SAFETY DATA SHEET
According to EC No 1907/2006 as amended as at the date of this SDS

Butadiene

Version	Revision Date:	SDS Number:	Date of last issue: 28.01.2024
6.4	31.01.2024	800001033923	Print Date 07.02.2024

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

1.1 Product identifier

Trade name	:	Butadiene
Product code	:	X2137, I1520
Registration number EU	:	01-2119471988-16-0012, 01-2119471988-16-0013
CAS-No.	:	106-99-0
Other means of identification	:	1,3-butadiene, Vinyl ethylene
EC-No.	:	203-450-8

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

Use of the Substance/Mixture	:	Base chemical., Raw material for use in the chemical industry. Please refer to section 16 and/or the annexes for the registered uses under REACH.
Uses advised against	:	This product must not be used in applications other than the above without first seeking the advice of the supplier.

1.3 Details of the supplier of the safety data sheet

Manufacturer/Supplier	:	**Shell Chemicals Europe B.V.** PO Box 2334 3000 CH Rotterdam Netherlands
Telephone	:	+31 (0)10 441 5137 / +31 (0)10 441 5191
Telefax	:	+31 (0)20 716 8316 / +31 (0)20 713 9230
Contact for Safety Data Sheet	:	sccmsds@shell.com

1.4 Emergency telephone number

+44 (0) 1235 239 670 (This telephone number is available 24 hours per day, 7 days per week)
Giftnotruf (Berlin): +49 (0) 30 3068 6700

SECTION 2: Hazards identification

2.1 Classification of the substance or mixture

Classification (REGULATION (EC) No 1272/2008)

Flammable gases, Category 1A	H220: Extremely flammable gas.
Gases under pressure, Liquefied gas	H280: Contains gas under pressure; may explode if heated.

Germ cell mutagenicity, Category 1B, Inhalation	H340: May cause genetic defects.
Carcinogenicity, Category 1A, Inhalation	H350: May cause cancer.

2.2 Label elements

Labelling (REGULATION (EC) No 1272/2008)

Hazard pictograms :

Signal word : Danger

Hazard statements :

PHYSICAL HAZARDS:
H220 Extremely flammable gas.
H280 Contains gas under pressure; may explode if heated.
HEALTH HAZARDS:
H340 May cause genetic defects if inhaled.
H350 May cause cancer.
ENVIRONMENTAL HAZARDS:
Not classified as environmental hazard according to CLP criteria.

Precautionary statements :

Prevention:

P202 Do not handle until all safety precautions have been read and understood.
P210 Keep away from heat, hot surfaces, sparks, open flames and other ignition sources. No smoking.
P243 Take action to prevent static discharges.
P280 Wear protective gloves/ protective clothing/ eye protection/ face protection.

Response:

P377 Leaking gas fire: Do not extinguish, unless leak can be stopped safely.
P381 In case of leakage, eliminate all ignition sources.

Storage:

P410 + P403 Protect from sunlight. Store in a well-ventilated place.

Disposal:

P501 Dispose of contents/ container to an approved waste disposal plant.

2.3 Other hazards

The substance does not fulfill all screening criteria for persistence, bioaccumulation and toxicity and hence is not considered to be PBT or vPvB.

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.

Vapours are heavier than air. Vapours may travel across the ground and reach remote ignition sources causing a flashback fire danger.
May form flammable/explosive vapour-air mixture.
This material is a static accumulator.
Even with proper grounding and bonding, this material can still accumulate an electrostatic charge.
If sufficient charge is allowed to accumulate, electrostatic discharge and ignition of flammable air-vapour mixtures can occur.
Highly reactive.
May form explosive peroxides.
Slightly irritating to respiratory system.
Slightly irritating to the eye.
Vapours may cause drowsiness and dizziness.
Rapid release of gases which are liquids under pressure may cause frost burns of exposed tissues (skin, eye) due to evaporative cooling.
Possibility of organ or organ system damage from prolonged exposure; see Section 11 for details.
Target organ(s):
Ovary

SECTION 3: Composition/information on ingredients

3.1 Substances

Components

Chemical name	CAS-No. EC-No.	Concentration (% w/w)
1,3-butadiene	106-99-0 203-450-8	>= 99,5

Stabilised with tertiary butyl catechol.

SECTION 4: First aid measures

4.1 Description of first aid measures

General advice : Not expected to be a health hazard when used under normal conditions.

Protection of first-aiders : When administering first aid, ensure that you are wearing the appropriate personal protective equipment according to the incident, injury and surroundings.

If inhaled	:	Call emergency number for your location / facility. Remove to fresh air. Do not attempt to rescue the victim unless proper respiratory protection is worn. If the victim has difficulty breathing or tightness of the chest, is dizzy, vomiting, or unresponsive, give 100% oxygen with rescue breathing or Cardio-Pulmonary Resuscitation as required and transport to the nearest medical facility.
In case of skin contact	:	Slowly warm the exposed area by rinsing with warm water. Transport to the nearest medical facility for additional treatment.
In case of eye contact	:	Slowly warm the exposed area by rinsing with warm water. Transport to the nearest medical facility for additional treatment.
If swallowed	:	In general no treatment is necessary unless large quantities are swallowed, however, get medical advice.

4.2 Most important symptoms and effects, both acute and delayed

Symptoms	:	Respiratory irritation signs and symptoms may include a temporary burning sensation of the nose and throat, coughing, and/or difficulty breathing. Breathing of high vapour concentrations may cause central nervous system (CNS) depression resulting in dizziness, lightheadedness, headache, nausea and loss of coordination. Continued inhalation may result in unconsciousness and death. Rapid release of gases which are liquids under pressure may cause frost burns of exposed tissues (skin, eye) due to evaporative cooling. No specific hazards under normal use conditions. Ingestion may result in nausea, vomiting and/or diarrhoea.

4.3 Indication of any immediate medical attention and special treatment needed

Treatment	:	IMMEDIATE TREATMENT IS EXTREMELY IMPORTANT! Artificial respiration and/or oxygen may be necessary. Call a doctor or poison control center for guidance. Treat symptomatically. Potential for cardiac sensitisation, particularly in abuse situations. Hypoxia or negative inotropes may enhance these effects. Consider: oxygen therapy.

SECTION 5: Firefighting measures

5.1 Extinguishing media

Suitable extinguishing media	:	Shut off supply. If not possible and no risk to surroundings, let

the fire burn itself out.

Unsuitable extinguishing media : Data not available

5.2 Special hazards arising from the substance or mixture

Specific hazards during fire-fighting : Sustained fire attack on vessels may result in a Boiling Liquid Expanding Vapor Explosion (BLEVE).
The vapour is heavier than air, spreads along the ground and distant ignition is possible.
Contents are under pressure and can explode when exposed to heat or flames.
As the vapours become lighter than air, the vapours may reach ignition sources at ground or elevated locations.

5.3 Advice for firefighters

Special protective equipment for firefighters : Proper protective equipment including chemical resistant gloves are to be worn; chemical resistant suit is indicated if large contact with spilled product is expected. Self-Contained Breathing Apparatus must be worn when approaching a fire in a confined space. Select fire fighter's clothing approved to relevant Standards (e.g. Europe: EN469).

Specific extinguishing methods : Standard procedure for chemical fires.

Further information : Clear fire area of all non-emergency personnel.
Keep adjacent containers cool by spraying with water.

