

# 1,3-BUTADIENE

BRASKEM S.A.

Version No:1.1  
Safety Data Sheet according to MoL Public Notice No. 2009-68 requirements

Project number: P2016112402

Issue Date:07/02/2018  
S.GHS.KOR.EN

## 1. PRODUCT AND COMPANY IDENTIFICATION

### a) Product Name

|                               |                        |
|-------------------------------|------------------------|
| Product name                  | 1,3-BUTADIENE          |
| Synonyms                      | BUTADIENE              |
| Proper shipping name          | BUTADIENES, STABILIZED |
| Chemical formula              | C4H6                   |
| Other means of identification | Not Available          |
| CAS number                    | 106-99-0               |

### b) Recommended use of the chemical and restrictions on use

|                          |   |
|--------------------------|---|
| Relevant identified uses | <ul style="list-style-type: none"> <li>Manufacture of substances</li> <li>Distribution</li> <li>Intermediate</li> <li>Rubber production and processing</li> </ul> |
|--------------------------|---|

### c) Manufacturer/Supplier/Distributor Information

|                     |   |
|---------------------|---|
| Manufacturer name   | BRASKEM S/A   |
| Address             | Av. Presidente Costa e Silva, 1178 – Capuava<br>09270-001 – Santo André – SP – Brasil |
| E-mail              | productsafety@braskem.com   |
| Emergency telephone | 1-800-424-9300 (CHEMTREC)   |
| Importer name       | INEOS STYROLUTION KOREA LTD.  |
| Address             | 5Fl., Landmark Tower 308, Gangnam-daero, Gangnam-Gu, Seoul - Korea 135-937            |
| Telephone           | +82 2 6322-7750   |
| Email               | yoonju.Chang@styrolution.com  |

### Emergency telephone number


|                                   |   |
|-----------------------------------|---|
| Association / Organisation        |   |
| Emergency telephone numbers       | Local number +(82) 070-7686-0086                            |
| Other emergency telephone numbers | Toll free number 00-308-13-2549 / 1-800-424-9300 (CHEMTREC) |

## 2. HAZARDS IDENTIFICATION

### a) Hazard .Risk Classification

|                |  |
|----------------|--|
| Classification | Germ cell mutagenicity Category 1B, Flammable Gas Category 1, Gas under Pressure (Compressed gas), Carcinogenicity Category 1A |
|----------------|--|

### b) Label elements including precautionary statements

|                    |   |
|--------------------|---|
| GHS label elements |  |
| SIGNAL WORD        | <b>DANGER</b>   |

### Hazard statement(s)

|      |                            |
|------|----------------------------|
| H340 | May cause genetic defects. |
| H220 | Extremely flammable gas.   |

Continued...

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|             |   |
|-------------|---|
| <b>H280</b> | Contains gas under pressure; may explode if heated. |
| <b>H350</b> | May cause cancer.                                   |

**Supplementary statement(s)**

Not Applicable

**Precautionary statement(s) Prevention**

|             |  |
|-------------|--|
| <b>P201</b> | Obtain special instructions before use.                                    |
| <b>P210</b> | Keep away from heat/sparks/open flames/hot surfaces. No smoking.           |
| <b>P280</b> | Wear protective gloves/protective clothing/eye protection/face protection. |

**Precautionary statement(s) Response**

|                  |   |
|------------------|---|
| <b>P308+P313</b> | IF exposed or concerned: Get medical advice/ attention.                 |
| <b>P377</b>      | Leaking gas fire: Do not extinguish, unless leak can be stopped safely. |
| <b>P381</b>      | Eliminate all ignition sources if safe to do so.                        |

**Precautionary statement(s) Storage**

|                  |  |
|------------------|--|
| <b>P405</b>      | Store locked up.   |
| <b>P410+P403</b> | Protect from sunlight. Store in a well-ventilated place. |

**Precautionary statement(s) Disposal**

|             |   |
|-------------|---|
| <b>P501</b> | Dispose of contents/container in accordance with local regulations. |
|-------------|---|

**Hazards which do not result in classification other hazards (NFPA)****3. COMPOSITION/INFORMATION ON INGREDIENTS****Substances**

| Name          | Synonyms  | CAS No   | %[weight] |
|---------------|---|----------|-----------|
| 1,3-butadiene | 1-methylallene, C <sub>4</sub> H <sub>6</sub> , CH <sub>2</sub> =CHCH=CH <sub>2</sub> , alpha, gamma-butadiene, biethylene, bivinylyl, buta-1,3-diene, divinyl, erythrene, methylallene, pyrrolene, vinylethylene | 106-99-0 | >99,5     |

