SAFETY DATA SHEET

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

1.1 Product identifiers

Product name: Toluene

Product Number: 244511
Brand: Sigma-Aldrich
Index-No.: 601-021-00-3
CAS-No.: 108-88-3

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

Identified uses: Laboratory chemicals, Synthesis of substances

1.3 Details of the supplier of the safety data sheet

Company: Sigma-Aldrich Inc.
3050 SPRUCE ST
ST. LOUIS MO  63103
UNITED STATES

Telephone: +1 314 771-5765
Fax: +1 800 325-5052

1.4 Emergency telephone

Emergency Phone #: 800-424-9300 CHEMTREC (USA) +1-703-527-3887 CHEMTREC (International) 24 Hours/day; 7 Days/week

SECTION 2: Hazards identification

2.1 Classification of the substance or mixture

GHS Classification in accordance with 29 CFR 1910 (OSHA HCS)

Flammable liquids (Category 2), H225
Skin irritation (Category 2), H315
Reproductive toxicity (Category 2), H361
Specific target organ toxicity - single exposure (Category 3), Central nervous system, H336
Specific target organ toxicity - repeated exposure (Category 2), Central nervous system, H373
Aspiration hazard (Category 1), H304
Short-term (acute) aquatic hazard (Category 2), H401
Long-term (chronic) aquatic hazard (Category 3), H412
2.2 **GHS Label elements, including precautionary statements**

<table>
<thead>
<tr>
<th>Pictogram</th>
</tr>
</thead>
<tbody>
<tr>
<td><img src="image" alt="Pictogram" /></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Signal Word</th>
<th>Danger</th>
</tr>
</thead>
</table>

**Hazard statement(s)**
- H225: Highly flammable liquid and vapor.
- H304: May be fatal if swallowed and enters airways.
- H315: Causes skin irritation.
- H336: May cause drowsiness or dizziness.
- H361: Suspected of damaging fertility or the unborn child.
- H373: May cause damage to organs (Central nervous system) through prolonged or repeated exposure.
- H401: Toxic to aquatic life.
- H412: Harmful to aquatic life with long lasting effects.

**Precautionary statement(s)**
- P201: Obtain special instructions before use.
- P202: Do not handle until all safety precautions have been read and understood.
- P210: Keep away from heat/ sparks/ open flames/ hot surfaces. No smoking.
- P233: Keep container tightly closed.
- P240: Ground/bond container and receiving equipment.
- P241: Use explosion-proof electrical/ ventilating/ lighting/ equipment.
- P242: Use only non-sparking tools.
- P243: Take precautionary measures against static discharge.
- P260: Do not breathe mist or vapors.
- P264: Wash skin thoroughly after handling.
- P271: Use only outdoors or in a well-ventilated area.
- P273: Avoid release to the environment.
- P280: Wear protective gloves/ protective clothing/ eye protection/ face protection.
- P301 + P310: IF SWALLOWED: Immediately call a POISON CENTER/ doctor.
- P303 + P361 + P353: IF ON SKIN (or hair): Take off immediately all contaminated clothing. Rinse skin with water/ shower.
- P304 + P340 + P312: IF INHALED: Remove person to fresh air and keep comfortable for breathing. Call a POISON CENTER/ doctor if you feel unwell.
- P308 + P313: IF exposed or concerned: Get medical advice/ attention.
- P331: Do NOT induce vomiting.
- P332 + P313: If skin irritation occurs: Get medical advice/ attention.
- P362: Take off contaminated clothing and wash before reuse.
- P370 + P378: In case of fire: Use dry sand, dry chemical or alcohol-resistant foam to extinguish.
- P403 + P233: Store in a well-ventilated place. Keep container tightly closed.
- P403 + P235: Store in a well-ventilated place. Keep cool.
- P405: Store locked up.
- P501: Dispose of contents/ container to an approved waste disposal plant.

