1. PRODUCT AND COMPANY IDENTIFICATION

Product name: Benzene
Product number: 319593
Brand: Sigma-Aldrich
Supplier: Sigma-Aldrich
3050 Spruce Street
SAINT LOUIS MO 63103
USA
Telephone: +1 800-355-5832
Fax: +1 800-355-5052
Emergency Phone # (For both supplier and manufacturer): (314) 776-6555
Preparation Information: Sigma-Aldrich Corporation
Product Safety - Americas Region
1-800-521-4995

2. HAZARDS IDENTIFICATION

Emergency Overview
OSHA Hazards
Flammable liquids, Carcinogen, Target Organ Effect, Irritant, Mutagen

Target Organs
Blood, Eyes, Female reproductive system, Bone marrow

GHS Classification
Flammable liquids (Category 2)
Acute toxicity, Oral (Category 5)
Skin irritation (Category 2A)
Eye irritation (Category 2A)
Germ cell mutagenicity (Category 1B)
Carcinogenicity (Category 1A)
Aspiration hazard (Category 1)
Acute aquatic toxicity (Category 2)

GHS Label elements, including precautionary statements

Pictogram
Signal word: Danger

Hazard statement(s)
H225: Highly flammable liquid and vapour.
H303: May be harmful if swallowed.
H304: May be fatal if swallowed and enters airways.
H315: Causes skin irritation.
H319: Causes serious eye irritation.
H335: May cause respiratory effects.
H350: May cause cancer.
H410: Toxic to aquatic life.

3. COMPOSITION/INFORMATION ON INGREDIENTS

Formula: C₇H₈
Molecular Weight: 106.11 g/mol

Component: Benzene
Concentration: 100%

CAS-No.: 71-43-2
EC-No.: 200-753-7
Index-No.: 601-020-00-8
Registration number: 01-211947186-44-XX

4. FIRST AID MEASURES

General advice
Consult a physician. Show this safety data sheet to the doctor in attendance. Move to fresh air.

If inhaled
If breathed in, move person into fresh air. If not breathing, give artificial respiration. Consult a physician.

In case of skin contact
Wash off with soap and plenty of water. Consult a physician.

In case of eye contact
Rinse thoroughly with plenty of water for at least 15 minutes and consult a physician.

If swallowed
Do NOT induce vomiting. Never give anything by mouth to an unconscious person. Rinse mouth with water. Consult a physician.

5. FIREFIGHTING MEASURES

Conditions of flammability
Flammable in the presence of a source of ignition when the temperature is above the flash point. Keep away from heat/sparks/open flame/hot surface. No smoking.

Suitable extinguishing media
Use water spray, alcohol-resistant foam, dry chemical or carbon dioxide.

Precautionary statement(s)
P201: Obtain special instructions before use.
P210: Keep away from heat/sparks/open flames/hot surfaces. No smoking.
P301 + P310: IF SWALLOWED: Immediately call a POISON CENTER or doctor/physician.
P305 + P351 + P338: IF IN EYES: Rinse cautiously with water for several minutes. Remove contact lenses, if present and easy to do. Continue rinsing.
P306 + P313: IF exposed or concerned: Get medical advice/attention.
P331: Do NOT induce vomiting.

HMIS Classification
Health hazard: 2
Chronic Health Hazard: 3
Flammability: 1
Physical hazards: 0

NFPA Rating
Health hazard: 2
Fire: 3
Reactivity Hazard: 0

Potential Health Effects
Inhalation: May be harmful if inhaled. Causes respiratory tract irritation.
Skin: May be harmful if absorbed through skin. Causes skin irritation.
Eyes: Causes eye irritation.
Ingestion: May be harmful if swallowed. Aspiration hazard if swallowed - can enter lungs and cause damage.
Specific hazards arising from the chemical
Flash back possible over considerable distance. Container explosion may occur under fire conditions.

Special protective equipment for firefighters
Wear self-contained breathing apparatus for fire fighting if necessary.

Hazardous combustion products
Hazardous decomposition products formed under fire conditions. - Carbon oxides

Further information
Use water spray to cool unopened containers.

6. ACCIDENTAL RELEASE MEASURES

Personal precautions
Use personal protective equipment. Avoid breathing vapors, mist or gas. Ensure adequate ventilation. Keep all sources of ignition away from vapors. Evacuate personnel to safe areas. Beware of vapors accumulating to form explosive concentrations. Vapors can accumulate in low areas.

