1,3 - BUTADIENE

Safety Data Sheet

according to Regulation (EU) No 2020/878

Revision date: 30.12.2022 Supersedes: 26.03.2018 Version: 8.0

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

1.1. Product identifier

Product form : Substance
Trade name : 1,3 - BUTADIENE
Chemical name : Buta-1,3-diene
CAS No : 106-99-0
EC No : 203-450-8
Index no : 601-013-00-X
REACH No : 01-2119471988-16-0088
Formula : C4H6
Synonyms : Divinyl / Vinylethylene / Biethylene / Erythrene
Product group : Trade product

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

1.2.1. Relevant identified uses

Main use category : Industrial/Professional use
Use of the substance : Raw material of Synthetic Rubber
(styrene-butadiene, nitrile butadiene, cis-polybutadiene rubber).
Production of plastic materials, paints and synthetic resins.

1.2.2. Uses advised against

See Section 15.1, REACH Annex XVII - Restriction

1.3. Details of the supplier of the safety data sheet

1.3.1. Manufacturer

HIP-Petrohemija d.o.o. Pancevo
Spoljnostarcevacka 82
26000 Pancevo
Republic of Serbia
www.hip-petrohemija.com

Tel: + 381 (0) 13 307 000
Fax: + 381 (0) 13 310 207
E-mail (person responsible for the SDS):
ivana.kosovic@hip-petrohemija.rs

1.4. Emergency telephone number

Poisoning Control Centre : + 381 (0) 11 266 11 22 (00-24h)
+ 381 (0) 11 266 27 55 (00-24h)
+ 381 (0) 11 360 84 40 (00-24h)

HIP-Petrohemija (available during office hours: Monday to Friday) : + 381 (0) 13 30 77 77 (08-16h)

European Emergency telephone number : See Section 16 for the Poison centres in the EEA

SECTION 2: Hazards identification

2.1. Classification of the substance or mixture

Classification according to Regulation (EC) No 1272/2008 [CLP]

Physical hazards:	Flam. Gas 1	H220
	Press. Gas (Liq)	H280
Helth hazard:	Mut. germ. 1B	H340
	Carc. 1A	H350

Note: Full text of hazard classes and H-statements: see section 16

2.2. Label elements

Labelling according to Regulation (EC) No 1272/2008 [CLP]

Hazard pictograms:

GHS02 GHS04 GHS08

Signal word: **DANGER**

Hazard statements:
H220 – Extremely flammable gas.
H280 – Contains gas under pressure; may explode if heated.
H340 – May cause genetic defects.
H350 – May cause cancer.

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.
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 – Eliminate all ignition sources if safe to do so.
P308+P313 – IF exposed or concerned: Get medical advice/attention.
- **Storage:**
P403 – Store in a well-ventilated place.

2.3. Other hazards

PBT/vPvB : The substance does not fulfil the PBT and vPvB criteria.
EDCs : The product has no endocrine disrupting potential.
Other information : Contact with liquid may cause cold burns/frostbite.

SECTION 3: Composition/information on ingredients

3.1. Substance

Substance name	Product identifier	% (w/w)	Classification according to Regulation (EC) No 1272/2008 [CLP]	Note
Buta-1,3-diene	(CAS No) 106-99-0 (EC No) 203-450-8 (Index No) 601-013-00-X (REACH No) 01-2119471988-16-0088	≥ 99.5	Flam. Gas 1, H220 Press. Gas (Liq), H280 Mut. germ. 1B, H340 Carc. 1A, H350	D U
Note: Full text of hazard classes and H-statements: see section 16				

3.2. Mixture

Not applicable.

SECTION 4: First aid measures

4.1. Description of first aid measures

First-aid measures general : Stop the influence of the substance on the human body. Check basic vital functions (blood circulation, breathing, conscious state). In case of unconsciousness, with spontaneous breathing and blood circulation, stabilize the situation. In the case of breathing and blood circulation stopped immediately apply cardio - pulmonary revival (heart-lung resuscitation, heart massage, artificial respiration). Immediately seek medical attention. Take the necessary precautions to protect their own health before rescue and providing first aid.

First-aid measures after inhalation : Move to fresh air and keep at rest in a comfortable position comfortable for breathing. Seek medical attention. If it is necessary give him oxygen. If breathing has stopped, qualified person to give him artificial respiration. Keep it under medical supervision.

First-aid measures after skin contact : In case of skin contact with the liquid caused frostbite. Immediately remove all contaminated clothing. Wash skin immediately with plenty of water. Frostbite

should be treated as burns. In case of serious contamination, the affected immediately taken to hospital treatment.

First-aid measures after eye contact : Rinse eyes thoroughly with plenty of water for at least 15 minutes, also under the eyelids to make sure that it is washed the entire surface of the eye. Use warm water. Immediately seek medical attention. Consult a physician. Do not wear lenses when you are working.

First-aid measures after ingestion : Swallowing during the handling is unlikely. If the affected person has spasms, is unconscious or fainting, do not induce vomiting. If the person is conscious should be given to drink about ¼ l water. Repeat after spontaneous vomiting.

Advice for a doctor : Treat symptomatically.

4.2. Most important symptoms and effects, both acute and delayed

Following inhalation : May cause irritation to the respiratory system, cough, sore throat, dizziness, headache, drowsiness, nausea and vomiting. The loss of oxygen can cause unconsciousness, and in extreme cases, coma and death. It can cause loss of sense of balance, fatigue. High concentrations can cause irregular heartbeat and possible sensitization of the heart.

Following skin contact : May cause irritation and redness. It can be absorbed through the skin. May cause swellings. Liquefied form may cause frostbites.

After eye contact : Gas is a mild irritant and can cause redness, pain and blurred vision. The liquid can cause frostbite, irritation, watery eyes, redness.

After ingestion : Ingestion is not considered a potential route of exposure to this product. It can cause frostbite tissues of the mouth and throat.

Additional symptoms and effects : *See Section 11, Toxicological information.*

4.3. Indication of any immediate medical attention and special treatment needed

Immediate medical attention : There is no specific antidote, to treat the symptoms. Standard methods to treat sleepiness, frostbite, nausea, decreased blood pressure and cardiac arrhythmias. Sympathomimetic and catecholamines should be avoided or used with caution (even small doses can have an impact) because it can cause cardiac sensitization. Provide oxygen mask if there is a disruption in breathing. Treatment of consequences from exposure should be directed at establishing control of symptoms and the clinical picture of the patient. After initial assistance there is no need for further treatment if symptoms do not happen again.

See Subsection 1.4, Emergency telephone number.

SECTION 5: Firefighting measures

5.1. Extinguishing media

Suitable extinguishing media : LARGE FIRE: Use water spray or fog to control fire fumes.

SMALL FIRE: Dry powder (ABC). Carbon dioxide. Dry sand or fire fighting foam.

Unsuitable extinguishing media : DO NOT use direct water stream as it may scatter and spread fire.

5.2. Special hazards arising from the substance or mixture

Complete combustion : Carbon dioxide and water vapor are made.

Incomplete combustion : Carbon monoxide, carbon dioxide and / or low molecular weight hydrocarbons: aldehydes and ketones.

5.3. Advice for firefighters

Special measures of protection during fire fighting : Fight fire from protected location of the maximum possible distance. Avoid breathing smoke or burnt material. Keep away in a case of fire at the opening of the container, or when changing the color of the tank caused by heat. Gas is heavier than air, spreads to the ground and can reach to the source of ignition.

Special protective equipment for firefighters : A set of protective equipment for firefighters (EN 469), protective gloves for firefighters (EN 659) and boots in conjunction with the appropriate respiratory protection devices (EN 137).

See Section 6, Accidental release measures.

SECTION 6: Accidental release measures

6.1. Personal precautions, protective equipment and emergency procedures

For non-emergency personnel : Immediately evacuate all personnel from danger area. Prohibit access to the accident zone until the rehabilitation is completed. Untrained staff must not take any action.

For emergency personnel : Be sure that wearing full personal protective equipment, including gloves, goggles or face shields. Wear breathing apparatus if there is a risk of exposure to vapor.

6.2. Environmental precautions

Land/water spillage : Ensure that it does not get into the drains and the environment. If it comes to the excessive spillage notify the local authorities. It should be covered entering drains and prevent vapor / liquid to reach the drains and waste water systems. Vapors are heavier than air and explosive mixtures can accumulate in low areas, and work in places remote from the place of expiration - there is a danger of explosion. There is a danger of polymerization after heating and after the impact of oxygen from the air - the explosive character of the polymerization. Warn the population in residential and industrial areas.

6.3. Methods and material for containment and cleaning up

Precaution methods : Stay upwind. Keep area evacuated and free from ignition sources until any spilled liquid has evaporated.

Methods for cleaning up : Allow that the product "under control" burns in the presence of fire-fighters if necessary. The product evaporates easily. In case of cold weather (low temperature) to cover the substance of combustible material to absorb (sand, universal binders) and place in closed containers. Dispose of contaminated material in accordance with *Section 13, Disposal considerations*. Use water spray to reduce the concentration in the air.

6.4. Reference to other sections

See Section 7, Handling and storage. See Subsection 8.2, Exposure controls. See Section 13, Disposal considerations.

SECTION 7: Handling and storage

7.1. Precautions for safe handling

Precautions for safe handling : Use antistatic personal protective equipment when handling. Ensure good ventilation in work areas. Eliminate all possible sources of ignition in the work environment. You must take all precautions to prevent the accumulation of static electricity. Prevent leakage of product into drains and water systems. Do not use an open flame near the product.

Hygiene measures : Wear appropriate personal protective equipment. Avoid prolonged exposure. Avoid inhalation. Avoid all sources of ignition: heat, sparks, open flame. Avoid contact with the skin, eyes and clothing. Wash your hands and exposed parts of body thoroughly with soap and water after work. Take off contaminated clothing. Do not wear contaminated clothing, shoes or protective equipment in the catering area.

7.2. Conditions for safe storage, including any incompatibilities

Safe storage : Storage area should be cool, dry, well-ventilated place, away from all sources of ignition. In the reaction of the product with substances, rich in oxygen and rusted iron, may form unstable peroxides. Peroxides, acids, alkaline solid metals, and various metal compounds (aluminum, iron and antimony chloride) catalyst - can cause the polymerization of 1,3-butadiene. Suitable materials for the manufacture of tanks - steel, stainless steel and nickel. Copper and its alloys can be damaged.

Incompatibilities : Store in well-ventilated place away from direct sunlight, flames, ignition sources and other sources of heat.

7.3. Specific end use(s)

None.

See Subsection 7.1, Precautions for safe handling.

SECTION 8: Exposure controls/personal protection

8.1. Control parameters

8.1.1 Occupational exposure limit values (Workplace Exposure Limits)

Buta-1,3-diene (106-99-0)		
EU directive	EU limit value / TWA [mg/m^3]	EU limit value / TWA [ppm]
DIRECTIVE (EU) 2019/130 (amending Directive 2004/37/EC)	2.2	1

8.1.2 Relevant DNELs//PNECs threshold levels

DNEL					
Used in	**Chemical name CAS No**	**Exposure time**	**Efect**	**Route of exposure**	**Threshold level**
Workers	**Buta-1,3-diene** 106-99-0	Long term	Local	Inhalation	1530 mg/m³
		Long term	Systemic	Inhalation	769 mg/m³

8.2. Exposure controls

Appropriate engineering controls : Ensure adequate ventilation.

Hand protection : Protective gloves resistant to cold, from chloroprene, butilnitrila and other materials resistant to 1,3-butadiene.

Body protection : Antistatic protective work clothing, antistatic shoes, in case of need for chemical protective clothing in case of fire, use a non-flammable clothing (EN 374).

Eye protection : Chemical goggles or safety glasses. Face masks, goggles or in combination with breathing apparatus. Do not wear contact lenses when working with 1,3 butadiene (EN 166).

Respiratory protection : Use a dust mask AX at lower concentrations, a breathing apparatus at higher concentrations (EN 137).

Thermal hazard protection : Wear thermal protective clothing, when necessary.

Environmental exposure controls : Prevent releases. Ensure all national/local regulations are observed.

Other information : Avoid all unnecessary exposure.