**Mixtures**

See section above for composition of Substances

**4. FIRST AID MEASURES****Description of first aid measures**

|                         |  |
|-------------------------|--|
| <b>a) Eye contact:</b>  | <ul style="list-style-type: none"> <li>‡ If product comes in contact with eyes remove the patient from gas source or contaminated area.</li> <li>‡ Take the patient to the nearest eye wash, shower or other source of clean water.</li> <li>‡ Open the eyelid(s) wide to allow the material to evaporate.</li> <li>‡ Gently rinse the affected eye(s) with clean, cool water for at least 15 minutes. Have the patient lie or sit down and tilt the head back. Hold the eyelid(s) open and pour water slowly over the eyeball(s) at the inner corners, letting the water run out of the outer corners.</li> <li>‡ The patient may be in great pain and wish to keep the eyes closed. It is important that the material is rinsed from the eyes to prevent further damage.</li> <li>‡ Ensure that the patient looks up, and side to side as the eye is rinsed in order to better reach all parts of the eye(s)</li> <li>‡ Transport to hospital or doctor.</li> <li>‡ Even when no pain persists and vision is good, a doctor should examine the eye as delayed damage may occur.</li> <li>‡ If the patient cannot tolerate light, protect the eyes with a clean, loosely tied bandage.</li> </ul> <p>Ensure verbal communication and physical contact with the patient.</p> <p><b>DO NOT</b> allow the patient to rub the eyes<br/> <b>DO NOT</b> allow the patient to tightly shut the eyes<br/> <b>DO NOT</b> introduce oil or ointment into the eye(s) without medical advice<br/> <b>DO NOT</b> use hot or tepid water.</p> |
| <b>b) Skin contact:</b> | <p>If skin or hair contact occurs:</p> <ul style="list-style-type: none"> <li>‡ Flush skin and hair with running water (and soap if available).</li> <li>‡ Seek medical attention in event of irritation.</li> </ul>   |
| <b>c) Inhalation:</b>   | <ul style="list-style-type: none"> <li>‡ Following exposure to gas, remove the patient from the gas source or contaminated area.</li> <li>‡ NOTE: Personal Protective Equipment (PPE), including positive pressure self-contained breathing apparatus may be required to assure the safety of the rescuer.</li> <li>‡ Prostheses such as false teeth, which may block the airway, should be removed, where possible, prior to initiating first aid procedures.</li> <li>‡ If the patient is not breathing spontaneously, administer rescue breathing.</li> <li>‡ If the patient does not have a pulse, administer CPR.</li> <li>‡ If medical oxygen and appropriately trained personnel are available, administer 100% oxygen.</li> <li>‡ Summon an emergency ambulance. If an ambulance is not available, contact a physician, hospital, or Poison Control Centre for further instruction.</li> <li>‡ Keep the patient warm, comfortable and at rest while awaiting medical care.</li> <li>‡ <b>MONITOR THE BREATHING AND PULSE, CONTINUOUSLY.</b></li> <li>‡ Administer rescue breathing (preferably with a demand-valve resuscitator, bag-valve mask-device, or pocket mask as trained) or CPR if necessary.</li> </ul>   |
| <b>d) Ingestion:</b>    | Not considered a normal route of entry.  |

**e) Indication of immediate medical attention and notes for physician:**

Continued...

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For gas exposures:

-----  
BASIC TREATMENT  
-----

- ▶ Establish a patent airway with suction where necessary.
- ▶ Watch for signs of respiratory insufficiency and assist ventilation as necessary.
- ▶ Administer oxygen by non-rebreather mask at 10 to 15 l/min.
- ▶ Monitor and treat, where necessary, for pulmonary oedema .
- ▶ Monitor and treat, where necessary, for shock.
- ▶ Anticipate seizures.

-----  
ADVANCED TREATMENT  
-----

- ▶ Consider orotracheal or nasotracheal intubation for airway control in unconscious patient or where respiratory arrest has occurred.
- ▶ Positive-pressure ventilation using a bag-valve mask might be of use.
- ▶ Monitor and treat, where necessary, for arrhythmias.
- ▶ Start an IV D5W TKO. If signs of hypovolaemia are present use lactated Ringers solution. Fluid overload might create complications.
- ▶ Drug therapy should be considered for pulmonary oedema.
- ▶ Hypotension with signs of hypovolaemia requires the cautious administration of fluids. Fluid overload might create complications.
- ▶ Treat seizures with diazepam.

Proparacaine hydrochloride should be used to assist eye irrigation.

BRONSTEIN, A.C. and CURRRANCE, P.L.

EMERGENCY CARE FOR HAZARDOUS MATERIALS EXPOSURE: 2nd Ed. 1994

As in all cases of suspected poisoning, follow the ABCDEs of emergency medicine (airway, breathing, circulation, disability, exposure), then the ABCDEs of toxicology (antidotes, basics, change absorption, change distribution, change elimination).

For poisons (where specific treatment regime is absent):

-----  
BASIC TREATMENT  
-----

- ▶ Establish a patent airway with suction where necessary.
- ▶ Watch for signs of respiratory insufficiency and assist ventilation as necessary.
- ▶ Administer oxygen by non-rebreather mask at 10 to 15 L/min.
- ▶ Monitor and treat, where necessary, for pulmonary oedema.
- ▶ Monitor and treat, where necessary, for shock.
- ▶ Anticipate seizures.
- ▶ **DO NOT** use emetics. Where ingestion is suspected rinse mouth and give up to 200 ml water (5 ml/kg recommended) for dilution where patient is able to swallow, has a strong gag reflex and does not drool.

