mg/m³	0,514	Benzene
inhalative	systemic	short-term	19,52 mg/m³		Benzene
dermal	systemic	long-term	0,137 mg/kg bw/day	0,433	Benzene
dermal	local	long-term	0,02 mg/cm2		Benzene
dermal	local	short-term	0,02 mg/cm2		Benzene
combined routes	systemic	long-term		0,455	

Additional information on exposure estimation
Available hazard data do not enable the derivation of a DNEL for dermal irritant effects. Available hazard data do not enable the derivation of a DNEL for eye irritant effects. Risk management measures are based on qualitative risk characterisation. Predicted exposures are not expected to exceed the DN(M)EL when the risk management measures/operational conditions outlined in section 2 are implemented.

2.3.9. Worker exposure: Manufacture or formulation in the chemical industry in closed batch processes with occasional controlled exposure or processes with equivalent containment condition (PROC3)

Exposure route	Health effect	Exposure indicator	Exposure level	RCR	Remarks
inhalative	systemic	long-term	0,976 mg/m³	0,514	Benzene
inhalative	systemic	short-term	19,52 mg/m³		Benzene
dermal	systemic	long-term	0,014 mg/kg bw/day	0,044	Benzene
dermal	local	long-term	0,004 mg/cm2		Benzene
dermal	local	short-term	0,004 mg/cm2		Benzene
combined routes	systemic	long-term		0,069	

Additional information on exposure estimation
Available hazard data do not enable the derivation of a DNEL for dermal irritant effects. Available hazard data do not enable the derivation of a DNEL for eye irritant effects. Risk management measures are based on qualitative risk characterisation. Predicted exposures are not expected to exceed the DN(M)EL when the risk management measures/operational conditions outlined in section 2 are implemented.

2.3.10. Worker exposure: Manufacture or formulation in the chemical industry in closed batch processes with occasional controlled exposure or processes with equivalent containment condition (PROC3)

Exposure route	Health effect	Exposure indicator	Exposure level	RCR	Remarks
inhalative	systemic	long-term	0,976 mg/m³	0,514	Benzene
inhalative	systemic	short-term	19,52 mg/m³		Benzene
dermal	systemic	long-term	0,014 mg/kg bw/day	0,044	Benzene
dermal	local	long-term	0,004 mg/cm2		Benzene
dermal	local	short-term	0,004 mg/cm2		Benzene
combined routes	systemic	long-term		0,069	

Additional information on exposure estimation
Available hazard data do not enable the derivation of a DNEL for dermal irritant effects. Available hazard data do not enable the derivation of a DNEL for eye irritant effects. Risk management measures are based on qualitative risk characterisation.

Predicted exposures are not expected to exceed the DN(M)EL when the risk management measures/operational conditions outlined in section 2 are implemented.

2.3.11. Worker exposure: Transfer of substance or mixture into small containers (dedicated filling line, including weighing) (PROC9)

Exposure route	Health effect	Exposure indicator	Exposure level	RCR	Remarks
inhalative	systemic	long-term	0,976 mg/m³	0,514	Benzene
inhalative	systemic	short-term	39,05 mg/m³		Benzene
dermal	systemic	long-term	0,069 mg/kg bw/day	0,043	Benzene
dermal	local	long-term	0,01 mg/cm2		Benzene
dermal	local	short-term	0,01 mg/cm2		Benzene
combined routes	systemic	long-term		0,444	

Additional information on exposure estimation
Available hazard data do not enable the derivation of a DNEL for dermal irritant effects. Available hazard data do not enable the derivation of a DNEL for eye irritant effects. Risk management measures are based on qualitative risk characterisation. Predicted exposures are not expected to exceed the DN(M)EL when the risk management measures/operational conditions outlined in section 2 are implemented.

2.3.12. Worker exposure: Use as laboratory reagent (PROC15)

Exposure route	Health effect	Exposure indicator	Exposure level	RCR	Remarks
inhalative	systemic	long-term	0,976 mg/m³	0,514	Benzene
inhalative	systemic	short-term	19,52 mg/m³		Benzene
dermal	systemic	long-term	0,0068 mg/kg bw/day	0,021	Benzene
dermal	local	long-term	0,002 mg/cm2		Benzene
dermal	local	short-term	0,002 mg/cm2		Benzene
combined routes	systemic	long-term		0,064	

Additional information on exposure estimation
Available hazard data do not enable the derivation of a DNEL for dermal irritant effects. Available hazard data do not enable the derivation of a DNEL for eye irritant effects. Risk management measures are based on qualitative risk characterisation.

Predicted exposures are not expected to exceed the DN(M)EL when the risk management measures/operational conditions outlined in section 2 are implemented.

2.3.13. Worker exposure: Transfer of substance or mixture (charging/discharging) at dedicated facilities (PROC8b)

Exposure route	Health effect	Exposure indicator	Exposure level	RCR	Remarks
inhalative	systemic	long-term	1,465 mg/m³	0,771	Benzene
inhalative	systemic	short-term	29,29 mg/m³		Benzene
dermal	systemic	long-term	0,137 mg/kg bw/day	0,433	Benzene
dermal	local	long-term	0,01 mg/cm2		Benzene
dermal	local	short-term	0,01 mg/cm2		Benzene
combined routes	systemic	long-term		0,454	

Additional information on exposure estimation
Available hazard data do not enable the derivation of a DNEL for dermal irritant effects. Available hazard data do not enable the derivation of a DNEL for eye irritant effects. Risk management measures are based on qualitative risk characterisation. Predicted exposures are not expected to exceed the DN(M)EL when the risk management measures/operational conditions outlined in section 2 are implemented.

2.3.14. Worker exposure: Transfer of substance or mixture (charging/discharging) at dedicated facilities (PROC8b)

Exposure route	Health effect	Exposure indicator	Exposure level	RCR	Remarks
inhalative	systemic	long-term	1,465 mg/m³	0,771	Benzene
inhalative	systemic	short-term	29,29 mg/m³		Benzene
dermal	systemic	long-term	0,137 mg/kg bw/day	0,433	Benzene
dermal	local	long-term	0,01 mg/cm2		Benzene
dermal	local	short-term	0,01 mg/cm2		Benzene
combined routes	systemic	long-term		0,454	

Additional information on exposure estimation
Available hazard data do not enable the derivation of a DNEL for dermal irritant effects. Available hazard data do not enable the derivation of a DNEL for eye irritant effects.

Risk management measures are based on qualitative risk characterisation.
Predicted exposures are not expected to exceed the DN(M)EL when the risk management measures/operational conditions outlined in section 2 are implemented.