SECTION 9: Physical and chemical properties

9.1. Information on basic physical and chemical properties

Physical state : Gas

Form : Compressed liquefied gas

Colour : Colourless

Odour : Slightly aromatic

Odour threshold : 1.0-4.0 mg/m^3

pH : Not applicable

Molecular weight : 54.1 g/mol

Melting point / Freezing point : - 108.9°C

Boiling point : - 4.4°C (760 mm Hg)

Flash point : - 76°C

Evaporation rate : Not applicable for gases

Flammability (gas) : Very easily flammable

Flammability range

Flammability limit- lower : 2 vol %

Flammability limit - upper : 12 vol %

Decomposition temperature : > 200°C

Auto-ignition temperature : 420°C

Critical pressure : No data available.

Relative density (air=1) : 1.87

Relative density (water=1) : 0.6149

Solubility at 20°C : 735 mg/l

Vapour pressure at 25°C : 2110 mm Hg

Partition coefficient (n-octanol/water) : 1,99

Viscosity : No data available.

Oxidising properties : When exposed to air it forms explosive peroxides.

Explosive properties : A mixture of steam and air is explosive.

9.2. Other information

Gas group : Liquefied gas.

Solubility in organic solvents : Ether, ethanol, very soluble in acetone.

Additional information : Gas/vapor heavier than air.
May accumulate in confined spaces, particularly at or below ground level.

SECTION 10: Stability and reactivity

10.1. Reactivity

Contact with strong oxidizing agents may cause fire and explosions.

10.2. Chemical stability

Stability was dependent on the content of an inhibitor in the product, on the temperature during storage, and on the duration of storage.

10.3. Possibility of hazardous reactions

Avoid contact with water and oxygen. Heating under pressure, the mixing with the phenols, the crotonaldehyde can cause an explosion. Peroxides, acids, solid alkaline metals and different metal compounds (aluminum, iron and antimony chloride) catalysts - the possibility of polymerization with explosive character. Risk of polymerization after heating and after the impact of the oxygen from the air - polymerization of explosive character. Due to the possibility of polymerization the product during storage and transportation is stabilized.

10.4. Conditions to avoid

Heat, sparks, open flames and other ignition sources.

10.5. Incompatible materials

Oxidizing agent, water, phenols, acids, alkali metals.

10.6. Hazardous decomposition products

Dangerous degradation products, which may arise from the carbon monoxide and carbon dioxide.

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 data, the classification criteria are not met.

Skin corrosion/irritation : Not classified.
Based on available data, the classification criteria are not met.
pH: Not applicable.

Serious eye damage/irritation : Not classified.
Based on available data, the classification criteria are not met.
pH: Not applicable.

Respiratory or skin sensitisation : Not classified.
Based on available data, the classification criteria are not met.

Germ cell mutagenicity : Mutagenicity of germ cell, category 1B
The positive results of in vivo tests in mice bone marrow.

Carcinogenicity : Carcinogenicity, category 1A
There is evidence on carcinogenicity for rodents, route of exposure, inhalation.

Reproductive toxicity : Not classified.
Based on available data, the classification criteria are not met.

Specific target organ toxicity (single exposure) : Not classified.
Based on available data, the classification criteria are not met.

Specific target organ toxicity (repeted exposure) : Not classified.
Based on available data, the classification criteria are not met.

Aspiration hazard : Not classified.
Based on available data, the classification criteria are not met.

11.2. Information on other hazards

Other hazards : No data available.

SECTION 12: Ecological information

12.1. Toxicity

Buta-1,3-diene (106-99-0)	
LC50 (fish)	38.99 mg/l (96h)
LC50 (crabs)	22.1 mg/l (48h)
EC50 (algae)	10.64 mg/l

12.2. Persistence and degradability

Buta-1,3-diene (106-99-0)	
Persistence and degradability	Product is easily biodegradable in the environment.

12.3. Bioaccumulative potential

Buta-1,3-diene (106-99-0)	
Partition coefficient n-octanol/water	The ability to bioaccumulate was determined by the octanol / water log Kow = 1.99 and log bioconcentration factor BCF = 0.98. Based on the data it can be concluded that the substance has no potential to bioconcentrate.

12.4. Mobility in soil

Buta-1,3-diene (106-99-0)	
Mobility in soil	log Koc = 1.72 (calculated value). Indicates a low potential for mobility in soil.

12.5. Results of PBT and vPvB assessment

Buta-1,3-diene (106-99-0)	
Results of PBT/vPvB assessment	Substance does not meet the criteria for PBT or vPvB in accordance with REGULATION (EC) No 1907/2006, Annex Xlll.

12.6. Endocrine disrupting properties

Buta-1,3-diene (106-99-0)	
Endocrine disrupting properties	The substance is not included in the list established in accordance with Article 59(1) of REACH for having endocrine disrupting properties, or is not identified as having endocrine disrupting properties in accordance with the criteria set out in Commission Delegated Regulation (EU) 2017/2100 or Commission Regulation (EU) 2018/605.

12.7. Other adverse effects

Buta-1,3-diene (106-99-0)	
Effect on ozone layer	None.
Effect on the global warming	No known effects from this product.

SECTION 13: Disposal considerations

13.1. Waste treatment methods

Waste disposal recommendations : Disposal of unused product is made in accordance with the regulations on waste management - the rest of the unused product shall be delivered to the authorized operator or the place designated for hazardous waste. This product is not packaged in a container.

SECTION 14: Transport information

In accordance with **ADR / IMDG / IATA / ADN/ RID:**

14.1. UN number or ID number

UN number	: 1010

14.2. UN proper shipping name

Proper Shipping Name (ADR)	: BUTADIENES, STABILIZED
Proper Shipping Name (IMDG)	: BUTADIENES, STABILIZED
Proper Shipping Name (IATA)	: Butadienes, stabilized
Proper Shipping Name (ADN)	: BUTADIENES, STABILIZED
Proper Shipping Name (RID)	: BUTADIENES, STABILIZED
Transport document description (ADR)	: UN 1010 BUTADIENES, STABILIZED, 2.1, (B/D)
Transport document description (IMDG)	: UN 1010 BUTADIENES, STABILIZED, 2.1
Transport document description (IATA)	: UN 1010 Butadienes, stabilized, 2.1
Transport document description (ADN)	: UN 1010 BUTADIENES, STABILIZED, 2.1
Transport document description (RID)	: UN 1010 BUTADIENES, STABILIZED, 2.1

14.3. Transport hazard class(es)

Transport hazard class(es)	: 2
Danger labels	: 2.1

14.4. Packing group

Packing group	: Not applicable.

14.5. Environmental hazards

Dangerous for the environment	: No
Marine pollutant	: No
Other information	: No supplementary information available.

14.6. Special precautions for user

Overland transport

Classification code (ADR)	: 2F
Special Provisions	: 386, 618, 662
Limited quantities (ADR)	: 0
Excepted quantities (ADR)	: E0
Packing instructions (ADR)	: P200
Mixed packing provisions (ADR)	: MP9
Portable tank and bulk container instructions (ADR)	: (M), T50
Tank code (ADR)	: PxBN(M)
Tank special provisions (ADR)	: TA4, TT9
Vehicle for tank carriage	: FL
Transport category (ADR)	: 2
Special provisions for carriage - Packages (ADR)	: V8
Special provisions for carriage - Loading, unloading and handling (ADR)	: CV9, CV10, CV36
Special provisions for carriage - Operation (ADR)	: S2, S4, S20
Hazard identification number	: 239
Tunnel restriction code	: B/D

Transport by sea

Limited quantities (IMDG)	: 0
Excepted quantities (IMDG)	: E0
Packing instructions (IMDG)	: P200
Tank instructions (IMDG)	: T50
EmS-No. (Fire)	: F-D
EmS-No. (Spillage)	: S-U
Properties and observations (IMDG)	: Flammable hydrocarbon gas. Explosive limits: 2 % to 12%. Heavier than air.

Air transport

PCA Limited quantities (IATA)	: Forbidden
PCA limited quantity max net quantity (IATA)	: Forbidden
PCA packing instructions (IATA)	: Forbidden
PCA max net quantity (IATA)	: Forbidden
CAO max net quantity (IATA)	: 150 kg

Inland waterway transport

Classification code (ADN)	: 2F
Limited quantities (ADN)	: 0
Excepted quantities (ADN)	: E0

Rail transport

Classification code (RID)	: 2F
Special provisions (RID)	: 386, 618, 662
Limited quantities (RID)	: 0
Excepted quantities (RID)	: E0
Packing instructions (RID)	: P200
Mixed packing provisions (RID)	: MP9
Portable tank and bulk container instructions (RID)	: (M)T50
Tank codes for RID tanks (RID)	: PxBN(M)
Transport category (RID)	: 2
Special provisions for carriage - Loading, unloading and handling (RID)	: CV9, CV10, CV36
Hazard identification number (RID)	: 239

14.7. Maritime transport in bulk according to IMO instruments

Not applicable.

SECTION 15: Regulatory information

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

- According to Annex XVII of the REACH Regulation (EC) No 1907/2006, Restrictions on the manufacture, placing on the market and use of certain dangerous substances, mixtures and articles: **Listed.**

28. Substances which are classified as carcinogen category 1A or 1B in Part 3 of Annex VI to Regulation (EC) No 1272/2008 and are listed in Appendix 1 or Appendix 2, respectively.	BUTA-1,3-DIENE
29. Substances which are classified as germ cell mutagen category 1A or 1B in Part 3 of Annex VI to Regulation (EC) No 1272/2008 and are listed in Appendix 3 or Appendix 4, respectively.	BUTA-1,3-DIENE
40. Substances classified as flammable gases category 1 or 2, flammable liquids categories 1, 2 or 3, flammable solids category 1 or 2, substances and mixtures which, in contact with water, emit flammable gases, category 1, 2 or 3, pyrophoric liquids category 1 or pyrophoric solids category 1, regardless of whether they appear in Part 3 of Annex VI to Regulation (EC) No 1272/2008.	BUTA-1,3-DIENE

- According to Article 59(10) of the REACH Regulation (EC) No 1907/2006, Candidate List of SVHC for Authorisation: **Not listed.**
- According to Annex XIV List of the REACH Regulation (EC) No 1907/2006, List of substances subject to authorisation: **Not listed.**
- According to Annex I DIRECTIVE 2012/18/EU, Dangerous substances covered by the hazard categories: **Listed.**

Part I	List of Categories of dangerous substances			
Nº	Hazard categories in accordance with Regulation (EC) No 1272/2008	Qualifying quantity (tonnes) of dangerous substances for the application of lower and upper-tier requirements		Section
8	Buta-1,3-diene / Flammable gases, Category 1 or 2	10	50	P2

15.2. Chemical safety assessment

Chemical safety assessment has been carried out. Exposure scenario is given in Annex of Safety Data Sheet.

SECTION 16: Other information

Indication of changes : Revised safety data sheet according to Regulation (EC) No 1907/2006 (REACH),

Annex II, as amended by Regulation (EU) No 2020/878.

Data sources : REGULATION (EC) No 1272/2008 OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL of 16 December 2008 on classification, labelling and packaging of substances and mixtures, amending and repealing Directives 67/548/EEC and 1999/45/EC, and amending Regulation (EC) No 1907/2006.

Training advice : THE PRODUCT IS RESTRICTED TO PROFESSIONAL USAGE ONLY and must be handled in accordance with good industrial hygiene and safety procedures. Ensure that all relevant regulations regarding explosive atmospheres, handling and storage facilities of flammable products are followed. Before using this product in any new process or experiment, a thorough material compatibility and safety study should be carried out.

Relevant hazard classes and H-statements not written out in full under Sections 2 and 3:

Flam. Gas 1	: Flammable gases, Category 1
Press. Gas (Liq)	: Gases under pressure (Liquefied gas)
Mut. germ. 1B	: Germ cell mutagenicity, Category 1B
Carc. 1A	: Carcinogenicity, Category 1A
H220	: Extremely flammable gas.
H280	: Contains gas under pressure; may explode if heated.
H340	: May cause genetic defects.
H350	: May cause cancer.