SECTION 6: Accidental release measures

6.1 Personal precautions, protective equipment and emergency procedures

Personal precautions : Avoid contact with spilled or released material. Immediately remove all contaminated clothing. For guidance on selection of personal protective equipment see Section 8 of this Safety Data Sheet. For guidance on disposal of spilled material see Section 13 of this Safety Data Sheet.
Be ready for fire or possible exposure.
Stay upwind and keep out of low areas.
6.1.1 For non emergency personnel:
Avoid contact with skin, eyes and clothing.
Isolate hazard area and deny entry to unnecessary or unprotected personnel.
Do not breathe fumes, vapour.
Do not operate electrical equipment.
6.1.2 For emergency responders:
Avoid contact with skin, eyes and clothing.
Isolate hazard area and deny entry to unnecessary or unprotected personnel.

Do not breathe fumes, vapour.
Do not operate electrical equipment.

6.2 Environmental precautions

Environmental precautions : Shut off leaks, if possible without personal risks. Remove all possible sources of ignition in the surrounding area and evacuate all personnel. Attempt to disperse the gas or to direct its flow to a safe location for example by using fog sprays. Take precautionary measures against static discharge. Ensure electrical continuity by bonding and grounding (earthing) all equipment. Monitor area with combustible gas meter.

6.3 Methods and material for containment and cleaning up

Methods for cleaning up : Allow to evaporate.
Attempt to disperse the vapour or to direct its flow to a safe location, for example by using fog sprays.

6.4 Reference to other sections

For guidance on selection of personal protective equipment see Section 8 of this Safety Data Sheet., Risk of explosion. Inform the emergency services if liquid enters surface water drains., For guidance on disposal of spilled material see Section 13 of this Safety Data Sheet., Vapour may form an explosive mixture with air.
Local authorities should be advised if significant spillages cannot be contained.

SECTION 7: Handling and storage

7.1 Precautions for safe handling

Technical measures : Avoid breathing of or direct contact with material. Only use in well ventilated areas. Wash thoroughly after handling. For guidance on selection of personal protective equipment see Section 8 of this Safety Data Sheet.
Use the information in this data sheet as input to a risk assessment of local circumstances to help determine appropriate controls for safe handling, storage and disposal of this material.
Ensure that all local regulations regarding handling and storage facilities are followed.

Advice on safe handling : Avoid inhaling vapour and/or mists.
Avoid contact with skin, eyes and clothing.
Extinguish any naked flames. Do not smoke. Remove ignition sources. Avoid sparks.
The vapour is heavier than air. Beware of accumulation in pits and confined spaces.
Use local exhaust ventilation if there is risk of inhalation of vapours, mists or aerosols.
Bulk storage tanks should be diked (bunded).
Properly dispose of any contaminated rags or cleaning materials in order to prevent fires.
Even with proper grounding and bonding, this material can still

accumulate an electrostatic charge.
If sufficient charge is allowed to accumulate, electrostatic discharge and ignition of flammable air-vapour mixtures can occur.
Be aware of handling operations that may give rise to additional hazards that result from the accumulation of static charges.
These include but are not limited to pumping (especially turbulent flow), mixing, filtering, splash filling, cleaning and filling of tanks and containers, sampling, switch loading, gauging, vacuum truck operations, and mechanical movements.
These activities may lead to static discharge e.g. spark formation.
Restrict line velocity during pumping in order to avoid generation of electrostatic discharge (≤ 1 m/s until fill pipe submerged to twice its diameter, then ≤ 7 m/s). Avoid splash filling.
Do NOT use compressed air for filling, discharging, or handling operations.

Product Transfer : Refer to guidance under Handling section.

Hygiene measures : Wash hands before eating, drinking, smoking and using the toilet. Launder contaminated clothing before re-use.

7.2 Conditions for safe storage, including any incompatibilities

Storage class (TRGS 510) : 2A, Gases

Further information on storage stability : Keep away from aerosols, flammables, oxidizing agents, corrosives and from other flammable products which are not harmful or toxic to man or to the environment.
Must be stored in a diked (bunded) well- ventilated area, away from sunlight, ignition sources and other sources of heat.
Must be kept inhibited during storage and shipment as material can polymerise.
Vapours from tanks should not be released to atmosphere.
Breathing losses during storage should be controlled by a suitable vapour treatment system.
Electrostatic charges will be generated during pumping.
Electrostatic discharge may cause fire. Ensure electrical continuity by bonding and grounding (earthing) all equipment to reduce the risk.
The vapours in the head space of the storage vessel may lie in the flammable/explosive range and hence may be flammable.
Storage Temperature:
Ambient.
Nitrogen blanket recommended.
The product is normally supplied in a stabilized form. If the permissible storage period and/or storage temperature is noticeably exceeded, the product may polymerise with heat evolution.
Stable under recommended storage conditions.

Packaging material : Suitable material: For containers, or container linings use mild steel, stainless steel.
Unsuitable material: Copper., Copper alloys., Magnesium., Mercury., Monel., Silver.

7.3 Specific end use(s)

Specific use(s) : Please refer to section 16 and/or the annexes for the registered uses under REACH.

Ensure that all local regulations regarding handling and storage facilities are followed.
See additional references that provide safe handling practices for liquids that are determined to be static accumulators: American Petroleum Institute 2003 (Protection Against Ignitions Arising out of Static, Lightning and Stray Currents) or National Fire Protection Agency 77 (Recommended Practices on Static Electricity).
IEC/TS 60079-32-1: Electrostatic hazards, guidance

SECTION 8: Exposure controls/personal protection

8.1 Control parameters

Occupational Exposure Limits

Components	CAS-No.	Value type (Form of exposure)	Control parameters	Basis
1,3-butadiene	106-99-0	Acceptable concentration	0,2 ppm 0,5 mg/m3	DE TRGS 910
1,3-butadiene		Tolerable concentration	2 ppm 5 mg/m3	DE TRGS 910
	Peak-limit: excursion factor (category): 8 - Excursion factor according to Number 3.2.6			

Biological occupational exposure limits

Substance name	CAS-No.	Control parameters	Sampling time	Basis
1,3-butadiene	106-99-0	3,4-dihydroxybutylmercapturic acid (DHBMA): 2900 µg/g creatinine (Urine)	Equivalence Value for Tolerable concentration: end of exposure or end of shift, Equivalence Value for Tolerable concentration: with long-term exposure: at the end of the shift after several previous shifts	TRGS 910
		3,4-dihydroxybutylmercapturic acid (DHBMA): 600	Equivalence Value for Acceptance concentration: end of exposure or end	TRGS 910

		µg/g creatinine (Urine)	of shift, Equivalence Value for Acceptance concentration: with long-term exposure: at the end of the shift after several previous shifts	
		2-hydroxy-3-butenyl-mercapturic acid (MHBMA): 80 µg/g creatinine (Urine)	Equivalence Value for Tolerable concentration: end of exposure or end of shift, Equivalence Value for Tolerable concentration: with long-term exposure: at the end of the shift after several previous shifts	TRGS 910
		2-hydroxy-3-butenyl-mercapturic acid (MHBMA): 10 µg/g creatinine (Urine)	Equivalence Value for Acceptance concentration: end of exposure or end of shift, Equivalence Value for Acceptance concentration: with long-term exposure: at the end of the shift after several previous shifts	TRGS 910

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

Substance name	End Use	Exposure routes	Potential health effects	Value
1,3-butadiene	Workers	Inhalation	Long-term systemic effects	2,21 mg/m3
1,3-butadiene	Consumers	Inhalation	Long-term systemic effects	0,0664 mg/m3

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

Substance name	Environmental Compartment	Value
1,3-butadiene		
Remarks:	Substance is a hydrocarbon with a complex, unknown or variable composition. Conventional methods of deriving PNECs are not appropriate and it is not possible to identify a single representative PNEC for such substances.	

