Section 1 - Product and Company Information

Product Name: 1-BUTANOL, ANHYDROUS, 99.8%
Product Number: 281549
Brand: ALDRICH

Company: Sigma-Aldrich
Street Address: 3050 Spruce Street
City, State, Zip, Country: SAINT LOUIS MO 63103 US
Technical Phone: 314 771 5765
Emergency Phone: 414 273 3850 Ext. 5996
Fax: 800 325 5052

Section 2 - Composition/Information on Ingredient

Substance Name: 1-BUTANOL
CAS #: 71-36-3
SARA 313: Yes

Formula: C4H10O
Synonyms: Alcool butylique (French) * Butanol * n-Butanol (ACGIH) * n-Butanol * 1-Butanol * Butan-1-ol * n-Butan-1-ol * Butanolen (Dutch) * Butanolo (Italian) * n-Butyl alcohol * 1-Butyl alcohol * n-Butyl alcohol (OSHA) * Butyl hydroxide * Butylowy alkohol (Polish) * Butyric or normal primary butyl alcohol * CCS 203 * Hemostyp * 1-Hydroxybutane * Methylolpropane * Propylcarbinol * Propylmethanol * RCRA waste number U031
RTECS Number: EO1400000

Section 3 - Hazards Identification

EMERGENCY OVERVIEW
Flammable. Harmful. Harmful if swallowed. Irritating to respiratory system and skin. Risk of serious damage to eyes. Vapors may cause drowsiness and dizziness. Target organ(s): Central nervous system. Ears.

HMIS RATING
HEALTH: 2*
FLAMMABILITY: 3
REACTIVITY: 1

NFPA RATING
HEALTH: 2
FLAMMABILITY: 3
REACTIVITY: 1

*additional chronic hazards present.

For additional information on toxicity, please refer to Section 11.
Section 4 - First Aid Measures

ORAL EXPOSURE
If swallowed, wash out mouth with water provided person is conscious. Call a physician.

INHALATION EXPOSURE
If inhaled, remove to fresh air. If not breathing give artificial respiration. If breathing is difficult, give oxygen.

DERMAL EXPOSURE
In case of skin contact, flush with copious amounts of water for at least 15 minutes. Remove contaminated clothing and shoes. Call a physician.

EYE EXPOSURE
In case of contact with eyes, flush with copious amounts of water for at least 15 minutes. Assure adequate flushing by separating the eyelids with fingers. Call a physician.

Section 5 - Fire Fighting Measures

FLAMMABLE HAZARDS
Flammable Hazards: Yes

EXPLOSION HAZARDS
Vapor may travel considerable distance to source of ignition and flash back. Container explosion can occur under fire conditions. In advanced or massive fires the area should be evacuated and the fire should be fought from a remote explosion-resistant location.

FLASH POINT
95 °F   35 °C   Method: closed cup

EXPLOSION LIMITS
Lower: 1.4 %   Upper: 11.2 %

AUTOIGNITION TEMP
343 °C

FLAMMABILITY
N/A

EXTINGUISHING MEDIA
Suitable: Carbon dioxide, dry chemical powder, or appropriate foam.
Unsuitable: Water may be effective for cooling, but may not effect extinguishment.

FIREFIGHTING
Protective Equipment: Wear self-contained breathing apparatus and protective clothing to prevent contact with skin and eyes.
Specific Hazard(s): Vapor may travel considerable distance to source of ignition and flash back. Flammable liquid.
Specific Method(s) of Fire Fighting: Use water spray to cool fire-exposed containers.

Section 6 - Accidental Release Measures

PROCEDURE TO BE FOLLOWED IN CASE OF LEAK OR SPILL
Evacuate area. Shut off all sources of ignition.

PROCEDURE(S) OF PERSONAL PRECAUTION(S)
Wear self-contained breathing apparatus, rubber boots, and heavy rubber gloves.

METHODS FOR CLEANING UP
Cover with dry-lime, sand, or soda ash. Place in covered containers using non-sparking tools and transport outdoors. Ventilate area and wash spill site after material pickup is complete.

Section 7 - Handling and Storage

HANDLING
User Exposure: Do not breathe vapor. Avoid contact with eyes, skin, and clothing. Avoid prolonged or repeated exposure.

STORAGE
Suitable: Keep container closed. Keep away from heat, sparks, and open flame. Store in a cool dry place. Handle and store under nitrogen.

SPECIAL REQUIREMENTS
Handle and store under inert gas. Hygroscopic.