Poison centres in the EEA:

AUSTRIA (Vienna)	: +43 1 406 68 98
BELGIUM (Bruxelles)	: +32 02 264 96 36
BULGARIA (Sofia)	: +359 2 9301214 / +359 29301216
CROATIA (Zagreb)	: +385 14 686 910
CZECH REPUBLIC (Praha)	: +420 267 082 236 / +420 267 082 230 / +420 267 082 229
FRANCE (NANCY)	: +33 3 83 85 21 92
GERMANY (Berlin)	: +49 30 18 41 20
GREECE (Athens)	: +30 21 064 79250 / +30 21 064 79450
HUNGARY (Budapest)	: +36 (1) 476 1135
LATVIA (Riga)	: +371 67032600
LITHUANIA (Vilnius)	: +370 682 92653
NETHERLANDS (Utrecht)	: +31 88 75 585 61
POLAND (Lodz)	: +48 42 2538 400
ROMANIA (Bucuresti)	: +40 21 318 3606
SLOVAKIA (Bratislava)	: +421 2 5465 2307
SLOVENIA (Ljubljana)	: +386 1 522 1293

Abbreviations and acronyms:

SDS	: Safety Data Sheet
UN	: United Nations
EU	: European Union
EC	: European Community
EEC	: European Economic Community
CAS No	: Chemical Abstract Service number
EC No (EINECS)	: European Inventory of Existing Commercial Chemical Substances (European Chemical number: EINECS, ELINCS or NLP)
ELINCS	: European List of Notified Chemical Substances
NLP	: No-Longer Polymer
CLP	: Regulation (EC) No 1272/2008 on classification, labelling and packaging of substance and mixtures
ECHA	: European Chemicals Agency
REACH	: Registration, Evulation, Authorisation and Restriction of Chemicals
PBT	: Persisten, Bioaccumulative and Toxic substance/mixture

vPvB	: Very Persisten and very Bioaccumulative substance/mixture
w/w	: Percent by mass
LC50	: Lethal concentration, 50 percent
LD50	: Lethal dose, 50 percent
EC50	: Effective concentration, 50 percent
ErC50	: EC50 in terms of reduction of growth rate
NOEC	: No observed effect concentration
DNEL	: Derived No Effect Level
PNEC	: Predicted No Effect Concentration
ADR	: European Agreement concerning the International Carriage of Dangerous Goods by Road
RID	: European Agreement concerning the International Rule for Transport of Dangerous Goods by Rail
ADN	: European Agreement concerning the International Carriage of Dangerous Goods by inland Waterways
IMDG	: International Maritime Dangerous Goods
IATA	: International Air Transport Association

The information and recommendations provide in this document are based on our current knowledge, information and experience at the date of its publication, and their purpose is to present prevention and safety measures in relation to this product. The information given is designed only as a guidance for safe handling, use, processing, storage, transport and disposal. All given information refer only to the product in the form it is supplied. It is the user`s responsibility to satisfy itself that the product is suitable for the intended use.

Users are obliged to have their activities harmonized with national, regional and local regulations, which are subject to modifications, and may differ depending on location/state. Users are responsible for handling, storage and manipulation in accordance with effective laws and regulations as required to provide health and safety at work and environmental protection. Since the use of this information and the conditions of use are not within the control of HIP Petrohemija, it is the user's obligation to determine the conditions of safe use of the product.

This version supersedes and replaces all previous version.

Exposure scenario is entirely taken from Chapter 9. EXPOSURE ASSESSMENT, „CHEMICAL SAFETY REPORT“, Part B“ for 1,3-butadiene.

9. EXPOSURE ASSESSMENT

The following generic uses were evaluated in the exposure assessment of 1,3-butadiene.

Exposure scenario	Identified use	Process category (PROC)	Product Category (PC)	Sector of Use (SU)	Article category (AC)	Environmental Release Category (ERC)	EU tonnage (tonnes/yr)	Regional fraction
1.	Manufacture (Industrial)	PROC 1, PROC 2, PROC 3, PROC 4, PROC 8a, PROC 8b, PROC 15	NA	3, 8, 9	NA	1, 4	5000000	0.4
2.	Distribution (Industrial)	PROC 1, PROC 2, PROC 3, PROC 4, PROC 8a, PROC 8b, PROC 9, PROC 15	NA	3, 8, 9	NA	1-7	5000000	0.1
3.	Use as an intermediate	PROC 1, PROC 2, PROC 3, PROC 4, PROC 8a, PROC 8b, PROC 15	NA	3, 8, 9	NA	6a	250000	0.4
4.	Formulation	PROC 1, PROC 2, PROC 3, PROC 4, PROC 5, PROC 8a, PROC 8b, PROC 9, PROC 14, PROC 15	NA	3, 10	NA	2	750000	0.1
5.	Uses in Fuels (Industrial)	PROC 1, PROC 2, PROC 3, PROC 8a, PROC 8b, PROC 16	NA	3	NA	7	500000	0.1
6.	Uses in Laboratory reagents (Industrial)	PROC 10, PROC 15	NA	3	NA	2, 4	1000	0.1

The following information was used for the exposure assessments:

Substance specific information			
Substance	1,3-butadiene	**MOLW**	54.09 g/mol
CAS RN	106-99-0	**MP**	-108.9 °C
Vapour pressure	151 kPa at 12 °C	**BP**	-4.41 °C
TRA volatility range	High	**SOL**	0.735 g/l
Log KOW	1.99		

Qualitative risk characterisation is required for the environmental assessment (See Section 7) because this substance is a gas. The purpose of the qualitative risk characterisation is to assess:

"...the likelihood that effects are avoided when implementing the exposure scenario…" (REACH Annex 1, Section 6.5).

The general approach aims to reduce/avoid contact or incidents with the substance. However, implementation of risk management measures (RMMs) and operational conditions (OCs) needs to be proportional to the degree of concern for the environmental hazard presented by the substance. Exposures should be controlled to at least the levels that represent an acceptable level of risk, i.e. implementation of the chosen RMMs will ensure that the likelihood of an event occurring due to the hazard of the substance is negligible, and the risk is considered to be controlled to a level of no concern.

The exposure of aquatic, terrestrial, sediment and sewage treatment microorganisms is considered to be negligible because the substance partitions primarily to air when found in the environment. Emission of butadiene to the air compartment is regulated by the VOC directive and the carcinogen directive. The limits in place of both of these directives would also limit exposure to ecological receptors. Hence the risks are considered to be controlled for ecological receptors.

9.1 EXPOSURE SCENARIO 1: Manufacture of 1,3-butadiene

9.1.1 Exposure scenario

Section 1	**Exposure Scenario Title**
Title	**Manufacture of 1,3-butadiene; CAS RN 106-99-0**
Use Descriptor	Sector of Use: Industrial (SU3)
	Process Categories: PROC1, PROC2, PROC3, PROC4, PROC8a, PROC8b, PROC15
	Environmental Release Categories: ERC1, ERC4
Processes, tasks, activities covered	Manufacture of the Substance or use as an intermediate or process chemical or extraction agent. Includes recycling/ recovery, material transfers, storage, sampling, associatedlaboratory activities, maintenance and loading (including marine vessel/barge, road/rail car and bulk container).
Section 2	**Operational conditions and risk management measures**
Field for additional statements to explain scenario if required	
Section 2.1	**Control of worker exposure**
Product characteristics	
Physical form of product	Liquid, vapour pressure > 10 kPa [OC5].
Concentration of substance in product	Covers percentage substance in the product up to 100% (unless stated differently) [G13].
Amounts used	*Not applicable*
Frequency and duration of use	Covers daily exposures up to 8 hours (unless stated differently) [G2].
Human factors not influenced by risk management	*Not applicable*
Other Operational Conditions affecting worker exposure	Assumes use at not > 20°C above ambient [G15]. Assumes a good basic standard of occupational hygiene is implemented [G1].
Contributing Scenarios	**Risk Management Measures** *Note: list RMM standard phrases according to the control hierarchy indicated in the ECHA template: 1. Technical measures to prevent release, 2. Technical measures to prevent dispersion, 3. Organisational measures, 4. Personal protection.* Phrases between brackets are good practice advice only, beyond REACH Chemical Safety Assessment and may be communicated in Section 5 of the ES or within the main sections of the SDS.
General measures (carcinogens) [G18]	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 / localexhaust 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 toauthorised 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. [G20].
General exposures (closed systems) [CS15]	Handle substance within a closed system [E47].
General exposures (closed systems) [CS15] With sample collection [CS56] With occasional controlled exposure [CS137]	Handle substance within a predominantly closed system provided with extract ventilation [E49]; Sample via a closed loop or other system to avoid exposure [E8]. Provide a good standard of general ventilation (not less than 3 to 5 air changes per hour).[E11]. Avoid carrying out activities involving exposure for more than 1 hour [OC27].
General exposures (closed systems) [CS15] Use in contained batch processes [CS37]	Handle substance within a predominantly closed system provided with extract ventilation [E49]. Sample via a closed loop or other system to avoid exposure [E8]. Provide a good standard of general ventilation (not less than 3 to 5 air changes per hour) [E11].

	Avoid carrying out activities involving exposure for more than 15 minutes [OC26].
General exposures (open systems) [CS16] Batch process [CS55] With sample collection [CS56]	Handle substance within a predominantly closed system provided with extract ventilation [E49]. Sample via a closed loop or other system to avoid exposure [E8]. Provide a good standard of general ventilation (not less than 3 to 5 air changes per hour) [E11]. Avoid carrying out activities involving exposure for more than 15 minutes [OC26].
Process sampling [CS2]	Sample via a closed loop or other system to avoid exposure [E8] Provide a good standard of general ventilation (not less than 3 to 5 air changes per hour) [E11]. Avoid carrying out activities involving exposure for more than 15 minutes [OC26].
Laboratory activities [CS36]	Use a high performance fume cupboard [E86], or [G9] alternatively [G10]. Handle within a fume cupboard or implement equivalent measures to minimise exposures [E12]. Wear a full face respirator conforming to EN140 with Type A filter or better [PPE24].
Bulk transfers [CS14] (open systems) [CS108] With potential for aerosol generation [CS138]	Use dry break couplings for material transfer [E75]. Ensure material transfers are under containment or extract ventilation [E66]. Provide a good standard of general ventilation (not less than 3 to 5 air changes per hour) [E11]. Avoid carrying out activities involving exposure for more than 1 hour [OC27].
Bulk transfers [CS14]. (closed systems) [CS107]	Use dry break couplings for material transfer [E75]. Avoid carrying out activities involving exposure for more than 1 hour [OC27].
Equipment cleaning and maintenance [CS39]	Drain down and flush system prior to equipment break-in or maintenance [E55]. Provide extract ventilation to pointswhere emissions occur [E54]. Provide a good standard of general ventilation (not less than 3 to 5 air changes per hour) [E11]. Clear spills immediately [C&H13]. Wear a respirator conforming to EN140 with Type A filter or better [PPE22]. Retain drain downs in sealed storage pending disposal or for subsequent recycle [ENVT4].
Storage [CS67] With occasional controlled exposure [CS137]	Sample via a closed loop or other system to avoid exposure [E8]. Provide extract ventilation to material transfer points and other openings [E82]. Store substance within a closed system [E84].
Section 2.2	**Control of environmental exposure**
The exposure of aquatic, terrestrial, sediment and sewage treatment microorganisms is considered to be negligible because the substance partitions primarily to air when found in the environment. Emission of butadiene to the air compartment is regulated by the VOC directive and the carcinogen directive. The limits in place of both of these directives would also limitexposure to ecological receptors. Hence the risks are considered to be controlled for ecological receptors.	
Section 3	**Exposure Estimation**
3.1 Health	*When the recommended risk management measures (RMMs) and operational conditions (OCs) are observed, exposures are not expected to exceed the predicted DNELs and the resulting risk characterisation ratios are expected to be less than 1 as indicated in Appendix A.*
3.2 Environment	
Section 4	**Guidance to check compliance with the Exposure Scenario**
4.1 Health	*Confirm that RMMs and OCs are as described or of equivalent efficiency. See Appendix A for details of efficiencies and OC.*
4.2 Environment	
Section 5	**Additional good practice advice beyond the REACH Chemical Safety Assessment - (Section Optional)**
Note: The measures reported in this section have not been taken into account in the exposure estimates related to the exposure scenario above. They are not subject to obligation laid down in Article 37 (4) of REACH.	
Control of Worker Exposure	
Selection of relevant Contributing Scenario phrases	*Good practice RMM phrases may be incorporated in this section or consolidated into the main sections of the SDS, depending on the preference of the Registrant and functionality of the available e-SDS system.*
Control of environmental exposure	
Selection of relevant RMM Core Phrases	*Good practice RMM phrases may be incorporated in this section or consolidated into the main sections of the SDS, depending on the preference of the Registrant and functionality of the available e-SDS system.*

9.1.2 Exposure estimation

9.1.2.1 Workers exposure

The worker exposure estimates for the activities associated with the manufacturing of 1,3-butadiene assessed using ECETOC TRAv2 (See Appendix A). Appendix A contains Tables 1 and 2 used to model the worker exposures. These tables contain all the operating conditions, and the efficiencies of the exposure modifiers including RPE, PPE and LEV. A separate table (also in Appendix A) contains the associated RMMs.