2.3.15. Worker exposure: Mixing or blending in batch processes (PROC5)

Exposure route	Health effect	Exposure indicator	Exposure level	RCR	Remarks
inhalative	systemic	long-term	1,465 mg/m³	0,771	Benzene
inhalative	systemic	short-term	9,764 mg/m³		Benzene
dermal	systemic	long-term	0,411 mg/kg bw/day	0,433	Benzene
dermal	local	long-term	0,06 mg/cm2		Benzene
dermal	local	short-term	0,06 mg/cm2		Benzene
combined routes	systemic	long-term		0,446	

Additional information on exposure estimation
Available hazard data do not enable the derivation of a DNEL for dermal irritant effects. Available hazard data do not enable the derivation of a DNEL for eye irritant effects. Risk management measures are based on qualitative risk characterisation. Predicted exposures are not expected to exceed the DN(M)EL when the risk management measures/operational conditions outlined in section 2 are implemented.

2.3.16. Worker exposure: Transfer of substance or mixture (charging/discharging) at non dedicated-facilities (PROC8a)

Exposure route	Health effect	Exposure indicator	Exposure level	RCR	Remarks
inhalative	systemic	long-term	1,139 mg/m³	0,771	Benzene
inhalative	systemic	short-term	22,78 mg/m³		Benzene
dermal	systemic	long-term	0,137 mg/kg bw/day	0,433	Benzene
dermal	local	long-term	0,01 mg/cm2		Benzene
dermal	local	short-term	0,01 mg/cm2		Benzene
combined routes	systemic	long-term		0,453	

Additional information on exposure estimation
Available hazard data do not enable the derivation of a DNEL for dermal irritant effects. Available hazard data do not enable the derivation of a DNEL for eye irritant effects.

Risk management measures are based on qualitative risk characterisation.
Predicted exposures are not expected to exceed the DN(M)EL when the risk management measures/operational conditions outlined in section 2 are implemented.

2.3.17. Worker exposure: Transfer of substance or mixture (charging/discharging) at dedicated facilities (PROC8b)

Exposure route	Health effect	Exposure indicator	Exposure level	RCR	Remarks
inhalative	systemic	long-term	1,465 mg/m³	0,771	Benzene
inhalative	systemic	short-term	29,29 mg/m³		Benzene
dermal	systemic	long-term	0,137 mg/kg bw/day	0,433	Benzene
dermal	local	long-term	0,01 mg/cm2		Benzene
dermal	local	short-term	0,01 mg/cm2		Benzene
combined routes	systemic	long-term		0,454	

Additional information on exposure estimation

Available hazard data do not enable the derivation of a DNEL for dermal irritant effects.
Available hazard data do not enable the derivation of a DNEL for eye irritant effects.
Risk management measures are based on qualitative risk characterisation.
Predicted exposures are not expected to exceed the DN(M)EL when the risk management measures/operational conditions outlined in section 2 are implemented.

2.3.18. Worker exposure: Transfer of substance or mixture (charging/discharging) at dedicated facilities (PROC8b)

Exposure route	Health effect	Exposure indicator	Exposure level	RCR	Remarks
inhalative	systemic	long-term	1,025 mg/m³	0,54	Benzene
inhalative	systemic	short-term	6,835 mg/m³		Benzene
dermal	systemic	long-term	0,411 mg/kg bw/day	0,433	Benzene
dermal	local	long-term	0,03 mg/cm2		Benzene
dermal	local	short-term	0,03 mg/cm2		Benzene
combined routes	systemic	long-term		0,448	

Additional information on exposure estimation

Available hazard data do not enable the derivation of a DNEL for dermal irritant effects.

Available hazard data do not enable the derivation of a DNEL for eye irritant effects.
Risk management measures are based on qualitative risk characterisation.
Predicted exposures are not expected to exceed the DN(M)EL when the risk management measures/operational conditions outlined in section 2 are implemented.

2.3.19. Worker exposure: Production of preparations or articles by tabletting, compression, extrusion, pelletisation (PROC14)

Exposure route	Health effect	Exposure indicator	Exposure level	RCR	Remarks
inhalative	systemic	long-term	1,465 mg/m³	0,771	Benzene
inhalative	systemic	short-term	9,764 mg/m³		Benzene
dermal	systemic	long-term	0,206 mg/kg bw/day	0,217	Benzene
dermal	local	long-term	0,03 mg/cm2		Benzene
dermal	local	short-term	0,03 mg/cm2		Benzene
combined routes	systemic	long-term		0,23	

Additional information on exposure estimation

Available hazard data do not enable the derivation of a DNEL for dermal irritant effects.
Available hazard data do not enable the derivation of a DNEL for eye irritant effects.
Risk management measures are based on qualitative risk characterisation.
Predicted exposures are not expected to exceed the DN(M)EL when the risk management measures/operational conditions outlined in section 2 are implemented.

2.3.20. Worker exposure: Transfer of substance or mixture into small containers (dedicated filling line, including weighing) (PROC9)

Exposure route	Health effect	Exposure indicator	Exposure level	RCR	Remarks
inhalative	systemic	long-term	0,91 mg/m³	0,206	Benzene
inhalative	systemic	short-term	7,811 mg/m³		Benzene
dermal	systemic	long-term	0,137 mg/kg bw/day	0,433	Benzene
dermal	local	long-term	0,02 mg/cm2		Benzene
dermal	local	short-term	0,02 mg/cm2		Benzene
combined routes	systemic	long-term		0,438	

Additional information on exposure estimation

Available hazard data do not enable the derivation of a DNEL for dermal irritant effects.
Available hazard data do not enable the derivation of a DNEL for eye irritant effects.
Risk management measures are based on qualitative risk characterisation.
Predicted exposures are not expected to exceed the DN(M)EL when the risk management measures/operational conditions outlined in section 2 are implemented.

2.3.21. Worker exposure: Transfer of substance or mixture into small containers (dedicated filling line, including weighing) (PROC9)

Exposure route	Health effect	Exposure indicator	Exposure level	RCR	Remarks
inhalative	systemic	long-term	0,911 mg/m³	0,48	Benzene
inhalative	systemic	short-term	18,22 mg/m³		Benzene
dermal	systemic	long-term	0,137 mg/kg bw/day	0,433	Benzene
dermal	local	long-term	0,02 mg/cm2		Benzene
dermal	local	short-term	0,02 mg/cm2		Benzene
combined routes	systemic	long-term		0,443	

Additional information on exposure estimation

Available hazard data do not enable the derivation of a DNEL for dermal irritant effects.
Available hazard data do not enable the derivation of a DNEL for eye irritant effects.
Risk management measures are based on qualitative risk characterisation.
Predicted exposures are not expected to exceed the DN(M)EL when the risk management measures/operational conditions outlined in section 2 are implemented.