8.2 Exposure controls

Engineering measures

Read in conjunction with the Exposure Scenario for your specific use contained in the Annex.
Use sealed systems as far as possible.

Adequate explosion-proof ventilation to control airborne concentrations below the exposure guidelines/limits.
Local exhaust ventilation is recommended.
Firewater monitors and deluge systems are recommended.
Eye washes and showers for emergency use.
The level of protection and types of controls necessary will vary depending upon potential exposure conditions. Select controls based on a risk assessment of local circumstances. Appropriate measures include:

General Information:
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 there is potential for inhalation; 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.

Personal protective equipment

Read in conjunction with the Exposure Scenario for your specific use contained in the Annex. The provided information is made in consideration of the PPE directive (Council Directive 89/686/EEC) and the CEN European Committee for Standardisation (CEN) standards.

Personal protective equipment (PPE) should meet recommended national standards. Check with PPE suppliers.

Eye protection	:	Wear goggles for use against liquids and gas, combined with face shield with chin guard. Approved to EU Standard EN166.
Hand protection		
Remarks	:	Where hand contact with the product may occur the use of gloves approved to relevant standards (e.g. Europe: EN374, US: F739) made from the following materials may provide suitable chemical protection. When prolonged or frequent repeated contact occurs. Viton. For incidental contact/splash protection - Neoprene rubber. If contact with liquefied product is possible or anticipated, gloves should be thermally insulated to prevent cold burns. For continuous contact we recommend gloves with breakthrough time of more than 240 minutes with preference for > 480 minutes where suitable gloves can be identified. For short-term/splash protection we recommend the same but recognize that suitable gloves offering this level of protection may not be available and in this case a lower breakthrough time maybe acceptable so long as appropriate maintenance and replacement regimes are followed. Glove thickness is not a good predictor of glove resistance to a chemical as it is dependent on the exact com-

position of the glove material. Glove thickness should be typically greater than 0.35 mm depending on the glove make and model. Suitability and durability of a glove is dependent on usage, e.g. frequency and duration of contact, chemical resistance of glove material, dexterity. Always seek advice from glove suppliers. Contaminated gloves should be replaced. Personal hygiene is a key element of effective hand care. Gloves must only be worn on clean hands. After using gloves, hands should be washed and dried thoroughly. Application of a non-perfumed moisturizer is recommended.

Skin and body protection : Wear antistatic and flame-retardant clothing.
Chemical and cryogenic gloves/gauntlets, boots, and apron.

Protective clothing approved to EU Standard EN14605.
Chemical and cryogenic gloves/gauntlets, boots, and apron.
Wear antistatic and flame-retardant clothing.

Respiratory protection : If engineering controls do not maintain airborne concentrations to a level which is adequate to protect worker health, select respiratory protection equipment suitable for the specific conditions of use and meeting relevant legislation.
Check with respiratory protective equipment suppliers.
Where air-filtering respirators are unsuitable (e.g. airborne concentrations are high, risk of oxygen deficiency, confined space) use appropriate positive pressure breathing apparatus.
Where air-filtering respirators are suitable, select an appropriate combination of mask and filter.
If air-filtering respirators are suitable for conditions of use:

Select a filter suitable for organic gases and vapours [Type AX boiling point < 65°C (149°F)] meeting EN14387.

SECTION 9: Physical and chemical properties

9.1 Information on basic physical and chemical properties

Physical state	:	Liquid under pressure.
Colour	:	colourless
Odour	:	Mild aromatic
Odour Threshold	:	1,3 ppm
Melting point/freezing point	:	-108,9 °C
Boiling point/boiling range	:	-4,4 °C
Flammability		

Flammability (solid, gas)	:	Flammable gas.

Lower explosion limit and upper explosion limit / flammability limit

Upper explosion limit / upper flammability limit	:	16,3 %(V)
Lower explosion limit / Lower flammability limit	:	1,4 %(V)
Flash point	:	ca. -79 °C Method: No information available.
Auto-ignition temperature	:	415 °C

Decomposition temperature

Decomposition temperature	:	Data not available
pH	:	Data not available

Viscosity

Viscosity, kinematic	:	0,288 mm2/s (0 °C) Method: ASTM D445

Solubility(ies)

Water solubility	:	735 mg/l
Partition coefficient: n-octanol/water	:	log Pow: 1,99
Vapour pressure	:	120 kPa (0 °C) 240 kPa (20 °C) 580 kPa (50 °C) 1.750 kPa (100 °C)
Relative density	:	no data available
Density	:	622 kg/m3 (20 °C) Method: ASTM D4052 (as liquid)
Relative vapour density	:	1,92 (21 °C, 1,013 bar) (Air = 1.0)

Particle characteristics

Particle size	:	Data not available

9.2 Other information

Explosive properties	:	no data available
Oxidizing properties	:	Data not available
Evaporation rate	:	Data not available
Conductivity	:	Low conductivity: < 100 pS/m The conductivity of this material makes it a static accumulator., A liquid is typically considered nonconductive if its conductivity is below 100 pS/m and is considered semi-conductive if its conductivity is below 10,000 pS/m., Whether a liquid is nonconductive or semi-conductive, the precautions are the same., A number of factors, for example liquid temperature, presence of contaminants, and anti-static additives can greatly influence the conductivity of a liquid
Surface tension	:	Data not available
Molecular weight	:	54,1 g/mol

SECTION 10: Stability and reactivity

10.1 Reactivity

Reacts violently with strong oxidising agents.

10.2 Chemical stability

Oxidises on contact with air to form unstable peroxides.
Unstable at elevated temperatures.

10.3 Possibility of hazardous reactions

Hazardous reactions	:	Polymerisation may occur at elevated temperatures.

10.4 Conditions to avoid

Conditions to avoid	:	Heat, flames, and sparks. Exposure to air.

10.5 Incompatible materials

Materials to avoid	:	Strong oxidising agents. If copper, copper alloys, monel, silver, mercury or magnesium is used during construction or maintenance, the formation of explosive acetylides can occur as a result of contact with butadiene. If Teflon® or Delrin® is used, polymer formation may result.

10.6 Hazardous decomposition products

SECTION 11: Toxicological information

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

Information on likely routes of exposure : Inhalation is the primary route of exposure.

Acute toxicity

Product:

Acute inhalation toxicity : LC 50 (Mouse): > 20.000 mg/l
Exposure time: 2 h
Test atmosphere: gas
Method: Literature data
Remarks: Based on available data, the classification criteria are not met.
High concentrations may cause central nervous system depression resulting in headaches, dizziness and nausea; continued inhalation may result in unconsciousness and/or death.

Components:

1,3-butadiene:

Acute oral toxicity : Remarks: no data available

Acute inhalation toxicity : LC 50 (Mouse): > 20.000 mg/l
Exposure time: 2 h
Test atmosphere: gas
Method: Literature data
Remarks: Based on available data, the classification criteria are not met.
High concentrations may cause central nervous system depression resulting in headaches, dizziness and nausea; continued inhalation may result in unconsciousness and/or death.

Acute dermal toxicity : Remarks: no data available

Skin corrosion/irritation

Product:

Remarks : Rapid release of gases which are liquids under pressure may cause frost burns of exposed tissues (skin, eye) due to evaporative cooling.

Components:

1,3-butadiene:

Remarks : Rapid release of gases which are liquids under pressure may

cause frost burns of exposed tissues (skin, eye) due to evaporative cooling.