Environmental precautions
Prevent further leakage or spillage if safe to do so. Do not let product enter drains. Discharge into the environment must be avoided.

Methods and materials for containment and cleanup
Contain spillage, and then collect with an electrically protected vacuum cleaner or by wet brushing and place in a container for disposal according to local regulations (see section 13).

7. HANDLING AND STORAGE

Precautions for safe handling
Avoid contact with skin and eyes. Avoid inhalation of vapour or mist. Use explosion-proof equipment. Keep away from sources of ignition. - No smoking. Take measures to prevent the build up of electrostatic charge. - Use non-metallic tools.

Conditions for safe storage
Keep container tightly closed in a dry and well-ventilated place. Containers which are opened must be carefully resealed and kept upright to prevent leakage.

8. EXPOSURE CONTROLS/PERSONAL PROTECTION

Components with workplace control parameters

<table>
<thead>
<tr>
<th>Components</th>
<th>CAS-No.</th>
<th>Value</th>
<th>Control parameters</th>
<th>Basis</th>
</tr>
</thead>
<tbody>
<tr>
<td>Benzene</td>
<td>71-43-2</td>
<td>TWA</td>
<td>0.5 ppm</td>
<td>USA. ACGIH Threshold Limit Values (TLV)</td>
</tr>
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</tr>
</tbody>
</table>

Remarks
Leukemia Substances for which there is a Biological Exposure Index or Indices (see BEI® section)
Confirmed human carcinogens Danger of cutaneous absorption

| STEL | 2.5 ppm | USA. ACGIH Threshold Limit Values (TLV) |
|      |         |                                     |

Leukemia Substances for which there is a Biological Exposure Index or Indices (see BEI® section)
Confirmed human carcinogens Danger of cutaneous absorption

<table>
<thead>
<tr>
<th>TWA</th>
<th>10 ppm</th>
<th>USA. Occupational Exposure Limits (OSHA) - Table Z2</th>
</tr>
</thead>
<tbody>
<tr>
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| CEIL | 25 ppm | USA. Occupational Exposure Limits (OSHA) - Table Z2 |
|      |        |                                                   |

| Z37.40-1969 | Peak | 60 ppm | USA. Occupational Exposure Limits (OSHA) - Table Z2 |

| Z37.40-1969 | |

See 1910.1028. See Table Z-2 for the limits applicable in the operations and processes excluded in 1910.1028. The limit benzene standard in Z37.40-1969 applies to all occupational exposures to benzene except those subgroups of industry where exposures are consistently under the action level (i.e., distribution and sale of fuels, sealed containers, pipelines, coke production, oil and gas refining and production, natural gas processing, and the percentage exclusion for liquid mixtures); for the exception subgroups, the benzene limits in Table Z-2 apply.

<table>
<thead>
<tr>
<th>TWA</th>
<th>0.1 ppm</th>
<th>USA. NIOSH Recommended Exposure Limits</th>
</tr>
</thead>
<tbody>
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</tbody>
</table>

Potential Occupational Carcinogen See Appendix A

<table>
<thead>
<tr>
<th>ST</th>
<th>1 ppm</th>
<th>USA. NIOSH Recommended Exposure Limits</th>
</tr>
</thead>
<tbody>
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</tbody>
</table>

Potential Occupational Carcinogen See Appendix A

Personal protective equipment

Respiratory protection
Where risk assessment shows air-purifying respirators are appropriate use a full-face respirator with multi-purpose combination (US) or type ABEK (EN 14387) respirator cartridges as a backup to engineering controls. If the respirator is the sole means of protection, use a full-face supplied air respirator. Use respirators and components tested and approved under appropriate government standards such as NIOSH (US) or CE EN (EU).

Hand protection
Handle with gloves. Gloves must be inspected prior to use. Use proper glove removal technique (without touching glove's outer surface) to avoid skin contact with this product. Dispose of contaminated gloves after use in accordance with applicable laws and good laboratory practices. Wash and dry hands.

Immersion protection
Material: Fluorinated rubber
Minimum layer thickness: 0.7 mm
Break through time: > 480 min
Material tested Vtetric® (Arlon Z677698, Size M)

Splash protection
Material: Fluorinated rubber
Minimum layer thickness: 0.7 mm
Break through time: > 30 min
Material tested Vtetric® (Arlon Z677698, Size M)

Eye protection
Face shield and safety glasses. Use equipment for eye protection tested and approved under appropriate government standards such as NIOSH (US) or EN 166 (EU).