2.3.22. Worker exposure: Transfer of substance or mixture (charging/discharging) at non dedicated-facilities (PROC8a) / Manual maintenance (cleaning and repair) of machinery (PROC28)

Exposure route	Health effect	Exposure indicator	Exposure level	RCR	Remarks
inhalative	systemic	long-term	1,139 mg/m³	0,6	Benzene
inhalative	systemic	short-term	22,78 mg/m³		Benzene
dermal	systemic	long-term	0,274 mg/kg bw/day	0,866	Benzene
dermal	local	long-term	0,02 mg/cm2		Benzene
dermal	local	short-term	0,02 mg/cm2		Benzene
combined routes	systemic	long-term		0,886	

Additional information on exposure estimation

Available hazard data do not enable the derivation of a DNEL for dermal irritant effects.
Available hazard data do not enable the derivation of a DNEL for eye irritant effects.
Risk management measures are based on qualitative risk characterisation.
Predicted exposures are not expected to exceed the DN(M)EL when the risk management measures/operational conditions outlined in section 2 are implemented.

2.3.23. Worker exposure: Chemical production or refinery in closed process without likelihood of exposure or processes with equivalent containment conditions (PROC1) / Chemical production or refinery in closed continuous process with occasional controlled exposure or processes with equivalent containment conditions (PROC2)

Exposure route	Health effect	Exposure indicator	Exposure level	RCR	Remarks
inhalative	systemic	long-term	0,023 mg/m³	0,012	Benzene
inhalative	systemic	short-term	0,091 mg/m³		Benzene
dermal	systemic	long-term	0,0034 mg/kg bw/day	< 0,01	Benzene
dermal	local	long-term	0,00099 mg/cm2		Benzene
dermal	local	short-term	0,00099 mg/cm2		Benzene
combined routes	systemic	long-term		0,012	

Additional information on exposure estimation
Available hazard data do not enable the derivation of a DNEL for dermal irritant effects. Available hazard data do not enable the derivation of a DNEL for eye irritant effects. Risk management measures are based on qualitative risk characterisation. Predicted exposures are not expected to exceed the DN(M)EL when the risk management measures/operational conditions outlined in section 2 are implemented.

2.3.24. Worker exposure: Chemical production or refinery in closed process without likelihood of exposure or processes with equivalent containment conditions (PROC1) / Chemical production or refinery in closed continuous process with occasional controlled exposure or processes with equivalent containment conditions (PROC2)

Exposure route	Health effect	Exposure indicator	Exposure level	RCR	Remarks
inhalative	systemic	long-term	0,57 mg/m³	0,3	Benzene
inhalative	systemic	short-term	22,78 mg/m³		Benzene
dermal	systemic	long-term	0,014 mg/kg bw/day	0,087	Benzene
dermal	local	long-term	0,002 mg/cm2		Benzene
dermal	local	short-term	0,002 mg/cm2		Benzene

combined routes	systemic	long-term		0,097	

Additional information on exposure estimation
Available hazard data do not enable the derivation of a DNEL for dermal irritant effects. Available hazard data do not enable the derivation of a DNEL for eye irritant effects. Risk management measures are based on qualitative risk characterisation. Predicted exposures are not expected to exceed the DN(M)EL when the risk management measures/operational conditions outlined in section 2 are implemented.

2.4. Guidance to DU to evaluate whether he works inside the boundaries set by the ES

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.

ES3: Use as an intermediate

3.1. Title section

Structured Short Title	:	Use at industrial sites, Use as an intermediate

Environment		
CS1	**Environment**	ERC6a
Worker		
CS2	**General measures (eye irritants), General measures (skin irritants), General measures (carcinogens), General risk management measures applicable to all activities**	PROC1, PROC2, PROC3, PROC4, PROC5, PROC8a, PROC8b, PROC9, PROC14, PROC15, PROC28
CS3	**General exposures (closed systems), Indoor**	PROC1
CS4	**General exposures (closed systems), Outdoor**	PROC1
CS5	**General exposures (closed systems), Local exhaust ventilation, Indoor**	PROC2
CS6	**General exposures (closed systems), Local exhaust ventilation, Indoor**	PROC3
CS7	**General exposures (open systems), Local exhaust ventilation, Indoor**	PROC4
CS8	**General exposures (open systems), Respiratory protection, Indoor**	PROC4
CS9	**General exposures (open systems), Respiratory protection, Outdoor**	PROC4
CS10	**Process sampling, Local exhaust ventilation, Indoor**	PROC9
CS11	**Process sampling, Respiratory protection, Indoor**	PROC9
CS12	**Process sampling, Respiratory protection, Outdoor**	PROC9
CS13	**Laboratory activities, Local exhaust ventilation, Indoor**	PROC15
CS14	**Bulk transfers, Closed systems, Local exhaust ventilation, Indoor**	PROC8b
CS15	**Bulk transfers, Open systems, Local exhaust ventilation, Indoor**	PROC8b
CS16	**Bulk transfers, Open systems, Respiratory protection, Indoor**	PROC8b
CS17	**Equipment cleaning and maintenance, Local exhaust ventilation, Indoor**	PROC8a,

		PROC28
CS18	**Storage, Outdoor**	PROC1, PROC2

3.2. Conditions of use affecting exposure

3.2.1. Control of environmental exposure: Use of intermediate (ERC6a)

Amount used, frequency and duration of use (or from service life)		
Annual amount per site	:	1400000 tonnes/year
Daily amount per site	:	4500000 kg/day
Emission days	:	300
Conditions and measures related to sewage treatment plant		
STP type	:	Municipal Sewage Treatment Plant
STP effluent	:	10.000 m³/d
Other conditions affecting environmental exposure		
Local freshwater dilution factor	:	10
Local marine water dilution factor	:	100

3.2.2. Control of worker exposure: General measures (eye irritants), General measures (skin irritants), General measures (carcinogens), General risk management measures applicable to all activities