9.1.2.2 Consumer exposure

Not applicable.

9.1.2.3 Indirect exposure of humans via the environment

See section 9.11.

9.1.2.4 Environmental exposure

Not applicable.

9.2 EXPOSURE SCENARIO 2: Distribution of 1,3-butadiene

9.2.1 Exposure scenario

Section 1	**Exposure Scenario Title**
Title	**Distribution of 1,3-butadiene; CAS RN 106-99-0**
Use Descriptor	Sector of Use: Industrial (SU3, SU8, SU9)
	Process Categories: PROC1, PROC2, PROC3, PROC4, PROC8a, PROC8b, PROC9, PROC15
	Environmental Release Categories: ERC1-7
Processes, tasks, activities covered	Loading (including marine vessel/barge, rail/road car and IBC loading) and repacking (including drums and small packs) of substance, including its distribution and associated laboratory activities.

Section 2	**Operational conditions and risk management measures**
Field for additional statements to explain scenario if required	
Section 2.1	**Control of worker exposure**
Product characteristics	
Physical form of product	Liquid, vapour pressure > 10 kPa [OC5].
Concentration of substance in product	Covers percentage substance in the product up to 100% (unless stated differently) [G13].
Amounts used	*Not applicable*
Frequency and duration of use	Covers daily exposures up to 8 hours (unless stated differently) [G2].
Human factors not influenced by risk management	*Not applicable*
Other Operational Conditions affecting worker exposure	Assumes use at not > 20°C above ambient [G15]. Assumes a good basic standard of occupational hygiene is implemented [G1].
Contributing Scenarios	**Risk Management Measures** *Note: list RMM standard phrases according to the control hierarchy indicated in the ECHA template: 1. Technical measures to prevent release, 2. Technical measures to prevent dispersion, 3. Organisational measures, 4. Personal protection.* Phrases between brackets are good practice advice only, beyond REACH Chemical Safety Assessment and may be communicated in Section 5 of the ES or within the main sections of the SDS.
General measures (carcinogens) [G18]	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 / localexhaust 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 toauthorised 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. [G20].
General exposures (closed systems)	Handle substance within a closed system [E47].

[CS15]	
General exposures (closed systems) [CS15] With sample collection [CS56] With occasional controlled exposure [CS137]	Handle substance within a closed system [E47]. Ensure material transfers are under containment or extract ventilation [E66]. Sample via a closed loop or other system to avoid exposure [E8]. Avoid carrying out activities involving exposure for more than 1 hour [OC27].
General exposures (closed systems) [CS15] Use in contained batch processes [CS37]	Handle substance within a closed system [E47]. Ensure material transfers are under containment or extract ventilation [E66]. Sample via a closed loop or other system to avoid exposure [E8]. Avoid carrying out activities involving exposure for more than 1 hour [OC27].
General exposures (open systems) [CS16] Batch process [CS55] With sample collection [CS56]	Handle substance within a closed system [E47]. Ensure material transfers are under containment or extract ventilation [E66]. Sample via a closed loop or other system to avoid exposure [E8]. Avoid carrying out activities involving exposure for more than 4 hours [OC28]. Clear transfer lines prior to de-coupling [E39]. Transfer via enclosed lines [E52].
Process sampling [CS2]	Handle substance within a closed system [E47]. Sample via a closed loop or other system to avoid exposure [E8].
Laboratory activities [CS36]	Use a high performance fume cupboard [E86], or [G9] alternatively [G10]. Handle within a fume cupboard or implement equivalent measures to minimise exposures [E12]. Wear a full face respirator conforming to EN140 with Type A filter or better [PPE24]. Provide a good standard of general ventilation (not less than 3 to 5 air changes per hour). [E11].
Bulk transfers [CS14] (closed systems) [CS107]	Clear transfer lines prior to de-coupling [E39]. Transfer via enclosed lines [E52]. Ensure material transfers are under containment or extract ventilation [E66]. Avoid carrying out activities involving exposure for more than 1 hour [OC27].
Bulk transfers [CS14] (open systems) [CS108]	Clear transfer lines prior to de-coupling [E39]. Transfer via enclosed lines [E52]. Ensure material transfers are under containment or extract ventilation [E66]. Avoid carrying out activities involving exposure for more than 1 hour [OC27].
Drum and small package filling [CS6]	Transfer via enclosed lines [E52]. Provide a good standard of general or controlled ventilation (10 to 15 air changes per hour) [E40]. Minimise exposure by partial enclosure of the operation or equipment and provide extract ventilation at openings [E60]. Avoid carrying out activities involving exposure for more than 1 hour [OC27].
Equipment cleaning and maintenance [CS39]	Drain down and flush system prior to equipment break-in or maintenance [E55]. Provide extract ventilation to points where emissions occur [E54]. Provide a good standard of general ventilation (not less than 3 to 5 air changes per hour) [E11]. Clear spills immediately [C&H13]. Retain drain downs in sealed storage pending disposal or for subsequent recycle [ENVT4].
Storage [CS67] With occasional controlled exposure [CS137]	Transfer via enclosed lines [E52]. Provide extract ventilation to points where emissions occur [E54]. Avoid carrying out activities involving exposure for more than 4 hours [OC28]
Section 2.2	**Control of environmental exposure**
The exposure of aquatic, terrestrial, sediment and sewage treatment microorganisms is considered to be negligible because the substance partitions primarily to air when found in the environment. Emission of butadiene to the air compartment is regulated by the VOC directive and the carcinogen directive. The limits in place of both of these directives would also limitexposure to ecological receptors. Hence the risks are considered to be controlled for ecological receptors.	
Section 3	**Exposure Estimation**
3.1 Health	*When the recommended risk management measures (RMMs) and operational conditions (OCs) are observed, exposures are not expected to exceed the predicted DNELs and the resulting risk characterisation ratios are expected to be less than 1 as indicated in Appendix A.*
3.2 Environment	
Section 4	**Guidance to check compliance with the Exposure Scenario**
4.1 Health	*Confirm that RMMs and OCs are as described or of equivalent efficiency. See Appendix A for details of efficiencies and OC.*
4.2 Environment	
Section 5	**Additional good practice advice beyond the REACH Chemical Safety Assessment - (Section Optional)**
Note: The measures reported in this section have not been taken into account in the exposure estimates related to the exposure	

scenario above. They are not subject to obligation laid down in Article 37 (4) of REACH.	
Control of Worker Exposure	
Selection of relevant Contributing Scenario phrases	*Good practice RMM phrases may be incorporated in this section or consolidated into the main sections of the SDS, depending on the preference of the Registrant and functionality of the available e-SDS system.*
Control of environmental exposure	
Selection of relevant RMM Core Phrases	*Good practice RMM phrases may be incorporated in this section or consolidated into the main sections of the SDS, depending on the preference of the Registrant and functionality of the available e-SDS system.*

9.2.2 Exposure estimation

9.2.2.1 Workers exposure

The worker exposure estimates for the activities associated with the distribution of 1,3-butadiene were assessed using ECETOC TRAv2 (See Appendix A). Appendix A contains Tables 1 and 2 used to model the worker exposures. These tables contain all the operating conditions, and the efficiencies of the exposure modifiers including RPE, PPE and LEV. A separate table (also in Appendix A) contains the associated RMMs.

9.2.2.2 Consumer exposure

Not applicable.

9.2.2.3 Indirect exposure of humans via the environment

See section 9.11.

9.2.2.4 Environmental exposure

Not applicable.

9.3 EXPOSURE SCENARIO 3: Use of 1,3-butadiene as an Intermediate.

Human health assessment is not required for this use, use as an intermediate is included in the manufacture of 1,3-butadiene see section 9.1.

9.3.1 Exposure estimation

9.3.1.1 Workers exposure

Human health assessment is not required for this use, use as an intermediate is included in the manufacture of 1,3-butadiene see section 9.1.

9.3.1.2 Consumer exposure

Not applicable.

9.3.1.3 Indirect exposure of humans via the environment

See section 9.11.

9.3.1.4 Environmental exposure

Not applicable.

9.4 Formulation of 1,3-butadiene

9.4.1 Exposure scenario

Section 1	Exposure Scenario Title
Title	**Formulation & (re)packaging of substances and mixtures of 1,3-butadiene; CAS RN 106-99-0**
Use Descriptor	Sector of Use: Industrial (SU3, SU10)
	Process Categories: PROC1, PROC2, PROC3, PROC4, PROC5, PROC8a, PROC8b, PROC9, PROC14, PROC15

	Environmental Release Categories: ERC2
Processes, tasks, activities covered	Formulation, packing and re-packing of the substance and its mixtures in batch or continuous operations, including storage, materials transfers, mixing, large and small scale packing, maintenance and associated laboratory activities.
Section 2	**Operational conditions and risk management measures**
Section 2.1	**Control of worker exposure**
Product characteristics	
Physical form of product	Liquid, vapour pressure > 10 kPa [OC5].
Concentration of substance in product	Covers percentage substance in the product up to 100% (unless stated differently) [G13].
Amounts used	*Not applicable*
Frequency and duration of use	Covers daily exposures up to 8 hours (unless stated differently) [G2].
Human factors not influenced by risk management	*Not applicable*
Other Operational Conditions affecting worker exposure	Assumes use at not > 20°C above ambient [G15]. Assumes a good basic standard of occupational hygiene is implemented [G1].
Contributing Scenarios	**Risk Management Measures** *Note: list RMM standard phrases according to the control hierarchy indicated in the ECHA template: 1. Technical measures to prevent release, 2. Technical measures to prevent dispersion, 3. Organisational measures, 4. Personal protection.* Phrases between brackets are good practice advice only, beyond REACH Chemical Safety Assessment and may be communicated in Section 5 of the ES or within the main sections of the SDS.
General measures (carcinogens) [G18]	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 / localexhaust 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 toauthorised 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. [G20].
General exposures (closed systems) [CS15]	Handle substance within a closed system [E47].
General exposures (closed systems) [CS15] With sample collection [CS56] With occasional controlled exposure [CS137]	Handle substance within a closed system [E47]. Provide extract ventilation to points where emissions occur [E54]. Provide a good standard of general ventilation (not less than 3 to 5 air changes per hour). [E11]. Sample via a closed loop or other system to avoid exposure [E8]. Avoid carrying out activities involving exposure for more than 1 hour [OC27].
General exposures (closed systems) [CS15] Use in contained batch processes [CS37]	Handle substance within a closed system [E47]. Provide extract ventilation to points where emissions occur [E54]. Provide a good standard of general ventilation (not less than 3 to 5 air changes per hour). [E11]. Sample via a closed loop or other system to avoid exposure [E8]. Avoid carrying out activities involving exposure for more than 1 hour [OC27].
General exposures (open systems) [CS16] Batch process [CS55] With sample collection [CS56] With potential for aerosol generation [CS138]	Formulate in enclosed or ventilated mixing vessels [E46]. Provide extract ventilation to points where emissions occur [E54]. Provide a good standard of general ventilation (not less than 3 to 5 air changes per hour). [E11]. Sample via a closed loop or other system to avoid exposure [E8]. Avoid carrying out activities involving exposure for more than 1 hour [OC27].
Batch processes at elevated temperatures [CS136]	Handle substance within a closed system [E47]. Provide extract ventilation to points where emissions occur [E54]. Provide a good standard of general ventilation (not less than 3 to 5 air changes per hour). [E11]. Sample via a closed loop or other system to avoid exposure [E8]. Avoid carrying out activities involving exposure for more than 1 hour [OC27].