Serious eye damage/eye irritation

Product:

Remarks : Rapid release of gases which are liquids under pressure may cause frost burns of exposed tissues (skin, eye) due to evaporative cooling.

Components:

1,3-butadiene:

Remarks : Rapid release of gases which are liquids under pressure may cause frost burns of exposed tissues (skin, eye) due to evaporative cooling.

Respiratory or skin sensitisation

Components:

1,3-butadiene:

Remarks : no data available

Germ cell mutagenicity

Product:

Genotoxicity in vitro : Method: Test(s) equivalent or similar to OECD Guideline 471
Remarks: May cause genetic defects.

Method: Test(s) equivalent or similar to OECD Test Guideline 473
Remarks: May cause genetic defects.

Genotoxicity in vivo : Species: mice
Method: Test(s) equivalent or similar to OECD Test Guideline 474
Remarks: May cause genetic defects.

Species: mice
Method: Test(s) equivalent or similar to OECD Test guideline 478
Remarks: May cause genetic defects.

Germ cell mutagenicity- Assessment : May cause genetic defects.

Components:

1,3-butadiene:

Genotoxicity in vitro	:	Method: OECD Test Guideline 471 Remarks: May cause genetic defects. Method: OECD Test Guideline 473 Method: OECD Test Guideline 476
Genotoxicity in vivo	:	Species: mice Method: Test(s) equivalent or similar to OECD Test Guideline 474 Remarks: May cause genetic defects. Method: OECD Test Guideline 478
Germ cell mutagenicity- Assessment	:	May cause genetic defects.

Carcinogenicity

Product:

Species	:	Mouse, male and female
Application Route	:	Inhalation
Method	:	Test(s) equivalent or similar to OECD Test Guideline 453
Remarks	:	May cause cancer. OSHA has concluded that there is strong evidence that workplace exposure to butadiene poses an increased risk of death from cancers of the lymphohematopoietic (blood-forming) system.
Carcinogenicity - Assessment	:	May cause cancer.

Components:

1,3-butadiene:

Species	:	Mouse, male and female
Application Route	:	Inhalation
Method	:	Test(s) equivalent or similar to OECD Test Guideline 453
Remarks	:	May cause cancer. OSHA has concluded that there is strong evidence that workplace exposure to butadiene poses an increased risk of death from cancers of the lymphohematopoietic (blood-forming) system.
Carcinogenicity - Assessment	:	May cause cancer.

Material	GHS/CLP Carcinogenicity Classification
1,3-butadiene	Carcinogenicity Category 1A

Material	Other Carcinogenicity Classification
1,3-butadiene	IARC: Group 1: Carcinogenic to humans

Reproductive toxicity

Product:

Effects on fertility : Species: Rat
Sex: male and female
Application Route: Inhalation

Method: OECD Test Guideline 421
Remarks: Based on available data, the classification criteria are not met.

Reproductive toxicity - Assessment : This product does not meet the criteria for classification in categories 1A/1B.

Components:

1,3-butadiene:

Effects on fertility : Species: Rat
Sex: male and female
Application Route: Inhalation

Method: OECD Test Guideline 421
Remarks: Based on available data, the classification criteria are not met.

Reproductive toxicity - Assessment : This product does not meet the criteria for classification in categories 1A/1B.

STOT - single exposure

Product:

Remarks : Based on available data, the classification criteria are not met. Inhalation of vapours or mists may cause irritation to the respiratory system.

Components:

1,3-butadiene:

Remarks : Based on available data, the classification criteria are not met. Inhalation of vapours or mists may cause irritation to the respiratory system.

STOT - repeated exposure

Product:

Remarks : Based on available data, the classification criteria are not met.
Blood-forming organs: repeated exposure affects the bone marrow.
Reproductive system: repeated exposure affects the ovaries and testes in mice.

Components:

1,3-butadiene:

Remarks : Based on available data, the classification criteria are not met.
Blood-forming organs: repeated exposure affects the bone marrow.
Reproductive system: repeated exposure affects the ovaries and testes in mice.

Repeated dose toxicity

Product:

Species	:	Rat, male and female
Application Route	:	Inhalation
Test atmosphere	:	Gas
Method	:	Test(s) equivalent or similar to OECD Test Guideline 453
Target Organs	:	No specific target organs noted

Components:

1,3-butadiene:

Species	:	Rat, male and female
Application Route	:	Inhalation
Test atmosphere	:	Gas
Method	:	Test(s) equivalent or similar to OECD Test Guideline 453
Target Organs	:	No specific target organs noted

Aspiration toxicity

Product:

Based on available data, the classification criteria are not met.

Components:

1,3-butadiene:

Based on available data, the classification criteria are not met.

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.

Further information

Product:

Remarks : Classifications by other authorities under varying regulatory frameworks may exist.

Remarks : Unless indicated otherwise, the data presented is representative of the product as a whole, rather than for individual component(s).

Components:

1,3-butadiene:

Remarks : Classifications by other authorities under varying regulatory frameworks may exist.

SECTION 12: Ecological information

12.1 Toxicity

Product:

Toxicity to fish : LC50 (Pimephales promelas (fathead minnow)): 45 mg/l
Exposure time: 96 h
Method: Based on quantitative structure-activity relationship (QSAR) modelling
Remarks: Data not available

Toxicity to daphnia and other aquatic invertebrates : EC50 (Daphnia magna (Water flea)): 33 mg/l
Exposure time: 48 h
Method: Information given is based on data obtained from similar substances.
Remarks: Data not available

Toxicity to algae/aquatic plants : EC50 (green algae): 33 mg/l
Exposure time: 72 h
Method: Information given is based on data obtained from similar substances.
Remarks: Data not available

Toxicity to daphnia and other aquatic invertebrates (Chronic toxicity)	:	Remarks: Data not available
Toxicity to microorganisms	:	Remarks: Data not available

Components:

1,3-butadiene:

Toxicity to fish	:	LC50 (Pimephales promelas (fathead minnow)): 45 mg/l Exposure time: 96 h Method: Based on quantitative structure-activity relationship (QSAR) modelling Remarks: Based on available data, the classification criteria are not met.
Toxicity to daphnia and other aquatic invertebrates	:	EC50 (Daphnia magna (Water flea)): 33 mg/l Exposure time: 48 h Method: Based on quantitative structure-activity relationship (QSAR) modelling Remarks: Based on available data, the classification criteria are not met.
Toxicity to algae/aquatic plants	:	EC50 (green algae): 33 mg/l Exposure time: 72 h Method: Based on quantitative structure-activity relationship (QSAR) modelling Remarks: Based on available data, the classification criteria are not met.
Toxicity to microorganisms	:	Remarks: no data available
Toxicity to fish (Chronic toxicity)	:	Remarks: no data available
Toxicity to daphnia and other aquatic invertebrates (Chronic toxicity)	:	Remarks: no data available

12.2 Persistence and degradability

Product:

Biodegradability	:	Remarks: Not readily biodegradable. Oxidises rapidly by photo-chemical reactions in air.
Photodegradation	:	

Components:

1,3-butadiene:

Biodegradability : Remarks: Not readily biodegradable.
Oxidises rapidly by photo-chemical reactions in air.

Photodegradation : Remarks: Oxidises rapidly by photo-chemical reactions in air.

12.3 Bioaccumulative potential

Product:

Bioaccumulation : Remarks: Does not bioaccumulate significantly.

Components:

1,3-butadiene:

Bioaccumulation : Remarks: Does not bioaccumulate significantly.