Chemical production or refinery in closed process without likelihood of exposure or processes with equivalent containment conditions (PROC1) / Chemical production or refinery in closed continuous process with occasional controlled exposure or processes with equivalent containment conditions (PROC2) / Manufacture or formulation in the chemical industry in closed batch processes with occasional controlled exposure or processes with equivalent containment condition (PROC3) / Chemical production where opportunity for exposure arises (PROC4) / Mixing or blending in batch processes (PROC5) / Transfer of substance or mixture (charging/discharging) at non dedicated-facilities (PROC8a) / Transfer of substance or mixture (charging/discharging) at dedicated facilities (PROC8b) / Transfer of substance or mixture into small containers (dedicated filling line, including weighing) (PROC9) / Tabletting, compression, extrusion, pelettisation, granulation (PROC14) / Use as laboratory reagent (PROC15) / Manual maintenance (cleaning and repair) of machinery (PROC28)

Product (article) characteristics		
Covers percentage substance in the product up to 100 %.		
Physical form of product	:	Liquid
Amount used, frequency and duration of use (or from service life)		
Duration	:	Covers daily exposures up to 8 hours (unless stated differently).
Conditions and measures related to personal protection, hygiene and health evaluation		
General measures (eye irritants) Use suitable eye protection. Avoid direct eye contact with product, also via contamination on hands.		
General measures (skin irritants) Avoid direct skin contact with product. Identify potential areas for indirect skin contact. Wear gloves (tested to EN374) if hand contact with substance likely. Clean up contamination/spills as soon as they occur. Wash off any skin contamination immediately. Provide basic employee training to prevent / minimise exposures and to report any skin problems that may develop.		
Additional good practice advice. Obligations according to Article 37(4) of REACH do not apply		
General measures (carcinogens) Consider technical advances and process upgrades (including automation) for the elimination of releases. Minimise exposure using measures such as closed systems, dedicated facilities and suitable general/local exhaust ventilation. Drain down systems and clear transfer lines prior to breaking containment. Clean/flush equipment, where possible, prior to maintenance. Where there is potential for exposure: restrict access to authorised persons; provide specific activity training to operators to minimise exposures; wear suitable gloves and coveralls to prevent skin contamination; wear respiratory protection when its use is identified for certain contributing scenarios; clear up spills immediately and dispose of wastes safely. Ensure safe systems of work or equivalent arrangements are in place to manage risks. Regularly inspect, test and maintain all control measures. Consider the need for risk based health surveillance.		

3.2.3. Control of worker exposure: General exposures (closed systems), Indoor
Chemical production or refinery in closed process without likelihood of exposure or processes with equivalent containment conditions (PROC1)

Technical and organisational conditions and measures
Use in closed process No other specific measures identified.
Occupational Health and Safety Management System: Advanced
Provide a good standard of general ventilation (not less than 3 to 5 air changes per hour).

Inhalation - minimum efficiency of 30 %		
Conditions and measures related to personal protection, hygiene and health evaluation		
Wear chemically resistant gloves (tested to EN374) in combination with 'basic' employee training. Dermal - minimum efficiency of 90 %		
Other conditions affecting workers exposure		
Indoor or outdoor use	:	Indoor use
Temperature	:	Assumes process temperature up to 20 °C

3.2.4. Control of worker exposure: General exposures (closed systems), Outdoor
Chemical production or refinery in closed process without likelihood of exposure or processes with equivalent containment conditions (PROC1)

Technical and organisational conditions and measures		
Use in closed process No other specific measures identified.		
Occupational Health and Safety Management System: Advanced		
Conditions and measures related to personal protection, hygiene and health evaluation		
Wear chemically resistant gloves (tested to EN374) in combination with 'basic' employee training. Dermal - minimum efficiency of 90 %		
Other conditions affecting workers exposure		
Indoor or outdoor use	:	Outdoor use
Temperature	:	Assumes process temperature up to 20 °C

3.2.5. Control of worker exposure: General exposures (closed systems), Local exhaust ventilation, Indoor
Chemical production or refinery in closed continuous process with occasional controlled exposure or processes with equivalent containment conditions (PROC2)

Amount used, frequency and duration of use (or from service life)		
Duration	:	Covers use up to 4 h
Technical and organisational conditions and measures		
Use in closed, continuous process with occasional controlled exposure		

Occupational Health and Safety Management System: Advanced		
Provide a good standard of controlled ventilation (5 to 10 air changes per hour). Inhalation - minimum efficiency of 70 %		
Local exhaust ventilation Handle substance within a predominantly closed system provided with extract ventilation. Inhalation - minimum efficiency of 90 %		
Conditions and measures related to personal protection, hygiene and health evaluation		
Wear chemically resistant gloves (tested to EN374) in combination with 'basic' employee training. Dermal - minimum efficiency of 90 %		
Other conditions affecting workers exposure		
Indoor or outdoor use	:	Indoor
Temperature	:	Assumes process temperature up to 20 °C

3.2.6. Control of worker exposure: General exposures (closed systems), Local exhaust ventilation, Indoor
Manufacture or formulation in the chemical industry in closed batch processes with occasional controlled exposure or processes with equivalent containment condition (PROC3)

Amount used, frequency and duration of use (or from service life)		
Duration	:	Covers use up to 1 h
Technical and organisational conditions and measures		
Closed batch process with occasional controlled exposure Occupational Health and Safety Management System: Advanced		
Provide a good standard of controlled ventilation (5 to 10 air changes per hour). Inhalation - minimum efficiency of 70 %		
Local exhaust ventilation Handle substance within a predominantly closed system provided with extract ventilation. Inhalation - minimum efficiency of 90 %		
Conditions and measures related to personal protection, hygiene and health evaluation		
Wear chemically resistant gloves (tested to EN374) in combination with 'basic' employee training. Dermal - minimum efficiency of 90 %		
Other conditions affecting workers exposure		
Indoor or outdoor use	:	Indoor

Temperature	:	Assumes process temperature up to 20 °C

3.2.7. Control of worker exposure: General exposures (open systems), Local exhaust ventilation, Indoor
Chemical production where opportunity for exposure arises (PROC4)

Amount used, frequency and duration of use (or from service life)		
Duration	:	Covers use up to 0,25 h
Technical and organisational conditions and measures		
Occupational Health and Safety Management System: Advanced		
Provide a good standard of controlled ventilation (5 to 10 air changes per hour). Inhalation - minimum efficiency of 70 %		
Local exhaust ventilation Provide extract ventilation to points where emissions occur. Inhalation - minimum efficiency of 90 %		
Conditions and measures related to personal protection, hygiene and health evaluation		
Wear chemically resistant gloves (tested to EN374) in combination with 'basic' employee training. Dermal - minimum efficiency of 90 %		
Other conditions affecting workers exposure		
Indoor or outdoor use	:	Indoor use
Temperature	:	Assumes process temperature up to 20 °C

3.2.8. Control of worker exposure: General exposures (open systems), Respiratory protection, Indoor
Chemical production where opportunity for exposure arises (PROC4)