-----  
ADVANCED TREATMENT  
-----

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- ▶ Start an IV D5W TKO. If signs of hypovolaemia are present use lactated Ringers solution. Fluid overload might create complications.
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## 5. FIRE-FIGHTING MEASURES

### a) Suitable (and unsuitable) extinguishing media:

**DO NOT EXTINGUISH BURNING GAS UNLESS LEAK CAN BE STOPPED SAFELY:  
OTHERWISE: LEAVE GAS TO BURN.**

#### FOR SMALL FIRE:

- ▶ Dry chemical, CO2 or water spray to extinguish gas (only if absolutely necessary and safe to do so).
- ▶ **DO NOT use water jets.**

#### FOR LARGE FIRE:

- ▶ Cool cylinder by direct flooding quantities of water onto upper surface until well after fire is out.

### b) Specific hazards arising from the chemical (e.g. nature of any hazardous combustion products):

#### Fire Incompatibility

- ▶ Avoid contamination with oxidising agents i.e. nitrates, oxidising acids, chlorine bleaches, pool chlorine etc. as ignition may result

### c) Special protective equipment and precautions for fire-fighters:

#### Fire Fighting

##### FOR FIRES INVOLVING MANY GAS CYLINDERS:

- ▶ To stop the flow of gas, specifically trained personnel may inert the atmosphere to reduce oxygen levels thus allowing the capping of leaking container(s).
- ▶ Reduce the rate of flow and inject an inert gas, if possible, before completely stopping the flow to prevent flashback.
- ▶ **DO NOT extinguish the fire until the supply is shut off** otherwise an explosive re-ignition may occur.
- ▶ If the fire is extinguished and the flow of gas continues, used increased ventilation to prevent build-up, of explosive atmosphere.

##### GENERAL

- ▶ Alert Fire Brigade and tell them location and nature of hazard.
- ▶ May be violently or explosively reactive.
- ▶ Wear breathing apparatus plus protective gloves.
- ▶ Consider evacuation
- ▶ Fight fire from a safe distance, with adequate cover.

#### Fire/Explosion Hazard

- ▶ **HIGHLY FLAMMABLE:** will be easily ignited by heat, sparks or flames.
- ▶ Will form explosive mixtures with air
- ▶ Fire exposed containers may vent contents through pressure relief valves thereby increasing fire intensity and/ or vapour concentration.
- ▶ Vapours may travel to source of ignition and flash back.

**1,3-BUTADIENE**

Containers may explode when heated - Ruptured cylinders may rocket

- ▶
  - ▶ Fire may produce irritating, poisonous or corrosive gases.
  - ▶ Runoff may create fire or explosion hazard.
  - ▶ May decompose explosively when heated or involved in fire.
  - ▶ High concentration of gas may cause asphyxiation without warning.
  - ▶ Contact with gas may cause burns, severe injury and/ or frostbite.
- Combustion products include:  
carbon monoxide (CO)  
carbon dioxide (CO<sub>2</sub>)  
other pyrolysis products typical of burning organic material.
- Contains low boiling substance:** Closed containers may rupture due to pressure buildup under fire conditions.  
**WARNING:** Long standing in contact with air and light may result in the formation of potentially explosive peroxides.

**6. ACCIDENTAL RELEASE MEASURES****a) Personal precautions, protective equipment and emergency procedures:**

See section 8

**b) Environmental precautions and protective procedures:**

See section 12

**c) Methods and materials for containment and cleaning up:**

|                     |  |
|---------------------|--|
| <b>Minor Spills</b> | <ul style="list-style-type: none"> <li>▶ Avoid breathing vapour and any contact with liquid or gas. Protective equipment including respirator should be used.</li> <li>▶ <b>DO NOT enter confined spaces where gas may have accumulated.</b></li> <li>▶ Shut off all sources of possible ignition and increase ventilation.</li> </ul>   |
| <b>Major Spills</b> | <ul style="list-style-type: none"> <li>▶ Clear area of all unprotected personnel and move upwind.</li> <li>▶ Alert Emergency Authority and advise them of the location and nature of hazard.</li> <li>▶ May be violently or explosively reactive.</li> <li>▶ Wear full body clothing with breathing apparatus.</li> <li>▶ Prevent by any means available, spillage from entering drains and water-courses.</li> <li>▶ Consider evacuation.</li> <li>▶ Shut off all possible sources of ignition and increase ventilation.</li> <li>▶ No smoking or naked lights within area.</li> <li>▶ Use extreme caution to prevent violent reaction.</li> <li>▶ Stop leak only if safe to do so.</li> <li>▶ Water spray or fog may be used to disperse vapour.</li> <li>▶ <b>DO NOT enter confined space where gas may have collected.</b></li> <li>▶ Keep area clear until gas has dispersed.</li> </ul><br><ul style="list-style-type: none"> <li>▶ Remove leaking cylinders to a safe place.</li> <li>▶ Fit vent pipes. Release pressure under safe, controlled conditions</li> <li>▶ Burn issuing gas at vent pipes.</li> <li>▶ <b>DO NOT exert excessive pressure on valve; DO NOT attempt to operate damaged valve.</b></li> </ul> |