Section 8 - Exposure Controls / PPE

ENGINEERING CONTROLS
Safety shower and eye bath. Use nonsparking tools. Mechanical exhaust required.

PERSONAL PROTECTIVE EQUIPMENT
Respiratory: Government approved respirator.
Hand: Compatible chemical-resistant gloves.
Eye: Chemical safety goggles.

GENERAL HYGIENE MEASURES
Wash thoroughly after handling. Wash contaminated clothing before reuse.

EXPOSURE LIMITS, RTECS

<table>
<thead>
<tr>
<th>Country</th>
<th>Source</th>
<th>Type</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>USA</td>
<td>ACGIH</td>
<td>Ceiling</td>
<td>co50 PPM</td>
</tr>
<tr>
<td>Remarks: Skin</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>USA</td>
<td>MSHA Standard-air</td>
<td>TWA</td>
<td>100 PPM (300 MG/M3)</td>
</tr>
<tr>
<td>USA</td>
<td>OSHA.</td>
<td>PEL</td>
<td>8H TWA 100 PPM (300 MG/M3)</td>
</tr>
<tr>
<td>New Zealand</td>
<td>OEL</td>
<td>Remarks: check ACGIH TLV</td>
<td></td>
</tr>
<tr>
<td>USA</td>
<td>NIOSH</td>
<td>Ceiling</td>
<td>co50 PPM (SK)</td>
</tr>
</tbody>
</table>

EXPOSURE LIMITS

<table>
<thead>
<tr>
<th>Country</th>
<th>Source</th>
<th>Type</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Poland</td>
<td>NDS</td>
<td>50 MG/M3</td>
<td></td>
</tr>
<tr>
<td>Poland</td>
<td>NDSCh</td>
<td>150 MG/M3</td>
<td></td>
</tr>
<tr>
<td>Poland</td>
<td>NDSP</td>
<td>-</td>
<td></td>
</tr>
<tr>
<td>USA</td>
<td>OSHA.</td>
<td>PEL</td>
<td>150 mg/m3</td>
</tr>
<tr>
<td>USA</td>
<td>ACGIH</td>
<td>TLV</td>
<td>50 ppm</td>
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<tr>
<td></td>
<td></td>
<td></td>
<td>152 mg/m3</td>
</tr>
</tbody>
</table>

Section 9 - Physical/Chemical Properties
### Appearance
Physical State: Clear liquid
Color: Colorless

### Property
<table>
<thead>
<tr>
<th>Property</th>
<th>Value</th>
<th>At Temperature or Pressure</th>
</tr>
</thead>
<tbody>
<tr>
<td>Molecular Weight</td>
<td>74.12 AMU</td>
<td></td>
</tr>
<tr>
<td>pH</td>
<td>N/A</td>
<td></td>
</tr>
<tr>
<td>BP/BP Range</td>
<td>117.7 °C</td>
<td>760 mmHg</td>
</tr>
<tr>
<td>MP/MP Range</td>
<td>-90 °C</td>
<td></td>
</tr>
<tr>
<td>Freezing Point</td>
<td>-89 °C</td>
<td></td>
</tr>
<tr>
<td>Vapor Pressure</td>
<td>4 mmHg</td>
<td>20 °C</td>
</tr>
<tr>
<td>Vapor Density</td>
<td>2.55 g/l</td>
<td></td>
</tr>
<tr>
<td>Saturated Vapor Conc.</td>
<td>N/A</td>
<td></td>
</tr>
<tr>
<td>SG/Density</td>
<td>0.811 g/cm³</td>
<td></td>
</tr>
<tr>
<td>Bulk Density</td>
<td>N/A</td>
<td></td>
</tr>
<tr>
<td>Odor Threshold</td>
<td>0.83 ppm</td>
<td></td>
</tr>
<tr>
<td>Volatile%</td>
<td>N/A</td>
<td></td>
</tr>
<tr>
<td>VOC Content</td>
<td>N/A</td>
<td></td>
</tr>
<tr>
<td>Water Content</td>
<td>N/A</td>
<td></td>
</tr>
<tr>
<td>Solvent Content</td>
<td>N/A</td>
<td></td>
</tr>
<tr>
<td>Evaporation Rate</td>
<td>N/A</td>
<td></td>
</tr>
<tr>
<td>Viscosity</td>
<td>3 Pas</td>
<td>20 °C</td>
</tr>
<tr>
<td>Surface Tension</td>
<td>N/A</td>
<td></td>
</tr>
<tr>
<td>Partition Coefficient</td>
<td>N/A</td>
<td></td>
</tr>
<tr>
<td>Decomposition Temp.</td>
<td>N/A</td>
<td></td>
</tr>
<tr>
<td>Flash Point</td>
<td>95 °F 35 °C</td>
<td>Method: closed cup</td>
</tr>
<tr>
<td>Explosion Limits</td>
<td>Lower: 1.4 %</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Upper: 11.2 %</td>
<td></td>
</tr>
<tr>
<td>Flammability</td>
<td>N/A</td>
<td></td>
</tr>
<tr>
<td>Autoignition Temp</td>
<td>343 °C</td>
<td></td>
</tr>
<tr>
<td>Refractive Index</td>
<td>1.399</td>
<td></td>
</tr>
<tr>
<td>Optical Rotation</td>
<td>N/A</td>
<td></td>
</tr>
<tr>
<td>Miscellaneous Data</td>
<td>N/A</td>
<td></td>
</tr>
<tr>
<td>Solubility</td>
<td>Solubility in Water:Soluble.</td>
<td></td>
</tr>
</tbody>
</table>