Amount used, frequency and duration of use (or from service life)		
Duration	:	Covers use up to 1 h
Technical and organisational conditions and measures		
Occupational Health and Safety Management System: Advanced		
Provide a good standard of controlled ventilation (5 to 10 air changes per hour). Inhalation - minimum efficiency of 70 %		

Conditions and measures related to personal protection, hygiene and health evaluation		
Wear chemically resistant gloves (tested to EN374) in combination with 'basic' employee training. Dermal - minimum efficiency of 90 %		
Wear suitable respiratory protection. Efficiency: APF 20 Inhalation - minimum efficiency of 95 %		
Other conditions affecting workers exposure		
Indoor or outdoor use	:	Indoor use
Temperature	:	Assumes process temperature up to 20 °C

3.2.9. Control of worker exposure: General exposures (open systems), Respiratory protection, Outdoor
Chemical production where opportunity for exposure arises (PROC4)

Amount used, frequency and duration of use (or from service life)		
Duration	:	Covers use up to 0,25 h
Technical and organisational conditions and measures		
Occupational Health and Safety Management System: Advanced		
Conditions and measures related to personal protection, hygiene and health evaluation		
Wear chemically resistant gloves (tested to EN374) in combination with 'basic' employee training. Dermal - minimum efficiency of 90 %		
Wear suitable respiratory protection. Efficiency: APF 20 Inhalation - minimum efficiency of 95 %		
Other conditions affecting workers exposure		
Indoor or outdoor use	:	Outdoor use
Temperature	:	Assumes process temperature up to 20 °C

3.2.10. Control of worker exposure: Process sampling, Local exhaust ventilation, Indoor
Transfer of substance or mixture into small containers (dedicated filling line, including weighing) (PROC9)

Amount used, frequency and duration of use (or from service life)

Duration	:	Covers use up to 0,25 h
Technical and organisational conditions and measures		
Occupational Health and Safety Management System: Advanced		
Provide a good standard of controlled ventilation (5 to 10 air changes per hour). Inhalation - minimum efficiency of 70 %		
Conditions and measures related to personal protection, hygiene and health evaluation		
Wear chemically resistant gloves (tested to EN374) in combination with 'basic' employee training. Dermal - minimum efficiency of 90 %		
Wear suitable respiratory protection. Efficiency: APF 20 Inhalation - minimum efficiency of 95 %		
Other conditions affecting workers exposure		
Indoor or outdoor use	:	Indoor use
Temperature	:	Assumes process temperature up to 20 °C

3.2.11. Control of worker exposure: Process sampling, Respiratory protection, Indoor Transfer of substance or mixture into small containers (dedicated filling line, including weighing) (PROC9)

Amount used, frequency and duration of use (or from service life)		
Duration	:	Covers use up to 0,25 h
Technical and organisational conditions and measures		
Occupational Health and Safety Management System: Advanced		
Provide a good standard of controlled ventilation (5 to 10 air changes per hour). Inhalation - minimum efficiency of 70 %		
Conditions and measures related to personal protection, hygiene and health evaluation		
Wear chemically resistant gloves (tested to EN374) in combination with 'basic' employee training. Dermal - minimum efficiency of 90 %		
Wear suitable respiratory protection. Efficiency: APF 20 Inhalation - minimum efficiency of 95 %		
Other conditions affecting workers exposure		
Indoor or outdoor use	:	Indoor use

Temperature	:	Assumes process temperature up to 20 °C

3.2.12. Control of worker exposure: Process sampling, Respiratory protection, Outdoor Transfer of substance or mixture into small containers (dedicated filling line, including weighing) (PROC9)

Product (article) characteristics		
Covers percentage substance in the product up to 25 %.		
Amount used, frequency and duration of use (or from service life)		
Duration	:	Covers use up to 0,25 h
Technical and organisational conditions and measures		
Occupational Health and Safety Management System: Advanced		
Conditions and measures related to personal protection, hygiene and health evaluation		
Wear chemically resistant gloves (tested to EN374) in combination with 'basic' employee training. Dermal - minimum efficiency of 90 %		
Wear suitable respiratory protection. Efficiency: APF 20 Inhalation - minimum efficiency of 95 %		
Other conditions affecting workers exposure		
Indoor or outdoor use	:	Outdoor use
Temperature	:	Assumes process temperature up to 20 °C

3.2.13. Control of worker exposure: Laboratory activities, Local exhaust ventilation, Indoor Use as laboratory reagent (PROC15)

Amount used, frequency and duration of use (or from service life)		
Duration	:	Covers use up to 1 h
Technical and organisational conditions and measures		
Occupational Health and Safety Management System: Advanced		
Handle in a fume cupboard or under extract ventilation. Inhalation - minimum efficiency of 90 %		
Provide a good standard of controlled ventilation (5 to 10 air changes per hour).		

Inhalation - minimum efficiency of 70 %		
Local exhaust ventilation Inhalation - minimum efficiency of 90 %		
Conditions and measures related to personal protection, hygiene and health evaluation		
Wear chemically resistant gloves (tested to EN374) in combination with 'basic' employee training. Dermal - minimum efficiency of 90 %		
Other conditions affecting workers exposure		
Indoor or outdoor use	:	Indoor use
Temperature	:	Assumes process temperature up to 20 °C

3.2.14. Control of worker exposure: Bulk transfers, Closed systems, Local exhaust ventilation, Indoor
Transfer of substance or mixture (charging/discharging) at dedicated facilities (PROC8b)

Amount used, frequency and duration of use (or from service life)		
Duration	:	Covers use up to 1 h
Technical and organisational conditions and measures		
Occupational Health and Safety Management System: Advanced		
Ensure material transfers are under containment or extract ventilation. Local exhaust ventilation Inhalation - minimum efficiency of 95 %		
Provide a good standard of controlled ventilation (5 to 10 air changes per hour). Inhalation - minimum efficiency of 70 %		
Conditions and measures related to personal protection, hygiene and health evaluation		
Wear chemically resistant gloves (tested to EN374) in combination with specific activity training. Dermal - minimum efficiency of 95 %		
Other conditions affecting workers exposure		
Indoor or outdoor use	:	Indoor use
Temperature	:	Assumes process temperature up to 20 °C

3.2.15. Control of worker exposure: Bulk transfers, Open systems, Local exhaust ventilation, Indoor
Transfer of substance or mixture (charging/discharging) at dedicated facilities (PROC8b)