**7. HANDLING AND STORAGE****a) Precautions for safe handling:**

|                          |   |
|--------------------------|---|
| <b>Safe handling</b>     | <ul style="list-style-type: none"> <li>▶ Consider use in closed pressurised systems, fitted with temperature, pressure and safety relief valves which are vented for safe dispersal. Use only properly specified equipment which is suitable for this product, its supply pressure and temperature</li> <li>▶ The tubing network design connecting gas cylinders to the delivery system should include appropriate pressure indicators and vacuum or suction lines.</li> <li>▶ Fully-welded types of pressure gauges, where the bourdon tubesensing element is welded to the gauge body, are recommended.</li> <li>▶ Before connecting gas cylinders, ensure manifold is mechanically secure and does not contain another gas.</li> <li>▶ Avoid generation of static electricity. Earth all lines and equipment.</li> <li>▶ <b>DO NOT transfer gas from one cylinder to another.</b></li> </ul> |
| <b>Other information</b> | <ul style="list-style-type: none"> <li>▶ Cylinders should be stored in a purpose-built compound with good ventilation, preferably in the open.</li> <li>▶ Such compounds should be sited and built in accordance with statutory requirements.</li> <li>▶ The storage compound should be kept clear and access restricted to authorised personnel only.</li> <li>▶ Cylinders stored in the open should be protected against rust and extremes of weather.</li> </ul>   |

**b) Conditions for safe storage (including any incompatibilities):**

|                                |   |
|--------------------------------|---|
| <b>Suitable container</b>      | <ul style="list-style-type: none"> <li>▶ Cylinder:</li> <li>▶ Ensure the use of equipment rated for cylinder pressure.</li> <li>▶ Ensure the use of compatible materials of construction.</li> <li>▶ Valve protection cap to be in place until cylinder is secured, connected.</li> <li>▶ Cylinder must be properly secured either in use or in storage.</li> </ul>   |
| <b>Storage incompatibility</b> | <p>1,3-Butadiene:</p> <ul style="list-style-type: none"> <li>▶ is self-reactive</li> <li>▶ forms heat-, shock-, and impact-sensitive peroxides in air unless inhibited (stabilisation with tert-butylcatechol or other inhibitors at all times and ensure these levels are maintained)</li> <li>▶ may polymerise violently, may ignite or explode on contact with strong oxidisers, copper, high copper alloys, chlorine dioxide, crotonaldehyde, strong acids, nitrogen dioxide, ozone, phenol, sodium nitrite, or polymerisation initiators, such as azobisisobutyronitrile, hydroquinone, or peroxyacetic acid is incompatible with rubber, plastics, halogen and silica-aluminium molecular sieves</li> <li>▶ may generate electrostatic charges due to low conductivity</li> <li>▶ uninhibited vapours may form polymers in plug vents, confined spaces, or flame arresters of storage tanks</li> <li>▶ The various oxides of nitrogen and peroxy acids may be dangerously reactive in the presence of alkenes. BREITHERICK L.: Handbook of Reactive Chemical Hazards</li> <li>▶ Avoid reaction with strong Lewis or mineral acids.</li> <li>▶ Reaction with halogens requires carefully controlled conditions.</li> <li>▶ Free radical initiators should be avoided.</li> </ul> |

## 1,3-BUTADIENE

**WARNING:**

May decompose violently or explosively on contact with other substances.

- ▶ This substance, or one of its components, is one of the relatively few compounds which are described as 'endothermic' i.e. heat is absorbed into the compound, rather than released from it, during its formation.
- ▶ The majority of endothermic compounds are thermodynamically unstable and may decompose explosively under various circumstances of initiation.
- ▶ Many but not all endothermic compounds have been involved in decompositions, reactions and explosions and, in general, compounds with significantly positive values of standard heats of formation, may be considered suspect on stability grounds.

BRETHERRICK L.: Handbook of Reactive Chemical Hazards

- The interaction of alkenes and alkynes with nitrogen oxides and oxygen may produce explosive addition products; these may form at very low temperatures and explode on heating to higher temperatures (the addition products from 1,3-butadiene and cyclopentadiene form rapidly at -150 C and ignite or explode on warming to -35 to -15 C). These derivatives ('pseudo-nitrosites') were formerly used to characterise terpene hydrocarbons.

- Exposure to air must be kept to a minimum so as to limit the build-up of peroxides which will concentrate in bottoms if the product is distilled. The product must not be distilled to dryness if the peroxide concentration is substantially above 10 ppm (as active oxygen) since explosive decomposition may occur. Distillate must be immediately inhibited to prevent peroxide formation. The effectiveness of the antioxidant is limited once the peroxide levels exceed 10 ppm as active oxygen. Addition of more inhibitor at this point is generally ineffective. Prior to distillation it is recommended that the product should be washed with aqueous ferrous ammonium sulfate to destroy peroxides; the washed product should be immediately re-inhibited.

- A range of exothermic decomposition energies for double bonds is given as 40-90 kJ/mol. The relationship between energy of decomposition and processing hazards has been the subject of discussion; it is suggested that values of energy released per unit of mass, rather than on a molar basis (J/g) be used in the assessment. For example, in 'open vessel processes' (with man-hole size openings, in an industrial setting), substances with exothermic decomposition energies below 500 J/g are unlikely to present a danger, whilst those in 'closed vessel processes' (opening is a safety valve or bursting disk) present some danger where the decomposition energy exceeds 150 J/g.