12.4 Mobility in soil

Product:

Mobility : Remarks: Because of their extreme volatility, air is the only environmental compartment that hydrocarbon gases will be found.

Components:

1,3-butadiene:

Mobility : Remarks: Because of their extreme volatility, air is the only environmental compartment that hydrocarbon gases will be found.

12.5 Results of PBT and vPvB assessment

Product:

Assessment : The substance does not fulfill all screening criteria for persistence, bioaccumulation and toxicity and hence is not considered to be PBT or vPvB..

Components:

1,3-butadiene:

Assessment : The substance does not fulfill all screening criteria for persistence, bioaccumulation and toxicity and hence is not considered to be PBT or vPvB..

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 : In view of the high rate of loss from solution, the product is unlikely to pose a significant hazard to aquatic life.

Unless indicated otherwise, the data presented is representative of the product as a whole, rather than for individual component(s).

Components:

1,3-butadiene:

Additional ecological information : In view of the high rate of loss from solution, the product is unlikely to pose a significant hazard to aquatic life.

SECTION 13: Disposal considerations

13.1 Waste treatment methods

Product : Recover or recycle if possible.
It is the responsibility of the waste generator to determine the toxicity and physical properties of the material generated to determine the proper waste classification and disposal methods in compliance with applicable regulations.

Do not dispose into the environment, in drains or in water courses.
Waste product should not be allowed to contaminate soil or water.

Disposal should be in accordance with applicable regional, national, and local laws and regulations.
Local regulations may be more stringent than regional or national requirements and must be complied with.

Contaminated packaging : Drain container thoroughly.
After draining, vent in a safe place away from sparks and fire.
Send to drum recoverer or metal reclaimer.

SECTION 14: Transport information

14.1 UN number or ID number

ADN : 1010

ADR : 1010

RID : 1010

IMDG : 1010

IATA : 1010

14.2 UN proper shipping name

ADN : BUTADIENES (1,3-BUTADIENE), STABILIZED

ADR : BUTADIENES, STABILIZED

RID : BUTADIENES, STABILIZED

IMDG : BUTADIENES, STABILIZED

IATA : BUTADIENES, STABILIZED

14.3 Transport hazard class(es)

ADN : 2

ADR : 2

RID : 2

IMDG : 2.1

IATA : 2.1

14.4 Packing group

ADN

Packing group : Not Assigned
Classification Code : 2F
Labels : 2.1 (INST, CMR)
CDNI Inland Water Waste Agreement : NST 3301 Butadienes

ADR

Packing group : Not assigned by regulation
Classification Code : 2F
Hazard Identification Number : 239
Labels : 2.1

RID

Packing group : Not assigned by regulation
Classification Code : 2F
Hazard Identification Number : 239
Labels : 2.1

IMDG

Packing group : Not assigned by regulation
Labels : 2.1

IATA

Packing group : Not Assigned
Labels : 2.1

14.5 Environmental hazards

ADN

Environmentally hazardous : no

ADR
Environmentally hazardous : no

RID
Environmentally hazardous : no

IMDG
Marine pollutant : no

14.6 Special precautions for user

Remarks : Special Precautions: Refer to Section 7, Handling & Storage, for special precautions which a user needs to be aware of or needs to comply with in connection with transport.

14.7 Maritime transport in bulk according to IMO instruments

Ship type : 2G/2PG
Product name : Butadiene (all isomers)

Additional Information **:** Transport in bulk according to the IGC code

This product may be transported under nitrogen blanketing. Nitrogen is an odourless and invisible gas. Exposure to nitrogen enriched atmospheres displaces available oxygen which may cause asphyxiation or death. Personnel must observe strict safety precautions when involved with a confined space entry.

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, mixtures and articles (Annex XVII) : Not applicable

REACH - List of substances subject to authorisation (Annex XIV) : Product is not subject to Authorisation under REACH.

REACH - Candidate List of Substances of Very High Concern for Authorisation (Article 59). : This product does not contain substances of very high concern (Regulation (EC) No 1907/2006 (REACH), Article 57).

Seveso III: Directive 2012/18/EU of the European Parliament and of the Council on the control of major-accident hazards involving dangerous substances.	18	Liquefied flammable gases (including LPG) and natural gas

Water hazard class (Germany) : WGK 3 highly hazardous to water
Code Number: 218

Remarks: Classification according to AwSV

Other regulations:

The regulatory information is not intended to be comprehensive. Other regulations may apply to this material.

Product is subject Betriebs-Sicherheits-Verordnung (BetrSichV).
Compliance with paragraph 22 of Youth Employment Law.
Take note of Law on the protection of mothers at work, in education and in studies (Maternity Protection Act - MuSchG).
Product is subject to Stoerfallverordnung (12. BImSchV) based on Seveso III directive (2012/18/EU).

The product is subject to the supply restrictions of the Ordinance on the Prohibition of Chemicals.

The components of this product are reported in the following inventories:

AIIC	:	Listed
DSL	:	Listed
IECSC	:	Listed
ENCS	:	Listed
KECI	:	Listed
NZIoC	:	Listed
PICCS	:	Listed
TCSI	:	Listed
TSCA	:	Listed

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

DE TRGS 910	:	Germany. TRGS 910 - Substance-specific acceptable and tolerable concentrations and equivalence values for carcinogenic hazardous substances.
TRGS 910	:	Germany. TRGS 910 - Substance-specific acceptable and tolerable concentrations and equivalence values for carcinogenic hazardous substances
DE TRGS 910 / Acceptable	:	Acceptable concentration

concentration
DE TRGS 910 / Tolerable concentration : Tolerable concentration

ADN - European Agreement concerning the International Carriage of Dangerous Goods by Inland Waterways; ADR - Agreement concerning the International Carriage of Dangerous Goods by Road; AIIC - Australian Inventory of Industrial Chemicals; ASTM - American Society for the Testing of Materials; bw - Body weight; CLP - Classification Labelling Packaging Regulation; Regulation (EC) No 1272/2008; CMR - Carcinogen, Mutagen or Reproductive Toxicant; DIN - Standard of the German Institute for Standardisation; DSL - Domestic Substances List (Canada); ECHA - European Chemicals Agency; EC-Number - European Community number; ECx - Concentration associated with x% response; ELx - Loading rate associated with x% response; EmS - Emergency Schedule; ENCS - Existing and New Chemical Substances (Japan); ErCx - Concentration associated with x% growth rate response; GHS - Globally Harmonized System; GLP - Good Laboratory Practice; IARC - International Agency for Research on Cancer; IATA - International Air Transport Association; IBC - International Code for the Construction and Equipment of Ships carrying Dangerous Chemicals in Bulk; IC50 - Half maximal inhibitory concentration; ICAO - International Civil Aviation Organization; IECSC - Inventory of Existing Chemical Substances in China; IMDG - International Maritime Dangerous Goods; IMO - International Maritime Organization; ISHL - Industrial Safety and Health Law (Japan); ISO - International Organisation for Standardization; KECI - Korea Existing Chemicals Inventory; LC50 - Lethal Concentration to 50 % of a test population; LD50 - Lethal Dose to 50% of a test population (Median Lethal Dose); MARPOL - International Convention for the Prevention of Pollution from Ships; n.o.s. - Not Otherwise Specified; NO(A)EC - No Observed (Adverse) Effect Concentration; NO(A)EL - No Observed (Adverse) Effect Level; NOELR - No Observable Effect Loading Rate; NZIoC - New Zealand Inventory of Chemicals; OECD - Organization for Economic Co-operation and Development; OPPTS - Office of Chemical Safety and Pollution Prevention; PBT - Persistent, Bioaccumulative and Toxic substance; PICCS - Philippines Inventory of Chemicals and Chemical Substances; (Q)SAR - (Quantitative) Structure Activity Relationship; REACH - Regulation (EC) No 1907/2006 of the European Parliament and of the Council concerning the Registration, Evaluation, Authorisation and Restriction of Chemicals; RID - Regulations concerning the International Carriage of Dangerous Goods by Rail; SADT - Self-Accelerating Decomposition Temperature; SDS - Safety Data Sheet; SVHC - Substance of Very High Concern; TCSI - Taiwan Chemical Substance Inventory; TECI - Thailand Existing Chemicals Inventory; TRGS - Technical Rule for Hazardous Substances; TSCA - Toxic Substances Control Act (United States); UN - United Nations; vPvB - Very Persistent and Very Bioaccumulative

Further information

Training advice : Provide adequate information, instruction and training for operators.