Amount used, frequency and duration of use (or from service life)		
Duration	:	Covers use up to 1 h
Technical and organisational conditions and measures		
Occupational Health and Safety Management System: Advanced		
Ensure material transfers are under containment or extract ventilation. Local exhaust ventilation Inhalation - minimum efficiency of 95 %		
Provide a good standard of controlled ventilation (5 to 10 air changes per hour). Inhalation - minimum efficiency of 70 %		
Conditions and measures related to personal protection, hygiene and health evaluation		
Wear chemically resistant gloves (tested to EN374) in combination with specific activity training. Dermal - minimum efficiency of 95 %		
Other conditions affecting workers exposure		
Indoor or outdoor use	:	Indoor use
Temperature	:	Assumes process temperature up to 20 °C

3.2.16. Control of worker exposure: Bulk transfers, Open systems, Respiratory protection, Indoor Transfer of substance or mixture (charging/discharging) at dedicated facilities (PROC8b)

Amount used, frequency and duration of use (or from service life)		
Duration	:	Covers use up to 0,25 h
Technical and organisational conditions and measures		
Occupational Health and Safety Management System: Advanced		
Conditions and measures related to personal protection, hygiene and health evaluation		
Wear chemically resistant gloves (tested to EN374) in combination with specific activity training. Dermal - minimum efficiency of 95 %		
Wear suitable respiratory protection. Efficiency: APF 20 Inhalation - minimum efficiency of 95 %		
Other conditions affecting workers exposure		
Indoor or outdoor use	:	Outdoor use

Temperature	:	Assumes process temperature up to 20 °C

3.2.17. Control of worker exposure: Equipment cleaning and maintenance, Local exhaust ventilation, Indoor
Transfer of substance or mixture (charging/discharging) at non dedicated-facilities (PROC8a) / Manual maintenance (cleaning and repair) of machinery (PROC28)

Amount used, frequency and duration of use (or from service life)		
Duration	:	Covers use up to 1 h
Technical and organisational conditions and measures		
Occupational Health and Safety Management System: Advanced		
Local exhaust ventilation Inhalation - minimum efficiency of 90 %		
Provide a good standard of general ventilation (not less than 3 to 5 air changes per hour). Inhalation - minimum efficiency of 30 %		
Conditions and measures related to personal protection, hygiene and health evaluation		
Wear chemically resistant gloves (tested to EN374) in combination with specific activity training. Dermal - minimum efficiency of 95 %		
Wear suitable respiratory protection. Efficiency: APF 10 Inhalation - minimum efficiency of 90 %		
Other conditions affecting workers exposure		
Indoor or outdoor use	:	Indoor use
Temperature	:	Assumes process temperature up to 20 °C

3.2.18. Control of worker exposure: Storage, Outdoor
Chemical production or refinery in closed process without likelihood of exposure or processes with equivalent containment conditions (PROC1) / Chemical production or refinery in closed continuous process with occasional controlled exposure or processes with equivalent containment conditions (PROC2)

Technical and organisational conditions and measures
Occupational Health and Safety Management System: Advanced
Store substance within a closed system.

Conditions and measures related to personal protection, hygiene and health evaluation		
Wear chemically resistant gloves (tested to EN374) in combination with 'basic' employee training. Dermal - minimum efficiency of 90 %		
Other conditions affecting workers exposure		
Indoor or outdoor use	:	Outdoor use
Temperature	:	Assumes process temperature up to 20 °C

3.3. Exposure estimation and reference to its source

3.3.1. Environmental release and exposure: Use of intermediate (ERC6a)

Compartment	Exposure level	RCR
Freshwater	0,21 mg/L	0,69
Marine water	0,021 mg/L	0,069
Freshwater sediment	0,96 mg/kg wet weight	0,91
Marine sediment	0,096 mg/kg wet weight	0,091
Agricultural soil	0,01 mg/kg wet weight	0,032

3.3.3. Worker exposure: Chemical production or refinery in closed process without likelihood of exposure or processes with equivalent containment conditions (PROC1)

Exposure route	Health effect	Exposure indicator	Exposure level	RCR	Remarks
inhalative	systemic	long-term	0,023 mg/m³	0,012	Benzene
inhalative	systemic	short-term	0,091 mg/m³		Benzene
dermal	systemic	long-term	0,0034 mg/kg bw/day	< 0,01	Benzene
dermal	local	long-term	0,00099 mg/cm2		Benzene
dermal	local	short-term	0,00099 mg/cm2		Benzene
combined routes	systemic	long-term		0,012	

Additional information on exposure estimation
Available hazard data do not enable the derivation of a DNEL for dermal irritant effects.

Available hazard data do not enable the derivation of a DNEL for eye irritant effects.
Risk management measures are based on qualitative risk characterisation.
Predicted exposures are not expected to exceed the DN(M)EL when the risk management measures/operational conditions outlined in section 2 are implemented.

3.3.4. Worker exposure: Chemical production or refinery in closed process without likelihood of exposure or processes with equivalent containment conditions (PROC1)

Exposure route	Health effect	Exposure indicator	Exposure level	RCR	Remarks
inhalative	systemic	long-term	0,023 mg/m³	0,012	Benzene
inhalative	systemic	short-term	0,091 mg/m³		Benzene
dermal	systemic	long-term	0,0034 mg/kg bw/day	< 0,01	Benzene
dermal	local	long-term	0,00099 mg/cm2		Benzene
dermal	local	short-term	0,00099 mg/cm2		Benzene
combined routes	systemic	long-term		0,012	

Additional information on exposure estimation

Available hazard data do not enable the derivation of a DNEL for dermal irritant effects.
Available hazard data do not enable the derivation of a DNEL for eye irritant effects.
Risk management measures are based on qualitative risk characterisation.
Predicted exposures are not expected to exceed the DN(M)EL when the risk management measures/operational conditions outlined in section 2 are implemented.

3.3.5. Worker exposure: Chemical production or refinery in closed continuous process with occasional controlled exposure or processes with equivalent containment conditions (PROC2)

Exposure route	Health effect	Exposure indicator	Exposure level	RCR	Remarks
inhalative	systemic	long-term	1,465 mg/m³	0,771	Benzene
inhalative	systemic	short-term	9,764 mg/m³		Benzene
dermal	systemic	long-term	0,082 mg/kg bw/day	0,087	Benzene
dermal	local	long-term	0,012 mg/cm2		Benzene
dermal	local	short-term	0,012 mg/cm2		Benzene
combined routes	systemic	long-term		0,112	

Additional information on exposure estimation

Available hazard data do not enable the derivation of a DNEL for dermal irritant effects.
Available hazard data do not enable the derivation of a DNEL for eye irritant effects.
Risk management measures are based on qualitative risk characterisation.
Predicted exposures are not expected to exceed the DN(M)EL when the risk management measures/operational conditions outlined in section 2 are implemented.