Process sampling [CS2]	Handle substance within a closed system [E47]. Provide extract ventilation to points where emissions occur [E54]. Provide a good standard of general ventilation (not less than 3 to 5 air changes per hour). [E11]. Sample via a closed loop or other system to avoid exposure [E8]. Avoid carrying out activities involving exposure for more than 1 hour [OC27].
Laboratory activities [CS36]	Use High Performance fumecupboard [E86]. Provide a good standard of general or controlled ventilation (10 to 15 air changes per hour) [E40].
Bulk transfers [CS14]	Clear transfer lines prior to de-coupling [E39]. Transfer via enclosed lines [E52]. Ensure material transfers are under containment or extract ventilation [E66].
Mixing operations (open systems) [CS30] With potential for aerosol generation [CS138]	Provide extract ventilation to points where emissions occur [E54]. Provide a good standard of general or controlled ventilation (10 to 15 air changes per hour) [E40]. Wear a respirator conforming to EN140 with Type A filter or better [PPE22].
Manual [CS34]. Transfer from/pouring from containers [CS22].	Use drum pumps or carefully pour from container [E64]. Provide extract ventilation to points where emissions occur [E54]. Provide a good standard of general or controlled ventilation (10 to 15 air changes per hour) [E40]. Avoid spillage when withdrawing pump [C&H16]. Avoid carrying out activities involving exposure for more than 4 hours [OC28].
Drum/batch transfers [CS8]	Use drum pumps or carefully pour from container [E64]. Provide extract ventilation to points where emissions occur [E54]. Provide a good standard of general or controlled ventilation (10 to 15 air changes per hour) [E40].
Production or preparation or articles by tabletting, compression, extrusion or pelletisation [CS100]	Limit the substance content in the product to 1% [OC16]. Provide a good standard of general or controlled ventilation (10 to 15 air changes per hour) [E40]. Wear a respirator conforming to EN140 with Type A filter or better [PPE22].
Drum and small package filling [CS6]	Clear transfer lines prior to de-coupling [E39]. Transfer via enclosed lines [E52]. Ensure material transfers are under containment or extract ventilation [E66]. Provide a good standard of general or controlled ventilation (10 to 15 air changes per hour) [E40].
Equipment cleaning and maintenance [CS39]	Drain down and flush system prior to equipment break-in or maintenance [E55]. Provide a good standard of general or controlled ventilation (10 to 15 air changes per hour) [E40]. Apply vessel entry procedures including use of forced supplied air [AP15]. Wear a respirator conforming to EN140 with Type A filter or better [PPE22].
Storage [CS67] With occasional controlled exposure [CS137]	Provide a good standard of general or controlled ventilation (10 to 15 air changes per hour) [E40]. Ensure material transfers are under containment or extract ventilation [E66]. Store substance within a closed system [E84]. Avoid carrying out activities involving exposure for more than 4 hours [OC28]
Section 2.2	**Control of environmental exposure**
The exposure of aquatic, terrestrial, sediment and sewage treatment microorganisms is considered to be negligible because the substance partitions primarily to air when found in the environment. Emission of butadiene to the air compartment is regulated by the VOC directive and the carcinogen directive. The limits in place of both of these directives would also limitexposure to ecological receptors. Hence the risks are considered to be controlled for ecological receptors.	
Section 3	**Exposure Estimation**
3.1 Health	*When the recommended risk management measures (RMMs) and operational conditions (OCs) are observed, exposures are not expected to exceed the predicted DNELs and the resulting risk characterisation ratios are expected to be less than 1 as indicated in Appendix A.*
3.2 Environment	
Section 4	**Guidance to check compliance with the Exposure Scenario**
4.1 Health	*Confirm that RMMs and OCs are as described or of equivalent efficiency. See Appendix A for details of efficiencies and OC.*
4.2 Environment	
Section 5	**Additional good practice advice beyond the REACH Chemical Safety Assessment - (Section Optional)**
Note: The measures reported in this section have not been taken into account in the exposure estimates related to the exposure scenario above. They are not subject to obligation laid down in Article 37 (4) of REACH.	
Control of Worker Exposure	
Selection of relevant Contributing Scenario phrases	*Good practice RMM phrases may be incorporated in this section or consolidated into the main sections of the SDS, depending on the preference of the Registrant and functionality of the available e-SDS system.*
Control of environmental exposure	

Selection of relevant RMM Core Phrases	*Good practice RMM phrases may be incorporated in this section or consolidated into the main sections of the SDS, depending on the preference of the Registrant and functionality of the available e-SDS system.*

9.4.2 Exposure estimation

9.4.2.1 Workers exposure

The worker exposure estimates for the activities associated with the use in formulation using 1,3- butadiene were assessed using ECETOC TRAv2. See Appendix A). Appendix A contains Tables 1 and 2, used to model the worker exposures. These tables contain all the operating conditions, and the efficiencies of the exposure modifiers including RPE, PPE and LEV. A separate table (also in Appendix A) contains the associated RMMs.

9.4.2.2 Consumer exposure

Not applicable.

9.4.2.3 Indirect exposure of humans via the environment

See section 9.11.

9.4.2.4 Environmental exposure

Not applicable.

9.5 EXPOSURE SCENARIO 4: Use of 1,3-butadiene in fuels - Industrial

9.5.1 Exposure scenario

Section 1	**Exposure Scenario Title**
Title	**Use in Fuels of 1,3-butadiene; CAS RN 106-99-0**
Use Descriptor	Sector of Use: Industrial (SU3)
	Process Categories: PROC1, PROC2, PROC3, PROC8a, PROC8b, PROC16
	Environmental Release Categories: ERC7
Processes, tasks, activities covered	Covers the use as a fuel (or fuel additive) and includes activities associated with its transfer, use, equipment maintenance and handling of waste.
Section 2	**Operational conditions and risk management measures**
Section 2.1	**Control of worker exposure**
Product characteristics	
Physical form of product	Liquid, vapour pressure > 10 kPa [OC5].
Concentration of substance in product	Covers percentage substance in the product up to 100% (unless stated differently) [G13].
Amounts used	*Not applicable*
Frequency and duration of use	Covers daily exposures up to 8 hours (unless stated differently) [G2].
Human factors not influenced by risk management	*Not applicable*
Other Operational Conditions affecting worker exposure	Assumes use at not > 20°C above ambient [G15]. Assumes a good basic standard of occupational hygiene is implemented [G1].
Contributing Scenarios	**Risk Management Measures** *Note: list RMM standard phrases according to the control hierarchy indicated in the ECHA template: 1. Technical measures to prevent release, 2. Technical measures to prevent dispersion, 3. Organisational measures, 4. Personal protection.* Phrases between brackets are good practice advice only, beyond REACH Chemical Safety Assessment and may be communicated in Section 5 of the ES or within the main sections of the SDS.
General measures (carcinogens) [G18]	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 / localexhaust 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 toauthorised 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. [G20].
Bulk transfers [CS14]	Transfer via enclosed lines [E52]. Provide extract ventilation to points where emissions occur [E54]. Provide a good standard of general or controlled ventilation (10 to 15 air changes per hour) [E40].
Drum/batch transfers [CS8]	Use drum pumps [E53]. Provide extract ventilation to material transfer points and other openings [E82]. Provide a good standard of general or controlled ventilation (10 to 15 air changes per hour) [E40].
General exposures (closed systems) [CS15]	Handle substance within a closed system [E47].
General exposures (closed systems) [CS15] With occasional controlled exposure [CS137]	Handle substance within a closed system [E47]. Provide extract ventilation to points where emissions occur [E54]. Provide a good standard of general or controlled ventilation (10 to 15 air changes per hour) [E40]. Avoid carrying out activities involvingexposure for more than 4 hours [OC28].
General exposures (closed systems) [CS15] Batch process [CS55]	Handle substance within a closed system [E47]. Provide extract ventilation to points where emissions occur [E54]. Provide a good standard of general or controlled ventilation (10 to 15 air changes per hour) [E40]. Avoid carrying out activities involving exposure for more than 1 hour [OC27].
General exposures (open systems) [CS16] (closed systems) [CS107]	Handle substance within a predominantly closed system provided with extract ventilation [E49]. Provide a good standard of general ventilation (not less than 3 to 5 air changes per hour). [E11]. Avoid carrying out activities involving exposure for more than 1 hour [OC27].
General exposures (open systems) [CS16] (closed systems) [CS107] Batch process [CS55]	Handle substance within a predominantly closed system provided with extract ventilation [E49]. Provide extract ventilation to points where emissions occur [E54]. Provide a good standard of general or controlled ventilation (10 to 15 air changes per hour) [E40]. Avoid carrying out activities involving exposure for more than 1 hour [OC27].
Equipment maintenance [CS5]	Drain down and flush system prior to equipment break-in or maintenance [E55]. Provide a good standard of general ventilation (not less than 3 to 5 air changes per hour) [E11]. Wear a full face respirator conforming to EN140 with Type A filter or better. [PPE24].
Storage [CS67]	Handle substance within a closed system [E47]. No specific measures identified [EI18].
Storage [CS67] With occasional controlled exposure [CS137]	Provide a good standard of general or controlled ventilation (10 to 15 air changes per hour) [E40]. Provide extract ventilation to points where emissions occur [E54]. Avoid carrying out activities involving exposure for more than 4 hours [OC28].
Disposal of wastes [CS28]	Transfer via enclosed lines [E52]. Provide extract ventilation to points where emissions occur [E54]. Provide a good standard of general or controlled ventilation (10 to 15 air changes per hour) [E40].
Section 2.2	**Control of environmental exposure**
The exposure of aquatic, terrestrial, sediment and sewage treatment microorganisms is considered to be negligible because the substance partitions primarily to air when found in the environment. Emission of butadiene to the air compartment is regulated by the VOC directive and the carcinogen directive. The limits in place of both of these directives would also limitexposure to ecological receptors. Hence the risks are considered to be controlled for ecological receptors.	
Section 3	**Exposure Estimation**
3.1 Health	*When the recommended risk management measures (RMMs) and operational conditions (OCs) are observed, exposures are not expected to exceed the predicted DNELs and the resulting risk characterisation ratios are expected to be less than 1 as indicated in Appendix A.*
3.2 Environment	
Section 4	**Guidance to check compliance with the Exposure Scenario**
4.1 Health	*Confirm that RMMs and OCs are as described or of equivalent efficiency. See Appendix A for details of efficiencies and OC.*
4.2 Environment	
Section 5	**Additional good practice advice beyond the REACH Chemical Safety Assessment - (Section Optional)**

Note: The measures reported in this section have not been taken into account in the exposure estimates related to the exposure scenario above. They are not subject to obligation laid down in Article 37 (4) of REACH.	
Control of Worker Exposure	
Selection of relevant Contributing Scenario phrases	*Good practice RMM phrases may be incorporated in this section or consolidated into the main sections of the SDS, depending on the preference of the Registrant and functionality of the available e-SDS system.*
Control of environmental exposure	
Selection of relevant RMM Core Phrases	*Good practice RMM phrases may be incorporated in this section or consolidated into the main sections of the SDS, depending on the preference of the Registrant and functionality of the available e-SDS system.*

9.5.2 Exposure estimation

9.5.2.1 Workers exposure

The worker exposure estimates for the activities associated with the industrial use in fuels of 1,3 butadiene were assessed using ECETOC TRAv2 (See Appendix A). Appendix A contains Tables 1 and 2 used to model the worker exposures. These tables contain all the operating conditions, and the efficiencies of the exposure modifiers including RPE, PPE and LEV. A separate table (also in Appendix A) contains the associated RMMs

9.5.2.2 Consumer exposure

Not applicable.

9.5.2.3 Indirect exposure of humans via the environment

See section 9.11.

9.5.2.4 Environmental exposure

Not applicable.