BRETHERRICK: Handbook of Reactive Chemical Hazards, 4th Edition

- The reaction of ozone with alkenes is believed to proceed via the formation of a vibrationally excited Primary Ozonide (POZ) which falls apart to give a vibrationally excited Criegee Intermediate (CI) The CI can decompose to give OH radicals, or be stabilised. This may be of relevance in atmospheric chemistry.

- Violent explosions at low temperatures in ammonia synthesis gas units have been traced to the addition products of dienes and nitrogen dioxide Avoid reaction with oxidising agents
- ▶ Compressed gases may contain a large amount of kinetic energy over and above that potentially available from the energy of reaction produced by the gas in chemical reaction with other substances

**Specific end use(s)**

See section 1.2

**8. EXPOSURE CONTROLS & PERSONAL PROTECTION****a) Control parameters (e.g. occupational exposure limit values, biological limit values):****OCCUPATIONAL EXPOSURE LIMITS (OEL)****INGREDIENT DATA**


| Source   | Ingredient    | Material name | TWA                           | STEL                          | Peak          | Notes   |
|--|---------------|---------------|-------------------------------|-------------------------------|---------------|---|
| Korea (South) Occupational Exposure Standards (Korean)                             | 1,3-butadiene | 1,3-Butadiene | 4.4 mg/m <sup>3</sup> / 2 ppm | 22 mg/m <sup>3</sup> / 10 ppm | Not Available | Carcinogenicity 1A, Germ cell mutagenicity 1B |
| Korea (South) Occupational Exposure Standards for Carcinogenic Substances (Korean) | 1,3-butadiene | 1,3-Butadiene | 4.4 mg/m <sup>3</sup> / 2 ppm | 22 mg/m <sup>3</sup> / 10 ppm | Not Available | Not Available                                 |

**EMERGENCY LIMITS**

| Ingredient    | Material name   | TEEL-1        | TEEL-2        | TEEL-3        |
|---------------|-----------------|---------------|---------------|---------------|
| 1,3-butadiene | Butadiene, 1,3- | Not Available | Not Available | Not Available |

| Ingredient    | Original IDLH    | Revised IDLH    |
|---------------|------------------|-----------------|
| 1,3-butadiene | 20,000 [LEL] ppm | 2,000 [LEL] ppm |

**Exposure controls**

|   |   |
|---|---|
| <b>b) Appropriate engineering controls:</b> | <p>Engineering controls are used to remove a hazard or place a barrier between the worker and the hazard. Well-designed engineering controls can be highly effective in protecting workers and will typically be independent of worker interactions to provide this high level of protection. The basic types of engineering controls are:</p> <p>Process controls which involve changing the way a job activity or process is done to reduce the risk.</p> <p>Enclosure and/or isolation of emission source which keeps a selected hazard 'physically' away from the worker and ventilation that strategically 'adds' and 'removes' air in the work environment.</p> |
| <b>Personal protection</b>                  |    |
| <b>Eye and face protection</b>              | <ul style="list-style-type: none"> <li>▶ Safety glasses with side shields</li> <li>▶ Chemical goggles.</li> <li>▶ Contact lenses may pose a special hazard; soft contact lenses may absorb and concentrate irritants. A written policy document, describing the wearing of lenses or restrictions on use, should be created for each workplace or task. This should include a review of lens absorption and adsorption for the class of chemicals in use and an account of injury experience.</li> </ul>  |
| <b>Skin protection</b>                      | See Hand protection below   |
| <b>Hands/feet protection</b>                | ▶ When handling sealed and suitably insulated cylinders wear cloth or leather gloves.   |
| <b>Body protection</b>                      | See Other protection below  |

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|                  |  |
|------------------|--|
| Other protection | <ul style="list-style-type: none"> <li>▶ Employees working with confirmed human carcinogens should be provided with, and be required to wear, clean, full body protective clothing (smocks, coveralls, or long-sleeved shirt and pants), shoe covers and gloves prior to entering the regulated area. [AS/NZS ISO 6529:2006 or national equivalent] Employees engaged in handling operations involving carcinogens should be provided with, and required to wear and use half-face filter-type respirators with filters for dusts, mists and fumes, or air purifying canisters or cartridges. A respirator affording higher levels of protection may be substituted. [AS/NZS 1715 or national equivalent]</li> <li>▶ Emergency deluge showers and eyewash fountains, supplied with potable water, should be located near, within sight of, and on the same level with locations where direct exposure is likely.</li> <li>▶ Prior to each exit from an area containing confirmed human carcinogens, employees should be required to remove and leave protective clothing and equipment at the point of exit and at the last exit of the day, to place used clothing and equipment in impervious containers at the point of exit for purposes of decontamination or disposal. The contents of such impervious containers must be identified with suitable labels. For maintenance and decontamination activities, authorized employees entering the area should be provided with and required to wear clean, impervious garments, including gloves, boots and continuous-air supplied hood.</li> <li>▶ Prior to removing protective garments the employee should undergo decontamination and be required to shower upon removal of the garments and hood.</li> <li>▶ The clothing worn by process operators insulated from earth may develop static charges far higher (up to 100 times) than the minimum ignition energies for various flammable gas-air mixtures. This holds true for a wide range of clothing materials including cotton.</li> <li>▶ Avoid dangerous levels of charge by ensuring a low resistivity of the surface material worn outermost.<br/>BREITHERICK: Handbook of Reactive Chemical Hazards.</li> <li>▶ Protective overalls, closely fitted at neck and wrist.</li> <li>▶ Eye-wash unit.</li> </ul> <p><b>IN CONFINED SPACES:</b></p> <ul style="list-style-type: none"> <li>▶ Non-sparking protective boots</li> <li>▶ Static-free clothing.</li> <li>▶ Ensure availability of lifeline. <ul style="list-style-type: none"> <li>·Some plastic personal protective equipment (PPE) (e.g. gloves, aprons, overshoes) are not recommended as they may produce static electricity.</li> <li>·For large scale or continuous use wear tight-weave non-static clothing (no metallic fasteners, cuffs or pockets).</li> <li>·Non sparking safety or conductive footwear should be considered. Conductive footwear describes a boot or shoe with a sole made from a conductive compound chemically bound to the bottom components, for permanent control to electrically ground the foot and shall dissipate static electricity from the body to reduce the possibility of ignition of volatile compounds.</li> </ul> </li> </ul> |
| Thermal hazards  | Not Available  |