3.3.6. Worker exposure: Manufacture or formulation in the chemical industry in closed batch processes with occasional controlled exposure or processes with equivalent containment condition (PROC3)

Exposure route	Health effect	Exposure indicator	Exposure level	RCR	Remarks
inhalative	systemic	long-term	0,976 mg/m³	0,514	Benzene
inhalative	systemic	short-term	19,52 mg/m³		Benzene
dermal	systemic	long-term	0,014 mg/kg bw/day	0,044	Benzene
dermal	local	long-term	0,004 mg/cm2		Benzene
dermal	local	short-term	0,004 mg/cm2		Benzene
combined routes	systemic	long-term		0,069	

Additional information on exposure estimation

Available hazard data do not enable the derivation of a DNEL for dermal irritant effects.
Available hazard data do not enable the derivation of a DNEL for eye irritant effects.
Risk management measures are based on qualitative risk characterisation.
Predicted exposures are not expected to exceed the DN(M)EL when the risk management measures/operational conditions outlined in section 2 are implemented.

3.3.7. Worker exposure: Chemical production where opportunity for exposure arises (PROC4)

Exposure route	Health effect	Exposure indicator	Exposure level	RCR	Remarks
inhalative	systemic	long-term	0,976 mg/m³	0,514	Benzene
inhalative	systemic	short-term	39,05 mg/m³		Benzene
dermal	systemic	long-term	0,069 mg/kg bw/day	0,433	Benzene
dermal	local	long-term	0,01 mg/cm2		Benzene
dermal	local	short-term	0,01 mg/cm2		Benzene
combined routes	systemic	long-term		0,455	

Additional information on exposure estimation

Available hazard data do not enable the derivation of a DNEL for dermal irritant effects.
Available hazard data do not enable the derivation of a DNEL for eye irritant effects.
Risk management measures are based on qualitative risk characterisation.
Predicted exposures are not expected to exceed the DN(M)EL when the risk management measures/operational conditions outlined in section 2 are implemented.

3.3.8. Worker exposure: Chemical production where opportunity for exposure arises (PROC4)

Exposure route	Health effect	Exposure indicator	Exposure level	RCR	Remarks
inhalative	systemic	long-term	0,976 mg/m³	0,514	Benzene
inhalative	systemic	short-term	19,52 mg/m³		Benzene
dermal	systemic	long-term	0,137 mg/kg bw/day	0,433	Benzene
dermal	local	long-term	0,02 mg/cm2		Benzene
dermal	local	short-term	0,02 mg/cm2		Benzene
combined routes	systemic	long-term		0,455	

Additional information on exposure estimation

Available hazard data do not enable the derivation of a DNEL for dermal irritant effects.
Available hazard data do not enable the derivation of a DNEL for eye irritant effects.
Risk management measures are based on qualitative risk characterisation.
Predicted exposures are not expected to exceed the DN(M)EL when the risk management measures/operational conditions outlined in section 2 are implemented.

3.3.9. Worker exposure: Chemical production where opportunity for exposure arises (PROC4)

Exposure route	Health effect	Exposure indicator	Exposure level	RCR	Remarks
inhalative	systemic	long-term	1,139 mg/m³	0,6	Benzene
inhalative	systemic	short-term	45,56 mg/m³		Benzene
dermal	systemic	long-term	0,069 mg/kg bw/day	0,433	Benzene
dermal	local	long-term	0,01 mg/cm2		Benzene
dermal	local	short-term	0,01 mg/cm2		Benzene
combined routes	systemic	long-term		0,458	

Additional information on exposure estimation

Available hazard data do not enable the derivation of a DNEL for dermal irritant effects.

Available hazard data do not enable the derivation of a DNEL for eye irritant effects.
Risk management measures are based on qualitative risk characterisation.
Predicted exposures are not expected to exceed the DN(M)EL when the risk management measures/operational conditions outlined in section 2 are implemented.

3.3.10. Worker exposure: Transfer of substance or mixture into small containers (dedicated filling line, including weighing) (PROC9)

Exposure route	Health effect	Exposure indicator	Exposure level	RCR	Remarks
inhalative	systemic	long-term	0,976 mg/m³	0,514	Benzene
inhalative	systemic	short-term	39,05 mg/m³		Benzene
dermal	systemic	long-term	0,069 mg/kg bw/day	0,433	Benzene
dermal	local	long-term	0,01 mg/cm2		Benzene
dermal	local	short-term	0,01 mg/cm2		Benzene
combined routes	systemic	long-term		0,444	

Additional information on exposure estimation

Available hazard data do not enable the derivation of a DNEL for dermal irritant effects.
Available hazard data do not enable the derivation of a DNEL for eye irritant effects.
Risk management measures are based on qualitative risk characterisation.
Predicted exposures are not expected to exceed the DN(M)EL when the risk management measures/operational conditions outlined in section 2 are implemented.

3.3.11. Worker exposure: Transfer of substance or mixture into small containers (dedicated filling line, including weighing) (PROC9)

Exposure route	Health effect	Exposure indicator	Exposure level	RCR	Remarks
inhalative	systemic	long-term	0,976 mg/m³	0,514	Benzene
inhalative	systemic	short-term	39,05 mg/m³		Benzene
dermal	systemic	long-term	0,069 mg/kg bw/day	0,433	Benzene
dermal	local	long-term	0,01 mg/cm2		Benzene
dermal	local	short-term	0,01 mg/cm2		Benzene
combined routes	systemic	long-term		0,444	

Additional information on exposure estimation

Available hazard data do not enable the derivation of a DNEL for dermal irritant effects.
Available hazard data do not enable the derivation of a DNEL for eye irritant effects.
Risk management measures are based on qualitative risk characterisation.
Predicted exposures are not expected to exceed the DN(M)EL when the risk management measures/operational conditions outlined in section 2 are implemented.

3.3.12. Worker exposure: Transfer of substance or mixture into small containers (dedicated filling line, including weighing) (PROC9)

Exposure route	Health effect	Exposure indicator	Exposure level	RCR	Remarks
inhalative	systemic	long-term	1,367 mg/m³	0,719	Benzene
inhalative	systemic	short-term	54,67 mg/m³		Benzene
dermal	systemic	long-term	0,041 mg/kg bw/day	0,26	Benzene
dermal	local	long-term	0,006 mg/cm2		Benzene
dermal	local	short-term	0,006 mg/cm2		Benzene
combined routes	systemic	long-term		0,275	

Additional information on exposure estimation

Available hazard data do not enable the derivation of a DNEL for dermal irritant effects.
Available hazard data do not enable the derivation of a DNEL for eye irritant effects.
Risk management measures are based on qualitative risk characterisation.
Predicted exposures are not expected to exceed the DN(M)EL when the risk management measures/operational conditions outlined in section 2 are implemented.