Other information : For Industry guidance and tools on REACH please visit the CEFIC website at http://cefic.org/Industry-support.
The substance does not fulfill all screening criteria for persistence, bioaccumulation and toxicity and hence is not considered to be PBT or vPvB.

A vertical bar (|) in the left margin indicates an amendment from the previous version.

Sources of key data used to compile the Safety Data : The quoted data are from, but not limited to, one or more sources of information (e.g. toxicological data from Shell

Sheet | Health Services, material suppliers' data, CONCAWE, EU IUCLID date base, EC 1272 regulation, etc).

Identified Uses according to the Use Descriptor System

Uses - Worker
Title : Manufacture of substance
- Industrial

Uses - Worker
Title : Distribution of substance
- Industrial

Uses - Worker
Title : Use as an intermediate
- Industrial

Uses - Worker
Title : Rubber production and processing
- Industrial

Uses - Worker
Title : Polymer production
- Industrial

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

DE / EN

Exposure Scenario - Worker

300000000254	
SECTION 1	**EXPOSURE SCENARIO TITLE**
Title	Manufacture of substance- Industrial
Use Descriptor	**Sector of Use**: SU3, SU8, SU9 **Process Categories**: PROC 1, PROC 2, PROC 3, PROC 8a, PROC 8b, PROC 15 **Environmental Release Categories**: ERC1, ERC4
Scope of process	Manufacture of the substance or use as a process chemical or extraction agent within closed or contained systems. Includes incidental exposures during recycling/ recovery, material transfers, storage, sampling, associated laboratory activities, maintenance and loading (including marine vessel/barge, road/rail car and bulk container).

SECTION 2	**OPERATIONAL CONDITIONS AND RISK MANAGEMENT MEASURES**
Additional Information	No exposure assessment presented for the environment.
Section 2.1	**Control of Worker Exposure**
Product Characteristics	
Physical form of product	Liquid, vapour pressure > 10 kPa at STP
Concentration of the Substance in Mixture/Article	Covers use of substance/product up to 100% (unless stated differently).,
Frequency and Duration of Use	
Covers daily exposures up to 8 hours (unless stated differently).	
Other Operational Conditions affecting Exposure	
Assumes a good basic standard of occupational hygiene is implemented.	
Contributing Scenarios	**Risk Management Measures**
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 maintain all control measures. Consider the need for risk based health surveillance.
General exposures (closed	Handle substance within a closed system.

systems)	
General exposures (closed systems)with sample collectionGeneral measures (skin irritants).	Handle substance within a predominantly closed system provided with extract ventilation. Sample via a closed loop or other system to avoid exposure Provide a good standard of general ventilation (not less than 3 to 5 air changes per hour). Avoid carrying out activities involving exposure for more than 1 hour.
General exposures (closed systems)Use in contained batch processes	Handle substance within a predominantly closed system provided with extract ventilation. Sample via a closed loop or other system to avoid exposure Provide a good standard of general ventilation (not less than 3 to 5 air changes per hour). Avoid carrying out activities involving exposure for more than 15 minutes.
Process sampling	Sample via a closed loop or other system to avoid exposure Provide a good standard of general ventilation (not less than 3 to 5 air changes per hour). Avoid carrying out activities involving exposure for more than 15 minutes.
Laboratory activities	Use high-performance fume cupboard.
Bulk transfers(closed systems)	Use dry break couplings for material transfer. Avoid carrying out activities involving exposure for more than 1 hour.
Equipment cleaning and maintenance	Drain down and flush system prior to equipment opening or maintenance. Provide extraction ventilation at points where emissions occur. Provide a good standard of general ventilation (not less than 3 to 5 air changes per hour). Clear spills immediately. Wear a respirator conforming to EN140 with Type AX filter or better. Retain drain downs in sealed storage pending disposal or for subsequent recycle.
Storage.General measures (skin irritants).	Store substance within a closed system. Sample via a closed loop or other system to avoid exposure Provide extract ventilation to material transfer points and other openings.
Section 2.2	**Control of Environmental Exposure**
No exposure assessment presented for the environment.	

SECTION 3	**EXPOSURE ESTIMATION**
Section 3.1 - Health	
The ECETOC TRA tool has been used to estimate workplace exposures unless otherwise	

indicated.

Section 3.2 -Environment
No exposure assessment presented for the environment.

SECTION 4	**GUIDANCE TO CHECK COMPLIANCE WITH THE EXPOSURE SCENARIO**

Section 4.1 - Health
Predicted exposures are not expected to exceed the DN(M)EL when the Risk Management Measures/Operational Conditions outlined in Section 2 are implemented. Where other Risk Management Measures/Operational Conditions are adopted, then users should ensure that risks are managed to at least equivalent levels.

Section 4.2 -Environment
No exposure assessment presented for the environment.

Exposure Scenario - Worker

300000000255	
SECTION 1	**EXPOSURE SCENARIO TITLE**
Title	Distribution of substance- Industrial
Use Descriptor	**Sector of Use**: SU3, SU8, SU9 **Process Categories**: PROC 1, PROC 2, PROC 3, PROC 8a, PROC 8b, PROC 9, PROC 15 **Environmental Release Categories**: ERC1, ERC2, ERC3, ERC4, ERC5, ERC6a, ERC6b, ERC 6C,, ERC7
Scope of process	Bulk loading (including marine vessel/barge, rail/road car and IBC loading) of substance within closed or contained systems, including incidental exposures during its sampling, storage, unloading, maintenance and associated laboratory activities.

SECTION 2	**OPERATIONAL CONDITIONS AND RISK MANAGEMENT MEASURES**
Additional Information	No exposure assessment presented for the environment.
Section 2.1	**Control of Worker Exposure**
Product Characteristics	
Physical form of product	Liquid, vapour pressure > 10 kPa at STP
Concentration of the Substance in Mixture/Article	Covers use of substance/product up to 100% (unless stated differently).,
Frequency and Duration of Use	
Covers daily exposures up to 8 hours (unless stated differently).	
Other Operational Conditions affecting Exposure	
Assumes a good basic standard of occupational hygiene is implemented.	
Contributing Scenarios	**Risk Management Measures**
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 maintain all control measures. Consider the need for risk based health surveillance.
General exposures (closed	Handle substance within a closed system.