Skin and bodys protection
Complete suit protecting against chemicals, Flame retardant antistatic protective clothing. The type of protective equipment must be selected according to the concentration and amount of the dangerous substance at the specific workplace.

Hygiene measures
Handle in accordance with good industrial hygiene and safety practice. Wash hands before breaks and at the end of workday.
9. PHYSICAL AND CHEMICAL PROPERTIES

Appearance
Form liquid
Colour colourless

Safety data
pH no data available
Melting point/freezing point 5.5 °C (41.9 °F) - vit.
Boiling point 80 °C (176 °F) - vit.
Flash point -11.0 °C (12.2 °F) - closed cup
Ignition temperature 562 °C (1,044 °F)
Autoignition temperature 580.0 °C (1,043.6 °F)
Lower explosion limit 1.3 % (V)
Upper explosion limit 8 % (V)
Vapour pressure 221.3 hPa (166.0 mmHg) at 27.7 °C (81.9 °F)
99.5 hPa (73.8 mmHg) at 20.1 °C (68.2 °F)
Density 0.874 g/cm³ at 25 °C (77 °F)
Water solubility no data available
Partition coefficient: n-octanol/water no data available
Relative vapour density no data available
Odour no data available
Odour Threshold no data available
Evaporation rate no data available

10. STABILITY AND REACTIVITY

Chemical stability
Stable under recommended storage conditions.

Possibility of hazardous reactions
Vapours may form explosive mixture with air.

Conditions to avoid
Heat, flames and sparks. Extremes of temperature and direct sunlight.

Materials to avoid
Acids, Bases, Halogens, Strong oxidizing agents, Metallic salts

Hazardous decomposition products
Hazardous decomposition products formed under fire conditions. - Carbon oxides
Other decomposition products - no data available

11. TOXICOLOGICAL INFORMATION

Acute toxicity
Oral LD₅₀
LD₅₀ Oral - rat - 2,990 mg/kg
Inhalation LC₅₀
LC₅₀ Inhalation - rat - female - 4 h - 44,700 mg/m³

Dermal LD₅₀
LD₅₀ Dermal - rabbit - 8,263 mg/kg

Other information on acute toxicity
no data available

Skin corrosion/irritation
Skin - rabbit - Skin irritation

Serious eye damage/eye irritation
Eyes - rabbit - Eye irritation

Respiratory or skin sensitization
no data available

Genotoxicity
Laboratory experiments have shown mutagenic effects.
In vivo tests showed mutagenic effects
Genotoxicity in vitro - Human - lymphocyte
Sister chromatid exchange

Genotoxicity in vitro - mouse - lymphocyte
Mutation in mammalian somatic cells.
Genotoxicity in vivo - mouse - Inhalation
Sister chromatid exchange
Carcinogenicity
Carcinogenicity - Human - male - Inhalation
Tumorigenic, Carcinogenic by RTECS criteria. Leukemia 3 blood:Thrombocytopenia
Carcinogenicity - rat - Oral
Tumorigenic, Carcinogenic by RTECS criteria. Endocrine Tumors, Leukemia

This is or contains a component that has been reported to be carcinogenic based on its IARC, OSHA, ACGIH, NTP, or EPA classification.
Human carcinogen.
IARC: 1 - Group 1: Carcinogenic to humans (Benzene)
NTP: Known to be human carcinogen (Benzene)

Reproductive toxicity
Reproductive toxicity - mouse - Intraperitoneal
Effects on Fertility: Pre-implantation mortality (e.g., reduction in number of implant sites: total number of implants per corpora lutea). Effects on Embryo or Fetus: Fetal death.

Teratogenicity
Developmental toxicity - rat - Inhalation
Effects on Embryo or Fetus: Extraembryonic structures (e.g., placenta, amniotic cavity). Effects on Embryo or Fetus: Fetotoxicity (except death, e.g., slanted fetus).
Developmental Toxicity - mouse Inhalation
Effects on Embryo or Fetus: Extraembryonic structures (e.g., somatic cell necrosis). Specific Developmental Abnormalities: Blood and lymphatic system (including spleen and marrow).
Specific target organ toxicity - single exposure (Globally Harmonized System)
no data available
Specific target organ toxicity - repeated exposure (Globally Harmonized System)
no data available

Aspiration hazard
May be fatal if swallowed and enters airways.

Potential health effects
Inhalation  May be harmful if inhaled. Causes respiratory tract irritation.

Ingestion  May be harmful if swallowed. Inhalation hazard if swallowed - can enter lungs and cause damage.

Skin  May be harmful if absorbed through skin. Causes skin irritation.