3.3.13. Worker exposure: Use as laboratory reagent (PROC15)

Exposure route	Health effect	Exposure indicator	Exposure level	RCR	Remarks
inhalative	systemic	long-term	0,976 mg/m³	0,514	Benzene
inhalative	systemic	short-term	19,52 mg/m³		Benzene
dermal	systemic	long-term	0,0068 mg/kg bw/day	0,021	Benzene
dermal	local	long-term	0,0020 mg/cm2		Benzene
dermal	local	short-term	0,0020 mg/cm2		Benzene
combined routes	systemic	long-term		0,064	

Additional information on exposure estimation

Available hazard data do not enable the derivation of a DNEL for dermal irritant effects.
Available hazard data do not enable the derivation of a DNEL for eye irritant effects.
Risk management measures are based on qualitative risk characterisation.
Predicted exposures are not expected to exceed the DN(M)EL when the risk management measures/operational conditions outlined in section 2 are implemented.

3.3.14. Worker exposure: Transfer of substance or mixture (charging/discharging) at dedicated facilities (PROC8b)

Exposure route	Health effect	Exposure indicator	Exposure level	RCR	Remarks
inhalative	systemic	long-term	1,465 mg/m³	0,771	Benzene
inhalative	systemic	short-term	29,29 mg/m³		Benzene
dermal	systemic	long-term	0,137 mg/kg bw/day	0,433	Benzene
dermal	local	long-term	0,01 mg/cm2		Benzene
dermal	local	short-term	0,01 mg/cm2		Benzene
combined routes	systemic	long-term		0,454	

Additional information on exposure estimation

Available hazard data do not enable the derivation of a DNEL for dermal irritant effects.
Available hazard data do not enable the derivation of a DNEL for eye irritant effects.
Risk management measures are based on qualitative risk characterisation.
Predicted exposures are not expected to exceed the DN(M)EL when the risk management measures/operational conditions outlined in section 2 are implemented.

3.3.15. Worker exposure: Transfer of substance or mixture (charging/discharging) at dedicated facilities (PROC8b)

Exposure route	Health effect	Exposure indicator	Exposure level	RCR	Remarks
inhalative	systemic	long-term	1,465 mg/m³	0,771	Benzene
inhalative	systemic	short-term	29,29 mg/m³		Benzene
dermal	systemic	long-term	0,137 mg/kg bw/day	0,433	Benzene
dermal	local	long-term	0,01 mg/cm2		Benzene
dermal	local	short-term	0,01 mg/cm2		Benzene
combined routes	systemic	long-term		0,454	

Additional information on exposure estimation

Available hazard data do not enable the derivation of a DNEL for dermal irritant effects.
Available hazard data do not enable the derivation of a DNEL for eye irritant effects.
Risk management measures are based on qualitative risk characterisation.
Predicted exposures are not expected to exceed the DN(M)EL when the risk management measures/operational conditions outlined in section 2 are implemented.

3.3.16. Worker exposure: Transfer of substance or mixture (charging/discharging) at dedicated facilities (PROC8b)

Exposure route	Health effect	Exposure indicator	Exposure level	RCR	Remarks
inhalative	systemic	long-term	1,709 mg/m³	0,899	Benzene
inhalative	systemic	short-term	68,34 mg/m³		Benzene
dermal	systemic	long-term	0,069 mg/kg bw/day	0,433	Benzene
dermal	local	long-term	0,005 mg/cm2		Benzene
dermal	local	short-term	0,005 mg/cm2		Benzene
combined routes	systemic	long-term		0,458	

Additional information on exposure estimation

Available hazard data do not enable the derivation of a DNEL for dermal irritant effects.
Available hazard data do not enable the derivation of a DNEL for eye irritant effects.
Risk management measures are based on qualitative risk characterisation.
Predicted exposures are not expected to exceed the DN(M)EL when the risk management measures/operational conditions outlined in section 2 are implemented.

3.3.17. Worker exposure: Transfer of substance or mixture (charging/discharging) at non dedicated-facilities (PROC8a) / Manual maintenance (cleaning and repair) of machinery (PROC28)

Exposure route	Health effect	Exposure indicator	Exposure level	RCR	Remarks
inhalative	systemic	long-term	1,139 mg/m³	0,6	Benzene
inhalative	systemic	short-term	22,78 mg/m³		Benzene
dermal	systemic	long-term	0,137 mg/kg bw/day	0,433	Benzene
dermal	local	long-term	0,01 mg/cm2		Benzene
dermal	local	short-term	0,01 mg/cm2		Benzene
combined routes	systemic	long-term		0,453	

Additional information on exposure estimation

Available hazard data do not enable the derivation of a DNEL for dermal irritant effects. Available hazard data do not enable the derivation of a DNEL for eye irritant effects. Risk management measures are based on qualitative risk characterisation. Predicted exposures are not expected to exceed the DN(M)EL when the risk management measures/operational conditions outlined in section 2 are implemented.

3.3.18. Worker exposure: Chemical production or refinery in closed process without likelihood of exposure or processes with equivalent containment conditions (PROC1) / Chemical production or refinery in closed continuous process with occasional controlled exposure or processes with equivalent containment conditions (PROC2)

Exposure route	Health effect	Exposure indicator	Exposure level	RCR	Remarks
inhalative	systemic	long-term	0,023 mg/m³	0,012	Benzene
inhalative	systemic	short-term	0,091 mg/m³		Benzene
dermal	systemic	long-term	0,0034 mg/kg bw/day	< 0,01	Benzene
dermal	local	long-term	0,0010 mg/cm2		Benzene
dermal	local	short-term	0,0010 mg/cm2		Benzene
combined routes	systemic	long-term		0,012	

Additional information on exposure estimation
Available hazard data do not enable the derivation of a DNEL for dermal irritant effects. Available hazard data do not enable the derivation of a DNEL for eye irritant effects. Risk management measures are based on qualitative risk characterisation. Predicted exposures are not expected to exceed the DN(M)EL when the risk management measures/operational conditions outlined in section 2 are implemented.

3.4. Guidance to DU to evaluate whether he works inside the boundaries set by the ES

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.