**Respiratory protection**

- ▶ Positive pressure, full face, air-supplied breathing apparatus should be used for work in enclosed spaces if a leak is suspected or the primary containment is to be opened (e.g. for a cylinder change)
- ▶ Air-supplied breathing apparatus is required where release of gas from primary containment is either suspected or demonstrated.

**Environmental exposure controls**

See section 12

**9. PHYSICAL AND CHEMICAL PROPERTIES****Information on basic physical and chemical properties**

|  |                             |   |                               |
|--|-----------------------------|---|-------------------------------|
| a) Appearance (physical state, color etc):     | Colorless gas               |   |                               |
| Physical state                                 | Gas                         | n) Relative density:                          | 0.6452 @ 0°C or 0.621 @ 20 °C |
| b) Odour:                                      | Mildly aromatic             | o) Partition coefficient:<br>n-octanol/water: | 1.99                          |
| c) Odour threshold:                            | Not Available               | p) Auto-ignition<br>temperature:              | 415 - 420                     |
| d) pH:   | Not Available               | q) Decomposition<br>temperature:              | Not Available                 |
| e) Melting point/freezing<br>point:            | -108.9                      | r) Viscosity:                                 | Not Available                 |
| f) Initial boiling point and<br>boiling range: | -4.41                       | s) Molecular mass:                            | Not Available                 |
| g) Flash point :                               | -76                         | Taste   | Not Available                 |
| h) Evaporation rate:                           | Not Available               | Explosive properties                          | Not Available                 |
| i) Flammability (solid, gas):                  | FLAMMABLE                   | Oxidising properties                          | Not Available                 |
| j) Upper flammability or<br>explosive limits:  | 12                          | Surface Tension (dyn/cm or<br>mN/m)           | Not Available                 |
| j) Lower flammability or<br>explosive limits:  | 2                           | Volatile Component (%vol)                     | Not Available                 |
| k) Vapor pressure:                             | 2.46 atm (248,9 kPa) @ 21°C | Gas group                                     | IIB                           |
| l) Solubility:                                 | 735 mg/l                    | pH as a solution (1%)                         | Not Available                 |
| m) Vapor density:                              | 1.87 @ 15 °C (air=1)        | VOC g/L                                       | Not Available                 |

**10. STABILITY AND REACTIVITY**

|   |  |
|---|--|
| Reactivity  | See section 7  |
| a) Chemical stability and possibility of hazardous reactions: | <ul style="list-style-type: none"> <li>▶ Unstable in the presence of incompatible materials.</li> <li>▶ Product is considered stable.</li> <li>▶ Hazardous polymerisation will not occur.</li> </ul> |
| Possibility of hazardous reactions                            | capable of strong chemical reaction at high temperatures and pressures, forming explosive polymers or sensitive to shock and heat.   |

## 1,3-BUTADIENE

|   |   |
|---|---|
| <b>b) Conditions to avoid (e.g. static discharge, shock or vibration, etc):</b> | Keep away from heat/sparks/open flames/hot surfaces. - No smoking. Avoid static electricity discharges.   |
| <b>c) Incompatible materials:</b>   | Air. Oxygen. Strong oxidizing agents. Copper (Cu). Monel alloy, aluminum tetrahydroborate, vinylacetylene, chrome-aldehyde, boron trifluoride, phenol, concentrated solutions of sodium nitrite(5%), halogen. |
| <b>d) Hazardous decomposition products:</b>                                     | Carbon monoxide. Carbon dioxide (CO <sub>2</sub> ).   |