N/A = not available

### Section 10 - Stability and Reactivity

**STABILITY**
- Stable: Stable.
- Conditions to Avoid: Sensitive to moisture.
- Materials to Avoid: Oxidizing agents, Alkali metals, Bases, Strong acids, Halogens.

**HAZARDOUS DECOMPOSITION PRODUCTS**
- Hazardous Decomposition Products: Carbon monoxide, Carbon dioxide.

**HAZARDOUS POLYMERIZATION**
- Hazardous Polymerization: Will not occur

### Section 11 - Toxicological Information

**ROUTE OF EXPOSURE**
- Skin Contact: Causes skin irritation.
- Skin Absorption: May be harmful if absorbed through the skin.
- Eye Contact: Causes severe eye irritation.
- Inhalation: May be harmful if inhaled. Vapor or mist is irritating to the mucous membranes and upper respiratory tract.
- Ingestion: Harmful if swallowed.

**TARGET ORGAN(S) OR SYSTEM(S)**

SIGNS AND SYMPTOMS OF EXPOSURE
Can cause CNS depression. Exposure can cause: Gastrointestinal disturbances. Drying, cracking, or irritation of the skin.

TOXICITY DATA

Oral
Rat
2,500 mg/kg
LD50

Oral
Rabbit
3,400 mg/kg
LD50
4 HR.

Inhalation
Rat
8,000 ppm
LC50

Skin
Rabbit
5,300 mg/kg
LD50

Oral
Rat
790 mg/kg
LD50

Inhalation
Rat
8,000 ppm
LC50

Intraperitoneal
Rat
1122 MG/KG
LD50

Intravenous
Rat
310 MG/KG
LD50

Oral
Mouse
2680 mg/kg
LD50

Intraperitoneal
Mouse
254 MG/KG
LD50
Remarks: Liver:Other changes.

Subcutaneous
Mouse
3200 MG/KG
LD50
Intravenous
Mouse
377 MG/KG
LD50

Oral
Rabbit
3484 mg/kg
LD50

Skin
Rabbit
3400 mg/kg
LD50

Inhalation
Mammal
28,400 mg/m3
LC50

Oral
Bird (wild)
2500 mg/kg
LD50

IRRITATION DATA
Skin
Rabbit
Remarks: Mild irritation effect
Eyes
Rabbit
Remarks: Moderate irritation effect

Eyes
Human
50 ppm

Skin
Rabbit
405 mg
24H
Remarks: Moderate irritation effect

Skin
Rabbit
20 mg
24H
Remarks: Moderate irritation effect

Eyes
Rabbit
2 mg
24H
Remarks: Severe irritation effect
Remarks: Severe irritation effect

CHRONIC EXPOSURE - TERATOGEN

Species: Rat
Dose: 35295 MG/KG
Route of Application: Oral
Exposure Time: (1-15D PREG)
Result: Effects on Embryo or Fetus: Fetotoxicity (except death, e.g., stunted fetus). Effects on Newborn: Biochemical and metabolic.

Species: Rat
Dose: 23100 MG/KG
Route of Application: Oral
Exposure Time: (8W PRE/0-20D PREG)
Result: Specific Developmental Abnormalities: Craniofacial (including nose and tongue). Specific Developmental Abnormalities: Musculoskeletal system.

Species: Rat
Dose: 6000 PPM/7H
Route of Application: Inhalation
Exposure Time: (1-19D PREG)
Result: Effects on Embryo or Fetus: Fetotoxicity (except death, e.g., stunted fetus).