Eyes  Causes eye irritation.

Signs and Symptoms of Exposure
Nausea, Dizziness, Headache, narcosis, Inhalation of high concentrations of benzene may have an initial stimulatory effect on the central nervous system characterized by exhilaration, nervousness and excitement, depression, drowsiness, or fatigue. The victim may experience tightness in the chest, breathlessness, and loss of consciousness. Tremors, convulsions, and death due to respiratory paralysis or circulatory collapse can occur in a few minutes to several hours after exposure. Aspiration of small amounts of liquid immediately causes pulmonary edema and hemorrhage of pulmonary tissue. Direct skin contact may cause irritaion. Repeated or prolonged skin contact may result in dry skin, dermatitis, or development of secondary skin infections. The chief target organ is the hematopoietic system. Bleeding from the nose, gums, or mucous membranes and the development of purpuric spots, pancytopenia, leukopenia, thrombocytopenia, aplastic anemia, and leukemia may occur as the condition progresses. The bone marrow may appear normal, aplastic or hyperplastic, and may not correlate with peripheral blood forming tissues. The onset of effects of prolonged benzene exposure may be delayed for many months or years after the actual exposure has ceased. Blood disorders

Synergistic effects
no data available

Additional Information
RTECS: CY1400000

12. ECOLOGICAL INFORMATION

Toxicity

Toxicity to fish

LC50 - Oncorhynchus mykiss (rainbow trout) - 5.69 mg/L - 96 h
LC50 - Pimephales promelas (fathead minnow) - 16.00 - 32.00 mg/L - 96 h
LC50 - Lepomis macrochir (bluegill) - 320.00 mg/L - 96 h

Toxicity to daphnia and other aquatic invertebrates

EC50 - Daphnia magna (Water flea) - 22.00 mg/L - 48 h
EC50 - Daphnia magna (Water flea) - 9.26 mg/L - 48 h

Toxicity to algae

EC50 - Pseudokirchneriella subcapitata (green algae) - 29.00 mg/L - 72 h

Persistence and degradability

Biodegradability  Result: Readily biodegradable.

Bioaccumulative potential

Bioconcentration  Leuciscus idus (Golden orle) - 3 d  Bioconcentration factor (BCF): 10

Mobility in soil

no data available

PBT and vPvB assessment

no data available

Other adverse effects

An environmental hazard cannot be excluded in the event of unprofessional handling or disposal.

Toxic to aquatic life.

13. DISPOSAL CONSIDERATIONS

Product

Burn in a chemical incinerator equipped with an afterburner and scrubber but exert extra care in igniting as this material is highly flammable. Offer surplus and non-recyclable solutions to a licensed disposal company. Contact a licensed professional waste disposal service to dispose of this material.

Contaminated packaging

Dispose of as unused product.

14. TRANSPORT INFORMATION

DOT (US)

UN number: 1114  Class: 3  Packing group: II

Proper shipping name: Benzene

Reportable Quantity (RQ): 10 lbs

Marine pollutant: No

Poison Inhalation Hazard: No

IMDG

UN number: 1114  Class: 3  Packing group: II

Proper shipping name: BENZENE

Marine pollutant: No

IATA

UN number: 1114  Class: 3  Packing group: II

Proper shipping name: Benzene

15. REGULATORY INFORMATION

OSHA Hazards
Flammable liquid, Carcinogen, Target Organ Effect, Irritant, Mutagen

SARA 302 Components
SARA 302: No chemicals in this material are subject to the reporting requirements of SARA Title III, Section 302.

SARA 313 Components
The following components are subject to reporting levels established by SARA Title III, Section 313:

CAS-No.  Benzene  Revision Date  2007-07-01

SARA 311/312 Hazards
Fire Hazard, Acute Health Hazard, Chronic Health Hazard

Massachusetts Right To Know Components

CAS-No.  Revision Date

Benzene  71-43-2  2007-07-01

Pennsylvania Right To Know Components

CAS-No.  Revision Date

Benzene  71-43-2  2007-07-01

New Jersey Right To Know Components

CAS-No.  Revision Date

Benzene  71-43-2  2007-07-01

California Prop. 65 Components
WARNING! This product contains a chemical known to the State of California to cause cancer.

CAS-No.  Revision Date

Benzene  71-43-2  2007-07-01

California Prop. 65 Components
WARNING! This product contains a chemical known to the State of California to cause birth defects or other reproductive harm.

CAS-No.  Revision Date

Benzene  71-43-2  2007-07-01