systems)	
General exposures (closed systems)with sample collectionGeneral measures (skin irritants).	Handle substance within a closed system. Ensure material transfers are under containment or extract ventilation. Sample via a closed loop or other system to avoid exposure Avoid carrying out activities involving exposure for more than 1 hour.
General exposures (closed systems)Use in contained batch processes	Handle substance within a closed system. Ensure material transfers are under containment or extract ventilation. Sample via a closed loop or other system to avoid exposure Avoid carrying out activities involving exposure for more than 1 hour.
Process sampling	Handle substance within a closed system. Sample via a closed loop or other system to avoid exposure
Laboratory activities	Use high-performance fume cupboard.
Bulk transfers(closed systems)	Clear transfer lines prior to de-coupling. Transfer via enclosed lines. Ensure material transfers are under containment or extract ventilation. Avoid carrying out activities involving exposure for more than 1 hour.
Small package filling	Transfer via enclosed lines. Provide a good standard of general or controlled ventilation (5 to 15 air changes per hour). Minimise exposure by partial enclosure of the operation or equipment and provide extract ventilation at openings. Avoid carrying out activities involving exposure for more than 1 hour.
Equipment cleaning and maintenance	Drain down and flush system prior to equipment opening or maintenance. Provide extraction ventilation at points where emissions occur. Provide a good standard of general ventilation (not less than 3 to 5 air changes per hour). Clear spills immediately. Retain drain downs in sealed storage pending disposal or for subsequent recycle.
Storage.General measures (skin irritants).	Sample via a closed loop or other system to avoid exposure Provide extract ventilation to material transfer points and other openings. Store substance within a closed system.
Section 2.2	**Control of Environmental Exposure**
No exposure assessment presented for the environment.	

SECTION 3	EXPOSURE ESTIMATION

Section 3.1 - Health

The ECETOC TRA tool has been used to estimate workplace exposures unless otherwise indicated.

Section 3.2 -Environment

No exposure assessment presented for the environment.

SECTION 4	GUIDANCE TO CHECK COMPLIANCE WITH THE EXPOSURE SCENARIO

Section 4.1 - Health

Predicted exposures are not expected to exceed the DN(M)EL when the Risk Management Measures/Operational Conditions outlined in Section 2 are implemented.
Where other Risk Management Measures/Operational Conditions are adopted, then users should ensure that risks are managed to at least equivalent levels.

Section 4.2 -Environment

No exposure assessment presented for the environment.

Exposure Scenario - Worker

300000000256	
SECTION 1	**EXPOSURE SCENARIO TITLE**
Title	Use as an intermediate- Industrial
Use Descriptor	**Sector of Use**: SU3, SU8, SU9 **Process Categories**: PROC 1, PROC 2, PROC 3, PROC 8a, PROC 8b, PROC 15 **Environmental Release Categories**: ERC6a
Scope of process	Use of substance as an intermediate within closed or contained systems (not related to Strictly Controlled Conditions). Includes incidental exposures during recycling/recovery, material transfers, storage, sampling, associated laboratory activities, maintenance and loading (including marine vessel/barge, road/rail car and bulk container).

SECTION 2	**OPERATIONAL CONDITIONS AND RISK MANAGEMENT MEASURES**
Additional Information	No exposure assessment presented for the environment.
Section 2.1	**Control of Worker Exposure**
Product Characteristics	
Physical form of product	Liquid, vapour pressure > 10 kPa at STP
Concentration of the Substance in Mixture/Article	Covers use of substance/product up to 100% (unless stated differently).,
Frequency and Duration of Use	
Covers daily exposures up to 8 hours (unless stated differently).	
Other Operational Conditions affecting Exposure	
Assumes use at not more than 20°C above ambient temperature (unless stated differently). Assumes a good basic standard of occupational hygiene is implemented.	
Contributing Scenarios	**Risk Management Measures**
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 maintain all control measures. Consider the need for risk based health surveillance.

General exposures (closed systems)	Handle substance within a closed system.
General exposures (closed systems)with sample collectionGeneral measures (skin irritants).	Handle substance within a predominantly closed system provided with extract ventilation. Sample via a closed loop or other system to avoid exposure Provide a good standard of general ventilation (not less than 3 to 5 air changes per hour). Avoid carrying out activities involving exposure for more than 1 hour.
General exposures (closed systems)Use in contained batch processes	Handle substance within a predominantly closed system provided with extract ventilation. Sample via a closed loop or other system to avoid exposure Provide a good standard of general ventilation (not less than 3 to 5 air changes per hour). Avoid carrying out activities involving exposure for more than 15 minutes.
Process sampling	Sample via a closed loop or other system to avoid exposure Provide a good standard of general ventilation (not less than 3 to 5 air changes per hour). Avoid carrying out activities involving exposure for more than 15 minutes.
Laboratory activities	Use high-performance fume cupboard.
Bulk transfers(closed systems)	Use dry break couplings for material transfer. Avoid carrying out activities involving exposure for more than 1 hour.
Equipment cleaning and maintenance	Drain down and flush system prior to equipment opening or maintenance. Provide extraction ventilation at points where emissions occur. Provide a good standard of general ventilation (not less than 3 to 5 air changes per hour). Clear spills immediately. Wear a respirator conforming to EN140 with Type AX filter or better. Retain drain downs in sealed storage pending disposal or for subsequent recycle.
Storage.General measures (skin irritants).	Sample via a closed loop or other system to avoid exposure Provide extract ventilation to material transfer points and other openings. Store substance within a closed system.
Section 2.2	**Control of Environmental Exposure**
No exposure assessment presented for the environment.	

SECTION 3	**EXPOSURE ESTIMATION**
Section 3.1 - Health	

The ECETOC TRA tool has been used to estimate workplace exposures unless otherwise indicated.

Section 3.2 -Environment
No exposure assessment presented for the environment.

SECTION 4	**GUIDANCE TO CHECK COMPLIANCE WITH THE EXPOSURE SCENARIO**

Section 4.1 - Health
Predicted exposures are not expected to exceed the DN(M)EL when the Risk Management Measures/Operational Conditions outlined in Section 2 are implemented. Where other Risk Management Measures/Operational Conditions are adopted, then users should ensure that risks are managed to at least equivalent levels.

Section 4.2 -Environment
No exposure assessment presented for the environment.

Exposure Scenario - Worker

300000000257	
SECTION 1	**EXPOSURE SCENARIO TITLE**
Title	Rubber production and processing- Industrial
Use Descriptor	**Sector of Use**: SU3, SU10 **Process Categories**: PROC 1, PROC 2, PROC 3, PROC 6, PROC 8a, PROC 8b, PROC 14, PROC 15 **Environmental Release Categories**: ERC4,
Scope of process	Manufacture of tyres and general rubber articles within closed or contained systems, including incidental exposures during processing of raw (uncured) rubber, handling and mixing of rubber additives, calendaring, vulcanising, cooling and finishing as well as maintenance.