9.6 EXPOSURE SCENARIO 5: Use of 1,3-butadiene in laboratory reagents – Industrial

9.6.1 Exposure scenario

Section 1	**Exposure Scenario Title**
Title	**Use in laboratory reagents of 1,3-butadiene; CAS RN 106-99-0**
Use Descriptor	Sector of Use: Industrial (SU3)
	Process Categories: PROC10, PROC15
	Environmental Release Categories: ERC2, ERC4
Processes, tasks, activities covered	Use of the substance within laboratory settings, including material transfers and equipment cleaning.
Section 2	**Operational conditions and risk management measures**
Section 2.1	**Control of worker exposure**
Product characteristics	
Physical form of product	Liquid, vapour pressure > 10 kPa [OC5].
Concentration of substance in product	Covers percentage substance in the product up to 100% (unless stated differently) [G13].
Amounts used	*Not applicable*
Frequency and duration of use	Covers daily exposures up to 8 hours (unless stated differently) [G2].
Human factors not influenced by risk management	*Not applicable*
Other Operational Conditions affecting worker exposure	Assumes use at not > 20°C above ambient [G15]. Assumes a good basic standard of occupational hygiene is implemented [G1].
Contributing Scenarios	**Risk Management Measures** *Note: list RMM standard phrases according to the control hierarchy indicated in the ECHA template: 1. Technical measures to prevent release, 2. Technical measures to prevent dispersion, 3.*

	Organisational measures, 4. Personal protection. Phrases between brackets are good practice advice only, beyond REACH Chemical Safety Assessment and may be communicated in Section 5 of the ES or within the main sections of the SDS.
General measures (carcinogens) [G18]	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 / localexhaust 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 toauthorised 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. [G20].
Laboratory activities [CS36] Small scale [CS61] Handling small quantities (<1000ml) for more than 4 hours/day - inside fume cupboard.	Use high-performance fume cupboard [E86].
Cleaning [CS47] Rolling, Brushing [CS51] Vessel and container cleaning [CS103] Cleaning equiment, glassware etc under general ventilation for 15 min - 1 hour/day	Provide a good standard of general or controlled ventilation (10 to 15 air changes per hour) [E40]. Use high-performance fume cupboard [E86].
Section 2.2	**Control of environmental exposure**
The exposure of aquatic, terrestrial, sediment and sewage treatment microorganisms is considered to be negligible because the substance partitions primarily to air when found in the environment. Emission of butadiene to the air compartment is regulated by the VOC directive and the carcinogen directive. The limits in place of both of these directives would also limitexposure to ecological receptors. Hence the risks are considered to be controlled for ecological receptors.	
Section 3	**Exposure Estimation**
3.1 Health	*When the recommended risk management measures (RMMs) and operational conditions (OCs) are observed, exposures are not expected to exceed the predicted DNELs and the resulting risk characterisation ratios are expected to be less than 1 as indicated in Appendix A.*
3.2 Environment	
Section 4	**Guidance to check compliance with the Exposure Scenario**
4.1 Health	*Confirm that RMMs and OCs are as described or of equivalent efficiency. See Appendix A for details of efficiencies and OC.*
4.2 Environment	
Section 5	**Additional good practice advice beyond the REACH Chemical Safety Assessment - (Section Optional)**
Note: The measures reported in this section have not been taken into account in the exposure estimates related to the exposure scenario above. They are not subject to obligation laid down in Article 37 (4) of REACH.	
Control of Worker Exposure	
Selection of relevant Contributing Scenario phrases	*Good practice RMM phrases may be incorporated in this section or consolidated into the main sections of the SDS, depending on the preference of the Registrant and functionality of the available e-SDS system.*
Control of environmental exposure	
Selection of relevant RMM Core Phrases	*Good practice RMM phrases may be incorporated in this section or consolidated into the main sections of the SDS, depending on the preference of the Registrant and functionality of the available e-SDS system.*

9.6.2 Exposure estimation

9.6.2.1 Workers exposure

The worker exposure estimates for activities associated with the use of 1,3-butadiene as laboratory reagents were assessed using ECETOC TRAv2 (See Appendix A). Appendix A contains Tables 1 and 2 used to model the worker exposures. These tables contain all the operating conditions, and the efficiencies of the exposure modifiers including RPE, PPE and LEV. A separate table (also in Appendix A) contains the associated RMMs.

9.6.2.2 Consumer exposure

Not applicable.

9.6.2.3 Indirect exposure of humans via the environment

See section 9.11.

9.6.2.4 Environmental exposure

Not applicable.

9.7 EXPOSURE SCENARIO 6: Use of 1,3-butadiene in rubber manufacture and processing – Industrial

9.7.1 Exposure scenario

Section 1	**Exposure Scenario Title**
Title	**Use in rubber manufacturing and processing of 1,3-butadiene; CAS RN 106-99-0**
Use Descriptor	Sector of Use: Industrial (SU3, SU10)
	Process Categories: PROC1, PROC2, PROC3, PROC4, PROC5, PROC6, PROC7, PROC8a, PROC8b, PROC13, PROC14, PROC21
	Environmental Release Categories: ERC4, ERC6D
Processes, tasks, activities covered	Manufacture of tyres and general rubber articles, including processing of raw (uncured) rubber, handling and mixing of rubber additives, vulcanising, cooling and finishing.
Section 2	**Operational conditions and risk management measures**
Section 2.1	**Control of worker exposure**
Product characteristics	
Physical form of product	Liquid, vapour pressure > 10 kPa [OC5].
Concentration of substance in product	Covers percentage substance in the product up to 100% (unless stated differently) [G13].
Amounts used	*Not applicable*
Frequency and duration of use	Covers daily exposures up to 8 hours (unless stated differently) [G2].
Human factors not influenced by risk management	*Not applicable*
Other Operational Conditions affecting worker exposure	Assumes use at not > 20°C above ambient [G15]. Assumes a good basic standard of occupational hygiene is implemented [G1].
Contributing Scenarios	**Risk Management Measures** *Note: list RMM standard phrases according to the control hierarchy indicated in the ECHA template: 1. Technical measures to prevent release, 2. Technical measures to prevent dispersion, 3. Organisational measures, 4. Personal protection.* Phrases between brackets are good practice advice only, beyond REACH Chemical Safety Assessment and may be communicated in Section 5 of the ES or within the main sections of the SDS.
General measures (carcinogens) [G18]	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 / localexhaust 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 toauthorised 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. [G20].
Material transfers [CS3]	Handle substance within a closed system [E47].
Material transfers [CS3]. With occasional controlled exposure [CS137]	Transfer via enclosed lines [E52]. Ensure material transfers are under containment or extract ventilation [E66]. Provide a good standard of general ventilation (not less than 3 to 5 air changes per hour) [E11].
Material transfers [CS3] Dedicated facility [CS81] Large Containers	Use drum pumps [E53]. Provide a good standard of general or controlled ventilation (10 to 15 air changes per hour) [E40]. Ensure material transfers are under containment or extract ventilation [E66].
Bulk weighing [CS91] (closed systems) [CS107]	Handle substance within a closed system [E47].
Bulk weighing [CS91] With occasional controlled exposure [CS137]	Ensure material transfers are under containment or extract ventilation [E66]. Provide a good standard of general or controlled ventilation (10 to 15 air changes per hour) [E40]. Avoid carrying out activities involving exposure for more than 4 hours [OC28].
Small scale weighing [CS90] Dedicated facility [CS81]	Transfer via enclosed lines [E52]. Ensure material transfers are under containment or extract ventilation [E66]. Provide a good standard of general or controlled ventilation (10 to 15 air changes per hour) [E40]. Avoid carrying out activities involving exposure for more than 4 hours [OC28].
Additive premixing [CS92] Batch process [CS55] (closed systems) [CS107]	Formulate in enclosed or ventilated mixing vessels [E46]. Ensure material transfers are under containment or extract ventilation [E66]. Minimise exposure by partial enclosure of the operation or equipment and provide extract ventilation at openings [E60]. Provide a good standard of general or controlled ventilation (10 to 15 air changes per hour) [E40]. Avoid carrying out activities involving exposure for more than 4 hours [OC28].
Additive premixing [CS92]	Ensure material transfers are under containment or extract ventilation [E66]. Provide a good standard of general or controlled ventilation (10 to 15 air changes per hour) [E40]. Avoid carrying out activities involving exposure for more than 1 hour [OC27].
Material transfers [CS3] Dedicated facility [CS81]	Transfer via enclosed lines [E52]. Ensure material transfers are under containment or extract ventilation [E66].
Material transfers [CS3] Small Containers	Transfer via enclosed lines [E52]. Ensure material transfers are under containment or extract ventilation [E66]. Provide a good standard of general or controlled ventilation (10 to 15 air changes per hour) [E40]. Avoid carrying out activities involving exposure for more than 4 hours [OC28].
Additive premixing [CS92] Mixing operations (open systems) [CS30]	Provide extract ventilation to points where emissions occur [E54]. Provide a good standard of general or controlled ventilation (10 to 15 air changes per hour) [E40]. Avoid carrying out activities involving exposure for more than 15 minutes [OC26] or Wear a respirator conforming to EN140 with Type A filter or better [PPE20].
Calendering (including Banburys) [CS64]	Limit the substance content in the product to 1% [OC16]. Minimise exposure by partial enclosure of the operation or equipment and provide extract ventilation at openings [E60]. Provide a good standard of general ventilation (not less than 3 to 5 air changes per hour) [E11].
Pressing uncured rubber blanks [CS73]	Limit the substance content in the product to 1% [OC16]. Ensure material transfers are under containment or extract ventilation [E66]. Provide a good standard of general or controlled ventilation (10 to 15 air changes per hour) [E40].
Vulcanisation [CS70]	Limit the substance content in the product to 1% [OC16]. Minimise exposure by partial enclosure of the operation or equipment and provide extract ventilation at openings [E60]. Provide a good standard of general ventilation (not less than 3 to 5 air changes per hour) [E11].
Cooling cured articles [CS71]	Limit the substance content in the product to 1% [OC16]. Minimise exposure by partial enclosure of the operation or equipment and provide extract ventilation at openings [E60]. Provide a good standard of general ventilation (not less than 3 to 5 air changes per hour). [E11].
Laboratory activities [CS36]	Use high-performance fume cupboard [E86].
Equipment maintenance [CS5]	Drain down and flush system prior to equipment break-in or maintenance [E55]. Provide a good standard of general or controlled ventilation (10 to 15 air changes per hour) [E40].

	Wear a respirator conforming to EN140 with Type A filter or better [PPE22].
Section 2.2	**Control of environmental exposure**
The exposure of aquatic, terrestrial, sediment and sewage treatment microorganisms is considered to be negligible because the substance partitions primarily to air when found in the environment. Emission of butadiene to the air compartment is regulated by the VOC directive and the carcinogen directive. The limits in place of both of these directives would also limitexposure to ecological receptors. Hence the risks are considered to be controlled for ecological receptors.	
Section 3	**Exposure Estimation**
3.1 Health	*When the recommended risk management measures (RMMs) and operational conditions (OCs) are observed, exposures are not expected to exceed the predicted DNELs and the resulting risk characterisation ratios are expected to be less than 1 as indicated in Appendix A.*
3.2 Environment	
Section 4	**Guidance to check compliance with the Exposure Scenario**
4.1 Health	*Confirm that RMMs and OCs are as described or of equivalent efficiency. See Appendix A for details of efficiencies and OC.*
4.2 Environment	
Section 5	**Additional good practice advice beyond the REACH Chemical Safety Assessment - (Section Optional)**
Note: The measures reported in this section have not been taken into account in the exposure estimates related to the exposure scenario above. They are not subject to obligation laid down in Article 37 (4) of REACH.	
Control of Worker Exposure	
Selection of relevant Contributing Scenario phrases	*Good practice RMM phrases may be incorporated in this section or consolidated into the main sections of the SDS, depending on the preference of the Registrant and functionality of the available e-SDS system.*
Control of environmental exposure	
Selection of relevant RMM Core Phrases	*Good practice RMM phrases may be incorporated in this section or consolidated into the main sections of the SDS, depending on the preference of the Registrant and functionality of the available e-SDS system.*

9.7.2 Exposure estimation

9.7.2.1 Workers exposure

The worker exposure estimates for the activities associated with the rubber manufacture using 1,3- butadiene were assessed using ECETOC TRAv2 (See Appendix A). Appendix A contains Tables 1 and 2 used to model the worker exposures. These tables contain all the operating conditions, and the efficiencies of the exposure modifiers including RPE, PPE and LEV. A separate table (also in Appendix A) contains the associated RMMs.

9.7.2.2 Consumer exposure

Not applicable.

9.7.2.3 Indirect exposure of humans via the environment

See section 9.11.

9.7.2.4 Environmental exposure

Not applicable.