Species: Rat
Dose: 8000 PPM/7H
Route of Application: Inhalation
Exposure Time: (1-19D PREG)
Result: Specific Developmental Abnormalities: Musculoskeletal system.

CHRONIC EXPOSURE - MUTAGEN

Species: Hamster
Dose: 100 MMOL/L
Cell Type: lung
Mutation test: SLN

CHRONIC EXPOSURE - REPRODUCTIVE HAZARD

Species: Rat
Dose: 35295 MG/KG
Route of Application: Oral
Exposure Time: (1-15D PREG)
Result: Effects on Fertility: Female fertility index (e.g., # females pregnant per # sperm positive females; # females pregnant per # females mated ). Effects on Fertility: Pre-implantation mortality (e.g., reduction in number of implants per female; total number of implants per corpora lutea). Effects on Fertility: Post-implantation mortality (e.g., dead and/or resorbed implants per total number of implants).

Section 12 - Ecological Information

N/A

ACUTE ECOTOXICITY TESTS

Test Type: LC50 Fish
Species: Carassius auratus (Goldfish)
Time: 24 h  
Value: 1,855 mg/l  

Test Type: LC50 Fish  
Species: Pimephales promelas (Fathead minnow)  
Time: 96 h  
Value: 1,840 mg/l  

Test Type: EC50 Daphnia  
Species: Daphnia  
Time: 24 h  
Value: 1,855 mg/l  

Section 13 - Disposal Considerations  

APPROPRIATE METHOD OF DISPOSAL OF SUBSTANCE OR PREPARATION  
Contact a licensed professional waste disposal service to dispose of this material. Burn in a chemical incinerator equipped with an afterburner and scrubber but exert extra care in igniting as this material is highly flammable. Observe all federal, state, and local environmental regulations.  

Section 14 - Transport Information  

DOT  
Proper Shipping Name: Butanols  
UN#: 1120  
Class: 3  
Packing Group: Packing Group III  
Hazard Label: Flammable liquid  
PIH: Not PIH  

IATA  
Proper Shipping Name: Butanols  
IATA UN Number: 1120  
Hazard Class: 3  
Packing Group: III  

Section 15 - Regulatory Information  

EU DIRECTIVES CLASSIFICATION  
Symbol of Danger: Xn  
Indication of Danger: Harmful.  
R: 10 22 37/38 41 67  
Risk Statements: Flammable. Harmful if swallowed. Irritating to respiratory system and skin. Risk of serious damage to eyes. Vapors may cause drowsiness and dizziness.  
S: 7/9 13 26 37/39 46  
Safety Statements: Keep container tightly closed and in well-ventilated place. Keep away from food, drink, and animal feedingstuffs. In case of contact with eyes, rinse immediately with plenty of water and seek medical advice. Wear suitable gloves and eye/face protection. If swallowed, seek medical advice immediately and show this container or label.  

US CLASSIFICATION AND LABEL TEXT  
Risk Statements: Harmful if swallowed. Irritating to respiratory system and skin. Risk of serious damage to eyes. Vapors may cause drowsiness and dizziness.  
Safety Statements: Keep away from sources of ignition - no smoking. In case of contact with eyes, rinse immediately with
plenty of water and seek medical advice. Wear suitable protective clothing and eye/face protection.
US Statements: Target organ(s): Central nervous system. Ears.

UNITED STATES REGULATORY INFORMATION
SARA LISTED: Yes
DEMINIMIS: 1 %
NOTES: This product is subject to SARA section 313 reporting requirements.
TSCA INVENTORY ITEM: Yes

CANADA REGULATORY INFORMATION
WHMIS Classification: This product has been classified in accordance with the hazard criteria of the CPR, and the MSDS contains all the information required by the CPR.
DSL: Yes
NDSL: No

Section 16 - Other Information

DISCLAIMER
For R&D use only. Not for drug, household or other uses.

WARRANTY
The above information is believed to be correct but does not purport to be all inclusive and shall be used only as a guide. The information in this document is based on the present state of our knowledge and is applicable to the product with regard to appropriate safety precautions. It does not represent any guarantee of the properties of the product. Sigma-Aldrich Inc., shall not be held liable for any damage resulting from handling or from contact with the above product. See reverse side of invoice or packing slip for additional terms and conditions of sale. Copyright 2004 Sigma-Aldrich Co. License granted to make unlimited paper copies for internal use only.