## 11. TOXICOLOGICAL INFORMATION

## a) Information on the likely routes of exposure:

|                     |  |
|---------------------|--|
| <b>Inhaled</b>      | <p>The material is not thought to produce adverse health effects or irritation of the respiratory tract (as classified by EC Directives using animal models). Nevertheless, good hygiene practice requires that exposure be kept to a minimum and that suitable control measures be used in an occupational setting. Inhalation of non-toxic gases may cause:</p> <ul style="list-style-type: none"> <li>▸ CNS effects: headache, confusion, dizziness, stupor, seizures and coma;</li> <li>▸ respiratory: shortness of breath and rapid breathing;</li> <li>▸ cardiovascular: collapse and irregular heart beats;</li> <li>▸ gastrointestinal: mucous membrane irritation, nausea and vomiting.</li> </ul> <p>Material is highly volatile and may quickly form a concentrated atmosphere in confined or unventilated areas. The vapour may displace and replace air in breathing zone, acting as a simple asphyxiant. This may happen with little warning of overexposure. The use of a quantity of material in an unventilated or confined space may result in increased exposure and an irritating atmosphere developing. Before starting consider control of exposure by mechanical ventilation.</p> |
| <b>Ingestion</b>    | <p>Not normally a hazard due to physical form of product.<br/>Considered an unlikely route of entry in commercial/industrial environments</p>  |
| <b>Skin Contact</b> | <p>The material is not thought to produce adverse health effects or skin irritation following contact (as classified by EC Directives using animal models). Nevertheless, good hygiene practice requires that exposure be kept to a minimum and that suitable gloves be used in an occupational setting. Open cuts, abraded or irritated skin should not be exposed to this material. Entry into the blood-stream, through, for example, cuts, abrasions or lesions, may produce systemic injury with harmful effects. Examine the skin prior to the use of the material and ensure that any external damage is suitably protected.</p>  |
| <b>Eye</b>          | <p>Although the material is not thought to be an irritant (as classified by EC Directives), direct contact with the eye may produce transient discomfort characterised by tearing or conjunctival redness (as with windburn).<br/>Not considered to be a risk because of the extreme volatility of the gas.</p>  |
| <b>Chronic</b>      | <p>There is sufficient evidence to suggest that this material directly causes cancer in humans.<br/>There is ample evidence to presume that exposure to this material can cause genetic defects that can be inherited.<br/>Based on experiments and other information, there is ample evidence to presume that exposure to this material can cause genetic defects that can be inherited.<br/>Principal route of occupational exposure to the gas is by inhalation.</p>  |

| 1,3-butadiene                                      | TOXICITY   | IRRITATION    |
|--|--|---------------|
|  | Inhalation (rat) LC50: 128000 ppm/4hr <sup>[2]</sup> | Not Available |
| Inhalation (rat) LC50: 285 mg/L/4hr <sup>[2]</sup> |  |               |
| Oral (rat) LD50: 3210 mg/kg <sup>[1]</sup>         |  |               |

**Legend:** 1. Value obtained from Europe ECHA Registered Substances - Acute toxicity 2.\* Value obtained from manufacturer's SDS. Unless otherwise specified data extracted from RTECS - Register of Toxic Effect of chemical Substances

## b) Health hazards information

|  |   |                                 |   |
|--|---|---------------------------------|---|
| <b>Acute Toxicity</b>                    | ☒ | <b>Carcinogenicity</b>          | ✓ |
| <b>Skin Irritation/Corrosion</b>         | ☒ | <b>Reproductivity</b>           | ☒ |
| <b>Serious Eye Damage/Irritation</b>     | ☒ | <b>STOT - Single Exposure</b>   | ☒ |
| <b>Respiratory or Skin sensitisation</b> | ☒ | <b>STOT - Repeated Exposure</b> | ☒ |
| <b>Mutagenicity</b>                      | ✓ | <b>Aspiration Hazard</b>        | ☒ |

**Legend:** ✗ – Data available but does not fill the criteria for classification  
 ✓ – Data required to make classification available  
 ☒ – Data Not Available to make classification

## 12. ECOLOGICAL INFORMATION

## a) Aquatic and terrestrial ecotoxicity:

| Ingredient    | Endpoint | Test Duration (hr) | Species                       | Value      | Source |
|---------------|----------|--------------------|-------------------------------|------------|--------|
| 1,3-butadiene | LC50     | 96                 | Fish                          | 8.734mg/L  | 3      |
| 1,3-butadiene | EC50     | 96                 | Algae or other aquatic plants | 25.269mg/L | 3      |
| 1,3-butadiene | EC50     | 384                | Crustacea                     | 2.097mg/L  | 3      |

**Legend:**

Extracted from 1. IUCLID Toxicity Data 2. Europe ECHA Registered Substances - Ecotoxicological Information - Aquatic Toxicity 3. EPIWIN Suite V3.12 - Aquatic Toxicity Data (Estimated) 4. US EPA, Ecotox database - Aquatic Toxicity Data 5. ECETOC Aquatic Hazard Assessment Data 6. NITE (Japan) - Bioconcentration Data 7. METI (Japan) - Bioconcentration Data 8. Vendor Data

**1,3-BUTADIENE**

Substances containing unsaturated carbons are ubiquitous in indoor environments. They result from many sources.