9.8 EXPOSURE SCENARIO 7: Use of 1,3-butadiene in polymer production – Industrial

9.8.1 Exposure scenario

Section 1	**Exposure Scenario Title**
Title	**Use in polymer production of 1,3-butadiene; CAS RN 106-99-0**
Use Descriptor	Sector of Use: Industrial (SU3, SU10)
	Process Categories: PROC1, PROC2, PROC3, PROC4, PROC5, PROC6, PROC8a, PROC8b, PROC9, PROC14, PROC21

	Environmental Release Categories: ERC6A, ERC6C
Processes, tasks, activities covered	Manufacture of polymers from monomers in continuous and batch processes, include sparging, discharging, and reactor maintenance and immediate polymer product formation (i.e. compounding, pelletisation, product off- gassing).
Section 2	**Operational conditions and risk management measures**
Field for additional statements to explain scenario if required	
Section 2.1	**Control of worker exposure**
Product characteristics	
Physical form of product	Liquid, vapour pressure > 10 kPa [OC5].
Concentration of substance in product	Covers percentage substance in the product up to 100% (unless stated differently) [G13].
Amounts used	*Not applicable*
Frequency and duration of use	Covers daily exposures up to 8 hours (unless stated differently) [G2]
Human factors not influenced by risk management	*Not applicable*
Other Operational Conditions affecting worker exposure	Assumes use at not > 20°C above ambient [G15]; Assumes a good basic standard of occupational hygiene is implemented [G1].
Contributing Scenarios	**Risk Management Measures** *Note: list RMM standard phrases according to the control hierarchy indicated in the ECHA template: 1. Technical measures to prevent release, 2. Technical measures to prevent dispersion, 3. Organisational measures, 4. Personal protection.* Phrases between brackets are good practice advice only, beyond REACH Chemical Safety Assessment and may be communicated in Section 5 of the ES or within the main sections of the SDS.
General measures (carcinogens) [G18]	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 / localexhaust 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 toauthorised 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. [G20].
General exposures (closed systems) [CS15] Continuous process [CS54] No sampling [CS57]	Handle substance within a closed system [E47].
Bulk transfers [CS14] Transport [CS58] With sample collection [CS56]	Ensure material transfers are under containment or extract ventilation [E66]. Provide a good standard of general or controlled ventilation (10 to 15 air changes per hour) [E40]. Sample via a closed loop or other system to avoid exposure [E8]. Avoid carrying out activities involving exposure for more than 4 hours [OC28].
Polymerisation (bulk and batch) [CS65] Continuous process [CS54] With sample collection [CS56]	Handle substance within a closed system [E47]. Provide a good standard of general ventilation (not less than 3 to 5 air changes per hour). [E11]. Provide extract ventilation to points where emissions occur [E54]. Sample via a closed loop or other system to avoid exposure [E8]. Avoid carrying out activities involving exposure for more than 1 hour [OC27].
Polymerisation (bulk and batch) [CS65] Batch process [CS55] With sample collection [CS56]. Elevated Temperature	Handle substance within a closed system [E47]. Provide a good standard of general ventilation (not less than 3 to 5 air changes per hour). [E11]. Provide extract ventilation to points where emissions occur [E54]. Sample via a closed loop or other system to avoid exposure [E8]Avoid carrying out activities involving exposure for more than 1 hour [OC27].
Finishing operations [CS102] Batch process [CS55] With sample collection [CS56]	Limit the substance content in the product to 5% [OC17]. Handle substance within a closed system [E47]. Provide a good standard of general ventilation (not less than 3 to 5 air changes per hour). [E11]. Provide extract ventilation to points where emissions occur [E54]. Sample via a closed loop or other system to avoid exposure [E8].

Intermediate polymer storage [CS66]	Limit the substance content in the product to 5% [OC17]. Handle substance within a closed system [E47]. Provide a good standard of general ventilation (not less than 3 to 5 air changes per hour). [E11]. Ensure material transfers are under containment or extract ventilation [E66]. Sample via a closed loop or other system to avoid exposure [E8].
Additivation and stabilisation [CS69]	Limit the substance content in the product to 5% [OC17]. Handle substance within a closed system [E47]. Provide a good standard of general ventilation (not less than 3 to 5 air changes per hour) [E11]. Ensure material transfers are under containment or extract ventilation [E66]. Sample via a closed loop or other system to avoid exposure [E8].
Mixing in containers [CS23] Batch process [CS55]	Handle substance within a closed system [E47]. Provide a good standard of general ventilation (not less than 3 to 5 air changes per hour) [E11]. Ensure material transfers are under containment or extract ventilation [E66]. Sample via a closed loop or other system to avoid exposure [E8].
Pelletizing [CS53] Extrusion and masterbatching [CS88]	Limit the substance content in the product to 1% [OC16]. Minimise exposure by partial enclosure of the operation or equipment and provide extract ventilation at openings [E60]. Provide a good standard of general or controlled ventilation (10 to 15 air changes per hour) [E40].
Pelletizing [CS53].	Limit the substance content in the product to 1% [OC16]. Provide extract ventilation to points where emissions occur [E54]. Provide a good standard of general or controlled ventilation (10 to 15 air changes per hour) [E40].
Pelletisation and pellet screening [CS68] (open systems) [CS108]	Limit the substance content in the product to 1% [OC16]. Ensure material transfers are under containment or extract ventilation [E66].
Bulk transfers [CS14] Continuous process [CS54] With sample collection [CS56]	Handle substance within a closed system [E47]. Ensure material transfers are under containment or extract ventilation [E66]. Sample via a closed loop or other system to avoid exposure [E8]. Provide a good standard of general ventilation (not less than 3 to 5 air changes per hour) [E11]. Avoid carrying out activities involving exposure for more than 1 hour [OC27].
Transport [CS58] With sample collection [CS56]	Ensure material transfers are under containment or extract ventilation [E66]. Avoid carrying out activities involving exposure for more than 1 hour [OC27].
Equipment maintenance [CS5]	Drain down and flush system prior to equipment break-in or maintenance [E55]. Provide a good standard of general or controlled ventilation (10 to 15 air changes per hour) [E40]. Clear spills immediately [C&H13]. Avoid carrying out activities involving exposure for more than 4 hours [OC28]. Wear a respirator conforming to EN140 with Type A filter or better [PPE22]. Retain drain downs in sealed storage pending disposal or for subsequent recycle [ENVT4].
Storage [CS67] With occasional controlled exposure [CS137]	Provide extract ventilation to points where emissions occur [E54]. Sample via a closed loop or other system to avoid exposure [E8]. Store substance within a closed system [E84]. Avoid carrying out activities involving exposure for more than 1 hour [OC27].
Section 2.2	**Control of environmental exposure**
The exposure of aquatic, terrestrial, sediment and sewage treatment microorganisms is considered to be negligible because the substance partitions primarily to air when found in the environment. Emission of butadiene to the air compartment is regulated by the VOC directive and the carcinogen directive. The limits in place of both of these directives would also limitexposure to ecological receptors. Hence the risks are considered to be controlled for ecological receptors.	
Section 3	**Exposure Estimation**
3.1 Health	*When the recommended risk management measures (RMMs) and operational conditions (OCs) are observed, exposures are not expected to exceed the predicted DNELs and the resulting risk characterisation ratios are expected to be less than 1 as indicated in Appendix A.*
3.2 Environment	
Section 4	**Guidance to check compliance with the Exposure Scenario**
4.1 Health	*Confirm that RMMs and OCs are as described or of equivalent efficiency. See Appendix A for details of efficiencies and OC.*
4.2 Environment	
Section 5	**Additional good practice advice beyond the REACH Chemical Safety Assessment - (Section Optional)**
Note: The measures reported in this section have not been taken into account in the exposure estimates related to the exposure scenario above. They are not subject to obligation laid down in Article 37 (4) of REACH.	

Control of Worker Exposure	
Selection of relevant Contributing Scenario phrases	*Good practice RMM phrases may be incorporated in this section or consolidated into the main sections of the SDS, depending on the preference of the Registrant and functionality of the available e-SDS system.*
Control of environmental exposure	
Selection of relevant RMM Core Phrases	*Good practice RMM phrases may be incorporated in this section or consolidated into the main sections of the SDS, depending on the preference of the Registrant and functionality of the available e-SDS system.*

9.8.2 Exposure estimation

9.8.2.1 Workers exposure

The worker exposure estimates for the activities associated with the polymer production using 1,3- butadiene were assessed using ECETOC TRAv2 (See Appendix A). Appendix A contains Tables 1 and 2 used to model the worker exposures. These tables contain all the operating conditions, and the efficiencies of the exposure modifiers including RPE, PPE and LEV. A separate table (also in Appendix A) contains the associated RMMs.

9.8.2.2 Consumer exposure

Not applicable.

9.8.2.3 Indirect exposure of humans via the environment

See section 9.11.

9.8.2.4 Environmental exposure

Not applicable.

9.9 EXPOSURE SCENARIO 8: Use of 1,3-butadiene in polymer processing – Industrial

Applicable only where there is a residual 1,3 butadiene concentration of between 0.1 and 1%. Below 0.1% no specific application of RMM / OC is required.

9.9.1 Exposure scenario

Section 1	**Exposure Scenario Title**
Title	**Use in polymer processing of 1,3-butadiene; CAS RN 106-99-0**
Use Descriptor	Sector of Use: Industrial (SU3, SU10)
	Process Categories: PROC1, PROC2, PROC3, PROC4, PROC5, PROC6, PROC8a, PROC8b, PROC9, PROC13, PROC14, PROC21
	Environmental Release Categories: ERC4
Processes, tasks, activities covered	Processing of formulated polymers including material transfers, additives handling (e.g. pigments, stabilisers, fillers, plasticisers, etc.), moulding, curing and forming activities, material re-works, storage and associated maintenance.
Section 2	**Operational conditions and risk management measures**
Section 2.1	**Control of worker exposure**
Product characteristics	
Physical form of product	Liquid, vapour pressure > 10 kPa [OC5].
Concentration of substance in product	Covers percentage substance in the product up to 100% (unless stated differently) [G13].
Amounts used	*Not applicable*
Frequency and duration of use	Covers daily exposures up to 8 hours (unless stated differently) [G2]
Human factors not influenced by risk management	*Not applicable*
Other Operational Conditions affecting worker exposure	Assumes use at not > 20°C above ambient [G15]; Assumes a good basic standard of occupational hygiene is implemented [G1].

Contributing Scenarios	Risk Management Measures *Note: list RMM standard phrases according to the control hierarchy indicated in the ECHA template: 1. Technical measures to prevent release, 2. Technical measures to prevent dispersion, 3. Organisational measures, 4. Personal protection.* Phrases between brackets are good practice advice only, beyond REACH Chemical Safety Assessment and may be communicated in Section 5 of the ES or within the main sections of the SDS.
General measures (carcinogens) [G18]	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 / localexhaust 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 toauthorised 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. [G20].
Bulk transfer [CS14] (closed systems) [CS107]	Handle substance within a closed system [E47].
Bulk transfers [CS14] (closed systems) [CS107] With occasional controlled exposure [CS137]	Limit the substance content in the product to 1% [OC16]. Handle substance within a closed system [E47]. Ensure material transfers are under containment or extract ventilation [E66].
Bulk transfers [CS14] Dedicated facility [CS81]	Limit the substance content in the product to 1% [OC16]. Ensure material transfers are under containment or extract ventilation [E66].
Bulk weighing [CS91] (closed systems) [CS107]	Handle substance within a closed system [E47].
Bulk weighing [CS91] With occasional controlled exposure [CS137]	Limit the substance content in the product to 1% [OC16]. Provide extract ventilation to points where emissions occur [E54]. Provide a good standard of general ventilation (not less than 3 to 5 air changes per hour) [E11].
Small scale weighing [CS90]	Limit the substance content in the product to 1% [OC16]. Ensure material transfers are under containment or extract ventilation [E66]. Provide a good standard of general or controlled ventilation (10 to 15 air changes per hour) [E40].
Additive premixing [CS92] (closed systems) [CS107]	Limit the substance content in the product to 1% [OC16]. Handle substance within a closed system [E47]. Ensure material transfers are under containment or extract ventilation [E66]. Provide a good standard of general ventilation (not less than 3 to 5 air changes per hour) [E11].
Additive premixing [CS92] (open systems) [CS108] With sample collection [CS56]	Limit the substance content in the product to 1% [OC16]. Ensure material transfers are under containment or extract ventilation [E66]. Provide a good standard of general ventilation (not less than 3 to 5 air changes per hour) [E11].
Additive premixing [CS92] General exposures (open systems) [CS16]	Limit the substance content in the product to 1% [OC16]. Ensure material transfers are under containment or extract ventilation [E66]. Provide a good standard of general or controlled ventilation (10 to 15 air changes per hour) [E40].
Bulk transfers [CS14] Drum/batch transfers [CS8]	Limit the substance content in the product to 1% [OC16]. Ensure material transfers are under containment or extract ventilation [E66]. Provide a good standard of general ventilation (not less than 3 to 5 air changes per hour) [E11].
Bulk transfers [CS14] Small package filling [CS7]	Transfer via enclosed lines [E52]. Limit the substance content in the product to 1% [OC16]. Ensure material transfers are under containment or extract ventilation [E66]. Provide a good standard of general ventilation (not less than 3 to 5 air changes per hour) [E11].
Calendering (including Banburys) [CS64]	Limit the substance content in the product to 1% [OC16]. Minimise exposure by partial enclosure of the operation or equipment and provide extract ventilation at openings [E60]. Provide a good standard of general ventilation (not less than 3 to 5 air changes per hour) [E11].