SECTION 2	**OPERATIONAL CONDITIONS AND RISK MANAGEMENT MEASURES**
Additional Information	No exposure assessment presented for the environment.
Section 2.1	**Control of Worker Exposure**
Product Characteristics	
Physical form of product	Liquid, vapour pressure > 10 kPa at STP
Concentration of the Substance in Mixture/Article	Covers use of substance/product up to 100% (unless stated differently).,
Frequency and Duration of Use	
Covers daily exposures up to 8 hours (unless stated differently).	
Other Operational Conditions affecting Exposure	
Assumes use at not more than 20°C above ambient temperature (unless stated differently). Assumes a good basic standard of occupational hygiene is implemented.	
Contributing Scenarios	**Risk Management Measures**
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 maintain all control measures. Consider the need for risk based health surveillance.
Material transfersGeneral	Transfer via enclosed lines.

measures (skin irritants).	Ensure material transfers are under containment or extract ventilation. Provide a good standard of general ventilation (not less than 3 to 5 air changes per hour).
General exposures.Continuous process	Handle substance within a closed system.
General exposures.Batch process	Handle substance within a closed system.
Bulk transfersDedicated facility	Transfer via enclosed lines. Ensure material transfers are under containment or extract ventilation.
Calendering (including Banburys)	Limit the substance content in the product to 1 %. Minimise exposure by partial enclosure of the operation or equipment and provide extract ventilation at openings. Provide a good standard of general ventilation (not less than 3 to 5 air changes per hour).
Pressing uncured rubber blanks	Limit the substance content in the product to 1 %. Ensure material transfers are under containment or extract ventilation. Provide a good standard of general or controlled ventilation (5 to 15 air changes per hour).
Vulcanisation	Limit the substance content in the product to 1 %. Minimise exposure by partial enclosure of the operation or equipment and provide extract ventilation at openings. Provide a good standard of general ventilation (not less than 3 to 5 air changes per hour).
Cooling cured articles	Limit the substance content in the product to 1 %. Minimise exposure by partial enclosure of the operation or equipment and provide extract ventilation at openings. Provide a good standard of general ventilation (not less than 3 to 5 air changes per hour).
Laboratory activities	Use high-performance fume cupboard.
Equipment maintenance	Drain down and flush system prior to equipment opening or maintenance. Provide a good standard of general or controlled ventilation (5 to 15 air changes per hour). Wear a respirator conforming to EN140 with Type AX filter or better.
Section 2.2	**Control of Environmental Exposure**
No exposure assessment presented for the environment.	

SECTION 3	**EXPOSURE ESTIMATION**
Section 3.1 - Health	
The ECETOC TRA tool has been used to estimate workplace exposures unless otherwise	

indicated.

Section 3.2 -Environment
No exposure assessment presented for the environment.

SECTION 4	**GUIDANCE TO CHECK COMPLIANCE WITH THE EXPOSURE SCENARIO**

Section 4.1 - Health
Predicted exposures are not expected to exceed the DN(M)EL when the Risk Management Measures/Operational Conditions outlined in Section 2 are implemented. Where other Risk Management Measures/Operational Conditions are adopted, then users should ensure that risks are managed to at least equivalent levels.

Section 4.2 -Environment
No exposure assessment presented for the environment.

Exposure Scenario - Worker

300000000258	
SECTION 1	**EXPOSURE SCENARIO TITLE**
Title	Polymer production- Industrial
Use Descriptor	**Sector of Use**: SU3, SU10 **Process Categories**: PROC 1, PROC 2, PROC 3, PROC 4, PROC 5, PROC 6, PROC 8a, PROC 8b, PROC 14, PROC 15 **Environmental Release Categories**: ERC6a, ERC 6C
Scope of process	Manufacture of polymers from monomers in continuous and batch processes. Including production, re-cycling and recovery, degassing, discharging, reactor maintenance and immediate polymer product formation (i.e. compounding, pelletisation, product off-gassing).

SECTION 2	**OPERATIONAL CONDITIONS AND RISK MANAGEMENT MEASURES**
Additional Information	No exposure assessment presented for the environment.
Section 2.1	**Control of Worker Exposure**
Product Characteristics	
Physical form of product	Liquid, vapour pressure > 10 kPa at STP
Concentration of the Substance in Mixture/Article	Covers use of substance/product up to 100% (unless stated differently).,
Frequency and Duration of Use	
Covers daily exposures up to 8 hours (unless stated differently).	
Other Operational Conditions affecting Exposure	
Assumes use at not more than 20°C above ambient temperature (unless stated differently). Assumes a good basic standard of occupational hygiene is implemented.	
Contributing Scenarios	**Risk Management Measures**
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 maintain all control measures. Consider the need for risk based health surveillance.
General exposures (closed	Handle substance within a closed system.

systems)Continuous processno sampling	
Bulk transferswith sample collection	Ensure material transfers are under containment or extract ventilation. Provide a good standard of general or controlled ventilation (5 to 15 air changes per hour). Sample via a closed loop or other system to avoid exposure Avoid carrying out activities involving exposure for more than 4 hours
Polymerisation (bulk and batch)with sample collection	Handle substance within a closed system. Provide a good standard of general ventilation (not less than 3 to 5 air changes per hour). Provide extraction ventilation at points where emissions occur. Sample via a closed loop or other system to avoid exposure Avoid carrying out activities involving exposure for more than 1 hour.
Finishing operationsBatch processwith sample collection	Limit the substance content in the product to 5 %. Handle substance within a closed system. Provide a good standard of general ventilation (not less than 3 to 5 air changes per hour). Provide extraction ventilation at points where emissions occur. Sample via a closed loop or other system to avoid exposure
Intermediate polymer storage	Limit the substance content in the product to 5 %. Handle substance within a closed system. Provide a good standard of general ventilation (not less than 3 to 5 air changes per hour). Ensure material transfers are under containment or extract ventilation. Sample via a closed loop or other system to avoid exposure
Additivation and stabilisation	Limit the substance content in the product to 5 %. Handle substance within a closed system. Provide a good standard of general ventilation (not less than 3 to 5 air changes per hour). Ensure material transfers are under containment or extract ventilation. Sample via a closed loop or other system to avoid exposure
Mixing in containers.Batch process	Handle substance within a closed system. Provide a good standard of general ventilation (not less than 3 to 5 air changes per hour). Ensure material transfers are under containment or extract ventilation. Sample via a closed loop or other system to avoid exposure
Extrusion and masterbatching	Limit the substance content in the product to 1 %. Minimise exposure by partial enclosure of the operation or

	equipment and provide extract ventilation at openings. Provide a good standard of general or controlled ventilation (5 to 15 air changes per hour).
Pelletizing	Limit the substance content in the product to 1 %. Provide extraction ventilation at points where emissions occur. Provide a good standard of general or controlled ventilation (5 to 15 air changes per hour).
Bulk transfersContinuous processwith sample collection	Limit the substance content in the product to 1 %. Ensure material transfers are under containment or extract ventilation. Sample via a closed loop or other system to avoid exposure Provide a good standard of general ventilation (not less than 3 to 5 air changes per hour).
Equipment maintenance	Drain down and flush system prior to equipment opening or maintenance. Provide a good standard of general or controlled ventilation (5 to 15 air changes per hour). Clear spills immediately. Avoid carrying out activities involving exposure for more than 4 hours Wear a respirator conforming to EN140 with Type AX filter or better. Retain drain downs in sealed storage pending disposal or for subsequent recycle.
Laboratory activities	Use high-performance fume cupboard.
Storage.General measures (skin irritants).	Provide extraction ventilation at points where emissions occur. Sample via a closed loop or other system to avoid exposure Store substance within a closed system. Avoid carrying out activities involving exposure for more than 1 hour.
Section 2.2	**Control of Environmental Exposure**
No exposure assessment presented for the environment.	

SECTION 3	**EXPOSURE ESTIMATION**
Section 3.1 - Health	
The ECETOC TRA tool has been used to estimate workplace exposures unless otherwise indicated.	

Section 3.2 -Environment
No exposure assessment presented for the environment.

SECTION 4	**GUIDANCE TO CHECK COMPLIANCE WITH THE**

	EXPOSURE SCENARIO
Section 4.1 - Health	
Predicted exposures are not expected to exceed the DN(M)EL when the Risk Management Measures/Operational Conditions outlined in Section 2 are implemented. Where other Risk Management Measures/Operational Conditions are adopted, then users should ensure that risks are managed to at least equivalent levels.	

Section 4.2 -Environment
No exposure assessment presented for the environment.