**DO NOT discharge into sewer or waterways.**

**b) Persistence and degradability:**

| Ingredient    | Persistence: Water/Soil   | Persistence: Air            |
|---------------|---------------------------|-----------------------------|
| 1,3-butadiene | LOW (Half-life = 56 days) | LOW (Half-life = 0.33 days) |

**c) Bioaccumulative potential:**

| Ingredient    | Bioaccumulation  |
|---------------|------------------|
| 1,3-butadiene | LOW (BCF = 19.1) |

**d) Mobility in soil:**

| Ingredient    | Mobility          |
|---------------|-------------------|
| 1,3-butadiene | LOW (KOC = 43.79) |

**e) Other adverse effects:**

No data available

**13. DISPOSAL CONSIDERATIONS****a) Disposal method:**

|  |  |
|--|--|
| <b>b) Disposal precaution (including the disposal method of contaminated container and packaging):</b> | <ul style="list-style-type: none"> <li>▶ Evaporate or incinerate residue at an approved site.</li> <li>▶ Return empty containers to supplier.</li> <li>▶ Ensure damaged or non-returnable cylinders are gas-free before disposal.</li> </ul> |
| <b>Other disposal recommendations</b>  | None known.  |

**14. TRANSPORT INFORMATION****Classification for LAND transport: UN**

|                      |                          |
|----------------------|--------------------------|
| UN Number            | : UN1010                 |
| Proper Shipping Name | : Butadienes, stabilized |
| Class                | : 2.1                    |
| Packing group        | : Not applicable         |
| Reportable quantity  | : Not applicable         |

**Classification for SEA transport: IMO - IMDG**

|  |   |
|--|---|
| UN Number  | : UN1010  |
| Proper Shipping Name   | : BUTADIENES, STABILIZED                                  |
| Class  | : 2.1   |
| Packing group  | : Not applicable  |
| Marine pollutant   | : Not considered marine pollutant based on available data |
| Transport in bulk according to Annex I or II of MARPOL 73/78 and the IBC or IGC Code : |   |
| Product name   | : Butadiene   |

**Classification for AIR transport: IATA - ICAO**

|                      |                          |
|----------------------|--------------------------|
| UN Number            | : UN1010                 |
| Proper Shipping Name | : Butadienes, stabilized |
| Class                | : 2.1                    |
| Packing group        | : Not applicable         |

This information does not intend to convey all specific regulatory or operational requirements/information relating to the product therefore it cannot be considered exhaustive. Consult UN DOT, IMO and ICAO regulations before transporting the product. It is the responsibility of the transporting organization to follow all applicable laws, regulations and rules relating to the transportation of the material.

**15. REGULATORY INFORMATION****Safety, health and environmental regulations / legislation specific for the substance or mixture**

|  |                |
|--|----------------|
| <b>a) Industrial Safety and Health Act:</b>                  | Not Applicable |
| <b>b) Toxic Chemical Control Act:</b>                        | 1,3-BUTADIENE  |
| <b>c) Dangerous Material Safety Control Act:</b>             | Not Available  |
| <b>d) Wastes Management Act:</b>                             | Not Available  |
| <b>e) Other requirements in domestic and other countries</b> | see below      |



### 1,3-BUTADIENE(106-99-0) IS FOUND ON THE FOLLOWING REGULATORY LISTS

International Agency for Research on Cancer (IARC) - Agents Classified by the IARC Monographs  
International Air Transport Association (IATA) Dangerous Goods Regulations - Prohibited List Passenger and Cargo Aircraft  
Korea (South) Carcinogenic Substances  
Korea (South) Existing Chemicals List (KECL)

## 16. OTHER INFORMATION

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### initial information date

30/11/2016

### amendment date

30/11/2016(Version 1.0)

#### a) Information source and references:

- 1) <https://echa.europa.eu/information-on-chemicals>
- 2) Recommendations on the transport of dangerous goods-The nineteenth revised edition
- 3) Korea (South) Occupational Exposure Standards (Korean)
- 4) RTECS - Register of Toxic Effect of chemical Substances
- 5) Europe ECHA Registered Substances
- 6) Manufacturer's SDS report

This information is based on our current knowledge and is intended to describe the product for the purposes of health, safety and environmental requirements only. It should not therefore be construed as guaranteeing any specific property of the product. It warns that the handling of any chemical substance requires the previous knowledge of its hazards for the user. It is up to the user of the product company providing this SDS to and promote the training of its employees about possible risks come upon of the product. The information contained herein is not absolute, but only general information on the use of the chemical and indication of safety and security measures.

#### Definitions and abbreviations

PC –TWA: Permissible Concentration-Time Weighted Average  
PC –STEL: Permissible Concentration-Short Term Exposure Limit  
IARC: International Agency for Research on Cancer  
ACGIH: American Conference of Governmental Industrial Hygienists  
STEL: Short Term Exposure Limit  
TEEL: Temporary Emergency Exposure Limit,  
IDLH: Immediately Dangerous to Life or Health Concentrations  
OSF: Odour Safety Factor  
NOAEL :No Observed Adverse Effect Level  
LOAEL: Lowest Observed Adverse Effect Level  
TLV: Threshold Limit Value  
LOD: Limit Of Detection  
OTV: Odour Threshold Value  
BCF: BioConcentration Factors  
BEI: Biological Exposure Index