Production of articles by dipping and pouring [CS113]	Limit the substance content in the product to 1% [OC16]. Minimise exposure by partial enclosure of the operation or equipment and provide extract ventilation at openings [E60]. Provide a good standard of general ventilation (not less than 3 to 5 air changes per hour) [E11].
Extrusion and masterbatching [CS88]	Limit the substance content in the product to 1% [OC16]. Minimise exposure by partial enclosure of the operation or equipment and provide extract ventilation at openings [E60]. Provide a good standard of general ventilation (not less than 3 to 5 air changes per hour) [E11].
Injection moulding of articles [CS89]	Restrict area of openings to equipment [E68]. Minimise exposure by partial enclosure of the operation or equipment and provide extract ventilation at openings [E60]. Provide a good standard of general ventilation (not less than 3 to 5 air changes per hour) [E11].
Equipment maintenance [CS5]	Drain down system prior to equipment break-in or maintenance [E65]. Provide a good standard of general or controlled ventilation (10 to 15 air changes per hour) [E40].
Storage [CS67] With occasional controlled exposure [CS137]	Limit the substance content in the product to 1% [OC16]. Store substance within a closed system [E84]. Provide a good standard of general ventilation (not less than 3 to 5 air changes per hour) [E11]. Avoid carrying out activities involving exposure for more than 1 hour [OC27].
Section 2.2	**Control of environmental exposure**
The exposure of aquatic, terrestrial, sediment and sewage treatment microorganisms is considered to be negligible because the substance partitions primarily to air when found in the environment. Emission of butadiene to the air compartment is regulated by the VOC directive and the carcinogen directive. The limits in place of both of these directives would also limitexposure to ecological receptors. Hence the risks are considered to be controlled for ecological receptors.	
Section 3	**Exposure Estimation**
3.1 Health	*When the recommended risk management measures (RMMs) and operational conditions (OCs) are observed, exposures are not expected to exceed the predicted DNELs and the resulting risk characterisation ratios are expected to be less than 1 as indicated in Appendix A.*
3.2 Environment	
Section 4	**Guidance to check compliance with the Exposure Scenario**
4.1 Health	*Confirm that RMMs and OCs are as described or of equivalent efficiency. See Appendix A for details of efficiencies and OC.*
4.2 Environment	
Section 5	**Additional good practice advice beyond the REACH Chemical Safety Assessment - (Section Optional)**
Note: The measures reported in this section have not been taken into account in the exposure estimates related to the exposure scenario above. They are not subject to obligation laid down in Article 37 (4) of REACH.	
Control of Worker Exposure	
Selection of relevant Contributing Scenario phrases	*Good practice RMM phrases may be incorporated in this section or consolidated into the main sections of the SDS, depending on the preference of the Registrant and functionality of the available e-SDS system.*
Control of environmental exposure	
Selection of relevant RMM Core Phrases	*Good practice RMM phrases may be incorporated in this section or consolidated into the main sections of the SDS, depending on the preference of the Registrant and functionality of the available e-SDS system.*

9.9.2 Exposure estimation

9.9.2.1 Workers exposure

The worker exposure estimates for the activities associated with the polymer processing using 1,3- butadiene were assessed using ECETOC TRAv2 (See Appendix A). Appendix A contains Tables 1 and 2 used to model the worker exposures. These tables contain all the operating conditions, and the efficiencies of the exposure modifiers including RPE, PPE and LEV. A separate table (also in Appendix A) contains the associated RMMs.

9.9.2.2 Consumer exposure

Not applicable.

9.9.2.3 Indirect exposure of humans via the environment

See section 9.11.

9.9.2.4 Environmental exposure

Not applicable.

9.10 EXPOSURE SCENARIO 9: Use of 1,3-butadiene in polymer processing – Professional

Applicable only where there is a residual 1,3 butadiene concentration of between 0.1 and 1%. Below 0.1% no specific application of RMM / OC is required.

9.10.1 Exposure scenario

Section 1	**Exposure Scenario Title**
Title	**Use in polymer processing of 1,3-butadiene; CAS RN 106-99-0**
Use Descriptor	Sector of Use: Industrial (SU22)
	Process Categories: PROC1, PROC2, PROC8a, PROC8b, PROC14, PROC21
	Environmental Release Categories: ERC8A, ERC8D
Processes, tasks, activities covered	Processing of formulated polymers including material transfers, moulding and forming activities, material re-works and associated maintenance.
Section 2	**Operational conditions and risk management measures**
Section 2.1	**Control of worker exposure**
Product characteristics	
Physical form of product	Liquid, vapour pressure > 10 kPa [OC5].
Concentration of substance in product	Covers percentage substance in the product up to 100% (unless stated differently) [G13].
Amounts used	*Not applicable*
Frequency and duration of use	Covers daily exposures up to 8 hours (unless stated differently) [G2].
Human factors not influenced by risk management	*Not applicable*
Other Operational Conditions affecting worker exposure	Assumes use at not > 20°C above ambient [G15]. Assumes a good basic standard of occupational hygiene is implemented [G1].
Contributing Scenarios	**Risk Management Measures** *Note: list RMM standard phrases according to the control hierarchy indicated in the ECHA template: 1. Technical measures to prevent release, 2. Technical measures to prevent dispersion, 3. Organisational measures, 4. Personal protection.* Phrases between brackets are good practice advice only, beyond REACH Chemical Safety Assessment and may be communicated in Section 5 of the ES or within the main sections of the SDS.
General measures (carcinogens) [G18]	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 / localexhaust 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 toauthorised 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. [G20].
Bulk transfer [CS14] (closed systems) [CS107]	Handle substance within a closed system [E47].
Bulk transfers [CS14] (closed systems) [CS107]	Limit the substance content in the product to 1% [OC16]. Provide a good standard of general ventilation (not less than 3 to 5 air changes per hour). [E11]. Ensure material transfers are under containment or extract ventilation [E66].

With occasional controlled exposure [CS137]	Avoid carrying out activities involving exposure for more than 1 hour [OC27].
Material transfers [CS3]	Limit the substance content in the product to 1% [OC16]. Provide a good standard of general ventilation (not less than 3 to 5 air changes per hour). [E11]. Ensure material transfers are under containment or extract ventilation [E66]. Avoid carrying out activities involving exposure for more than 1 hour [OC27].
Injection moulding of articles [CS89]	Limit the substance content in the product to 1% [OC16]. Minimiseexposure by partial enclosure of the operation or equipment and provide extract ventilation at openings [E60]. Provide a good standard of general or controlled ventilation (10 to 15 air changes per hour) [E40]. Avoid carrying out activities involving exposure for more than 1 hour [OC27].
Rework of articles [CS86]	No specific measures identified [EI18].
Equipment maintenance [CS5]	Drain down and flush system prior to equipment break-in or maintenance [E55]. Limit the substance content in the product to 1% [OC16]. Provide a good standard of general ventilation (not less than 3 to 5 air changes per hour) [E11]. Wear a respirator conforming to EN140 with Type A filter or better [PPE22].
Storage [CS67]	Handle substance within a closed system [E47]. Limit the substance content in the product to 1% [OC16].
Storage [CS67] With occasional controlled exposure [CS137]	Limit the substance content in the product to 1% [OC16]. Store substance within a closed system [E84]. Provide a good standard of general ventilation (not less than 3 to 5 air changes per hour) [E11].
Section 2.2	**Control of environmental exposure**
The exposure of aquatic, terrestrial, sediment and sewage treatment microorganisms is considered to be negligible because the substance partitions primarily to air when found in the environment. Emission of butadiene to the air compartment is regulated by the VOC directive and the carcinogen directive. The limits in place of both of these directives would also limitexposure to ecological receptors. Hence the risks are considered to be controlled for ecological receptors.	
Section 3	**Exposure Estimation**
3.1 Health	*When the recommended risk management measures (RMMs) and operational conditions (OCs) are observed, exposures are not expected to exceed the predicted DNELs and the resulting risk characterisation ratios are expected to be less than 1 as indicated in Appendix A.*
3.2 Environment	
Section 4	**Guidance to check compliance with the Exposure Scenario**
4.1 Health	*Confirm that RMMs and OCs are as described or of equivalent efficiency. See Appendix A for details of efficiencies and OC.*
4.2 Environment	
Section 5	**Additional good practice advice beyond the REACH Chemical Safety Assessment - (Section Optional)**
Note: The measures reported in this section have not been taken into account in the exposure estimates related to the exposure scenario above. They are not subject to obligation laid down in Article 37 (4) of REACH.	
Control of Worker Exposure	
Selection of relevant Contributing Scenario phrases	*Good practice RMM phrases may be incorporated in this section or consolidated into the main sections of the SDS, depending on the preference of the Registrant and functionality of the available e-SDS system.*
Control of environmental exposure	
Selection of relevant RMM Core Phrases	*Good practice RMM phrases may be incorporated in this section or consolidated into the main sections of the SDS, depending on the preference of the Registrant and functionality of the available e-SDS system.*

9.10.2 Exposure estimation

9.10.2.1 Workers exposure

The worker exposure estimates for the activities associated with the polymer processing using 1,3- butadiene were assessed using ECETOC TRAv2 (See Appendix A). Appendix A contains Tables 1 and 2 used to model the worker exposures. These tables contain all the operating conditions, and the efficiencies of the exposure modifiers including RPE, PPE and LEV. A separate table (also in Appendix A) contains the associated RMMs.

9.10.2.2 Consumer exposure

Not applicable.

9.10.2.3 Indirect exposure of humans via the environment

See section 9.11.

9.10.2.4 Environmental exposure

Not applicable.

9.11 Indirect exposure of humans via the environment

An assessment of the risk posed by indirect exposure of man via the environment was made for each ES in EUSES. Emissions values were taken from the appropriate SpERC. Further details on scaling and control technologies are provided in SpERC factsheet). The SpERC emissions to air, and/or water, have first been amended (http://cefic.org/en/reach-for_industrieslibraries.html) to reflect those reported in the EU risk assessment report on 1,3-butadiene (EU, 2002), and then (if safe use was not achieved) further reduced to ensure safe working conditions. The usual scaling factors can be amended to avoid the use of these emissions. The emission values used in the modelling are reported below.

ES	Site tonnage/yr	SpERC reference	Modelled emissions to air	Modelled emissions to water	Substance characteristics
1 Manufacture	2000000	1.1.v1	2.00E-04*	1.00E-03*	Water solubilityis 735 mg/l. Vapour pressure is 151 kPa at 12°C. Log Kow is 1.99. Not considered to be readily biodegradable.
2 Distribution	500000	1.1b.v1	1.00E-02	1.00E-03	
3 Use as an intermediate	100000	6.1a.v1	3.00E-02*	5.00E-02*	
4 Formulation	75000	2.2.v1	1.00E-02*	1.00E-03*	
5 Uses in Fuels (Industrial)	50000	7.12a.v1	1.25E-03*	5.00E-06*	
6 Uses in Laboratory reagents (Industrial)	10	ERC 2, 4	2.50E+00	2.00E+00	
7 Uses in Rubber production and processing (Industrial)	100000	4.19.v1	1.00E-02*	5.00E-02*	
8 Use in polymerproduction (Industrial)	100000	4.20.v1	1.00E-02*	5.00E-02*	
9 Use in polymer processing(Industrial)	10000	4.21a.v1	5.00E-01*	0.00E+00	
10 Use in polymerprocessing (Professional)	2500	8.21b.v1	1.00E+00*	1.00E+00	

*SpERC Emissions modified

9.12 Regional Exposure Concentrations

Environmental exposure assessment is not required for this substance. Regional exposure concentrations based on the ES described above were used in the assessment of indirect exposure of man via the environment.