2.3 **Hazards not otherwise classified (HNOC) or not covered by GHS - none**

Sigma-Aldrich - 244511
SECTION 3: Composition/information on ingredients

3.1 Substances

<table>
<thead>
<tr>
<th>Substance</th>
<th>Classification</th>
<th>Concentration</th>
</tr>
</thead>
<tbody>
<tr>
<td>Toluene</td>
<td>Flam. Liq. 2; Skin Irrit. 2; Repr. 2; STOT SE 3; STOT RE 2; Asp. Tox. 1; Aquatic Acute 2; Aquatic Chronic 3; H225, H315, H361, H336, H373, H304, H401, H412</td>
<td>&lt;= 100 %</td>
</tr>
</tbody>
</table>

For the full text of the H-Statements mentioned in this Section, see Section 16.

SECTION 4: First aid measures

4.1 Description of first-aid measures

General advice
Show this material safety data sheet to the doctor in attendance.

If inhaled
After inhalation: fresh air. Call in physician.

In case of skin contact
In case of skin contact: Take off immediately all contaminated clothing. Rinse skin with water/ shower. Consult a physician.

In case of eye contact
After eye contact: rinse out with plenty of water. Call in ophthalmologist. Remove contact lenses.

If swallowed

4.2 Most important symptoms and effects, both acute and delayed
The most important known symptoms and effects are described in the labelling (see section 2.2) and/or in section 11

4.3 Indication of any immediate medical attention and special treatment needed
No data available
SECTION 5: Firefighting measures

5.1 Extinguishing media

Suitable extinguishing media
Carbon dioxide (CO2) Foam Dry powder

Unsuitable extinguishing media
For this substance/mixture no limitations of extinguishing agents are given.

5.2 Special hazards arising from the substance or mixture
Carbon oxides
Combustible.
Pay attention to flashback.
Vapors are heavier than air and may spread along floors.
Development of hazardous combustion gases or vapours possible in the event of fire.
Forms explosive mixtures with air at ambient temperatures.

5.3 Advice for firefighters
Stay in danger area only with self-contained breathing apparatus. Prevent skin contact by keeping a safe distance or by wearing suitable protective clothing.

5.4 Further information
Remove container from danger zone and cool with water. Prevent fire extinguishing water from contaminating surface water or the ground water system.

SECTION 6: Accidental release measures

6.1 Personal precautions, protective equipment and emergency procedures
Advice for non-emergency personnel: Do not breathe vapors, aerosols. Avoid substance contact. Ensure adequate ventilation. Keep away from heat and sources of ignition. Evacuate the danger area, observe emergency procedures, consult an expert.
For personal protection see section 8.

6.2 Environmental precautions
Do not let product enter drains. Risk of explosion.

6.3 Methods and materials for containment and cleaning up
Cover drains. Collect, bind, and pump off spills. Observe possible material restrictions (see sections 7 and 10). Take up carefully with liquid-absorbent material (e.g. Chemizorb®). Dispose of properly. Clean up affected area.

6.4 Reference to other sections
For disposal see section 13.

SECTION 7: Handling and storage

7.1 Precautions for safe handling

Advice on safe handling
Work under hood. Do not inhale substance/mixture. Avoid generation of vapours/aerosols.

Advice on protection against fire and explosion
Keep away from open flames, hot surfaces and sources of ignition. Take precautionary measures against static discharge.

**Hygiene measures**
Immediately change contaminated clothing. Apply preventive skin protection. Wash hands and face after working with substance.
For precautions see section 2.2.

### 7.2 Conditions for safe storage, including any incompatibilities

**Storage conditions**
Keep container tightly closed in a dry and well-ventilated place. Keep away from heat and sources of ignition.
Handle and store under inert gas.

**Storage class**
Storage class (TRGS 510): 3: Flammable liquids

### 7.3 Specific end use(s)
Apart from the uses mentioned in section 1.2 no other specific uses are stipulated

### SECTION 8: Exposure controls/personal protection

#### 8.1 Control parameters

<table>
<thead>
<tr>
<th>Ingredients with workplace control parameters</th>
</tr>
</thead>
<tbody>
<tr>
<td>Component</td>
</tr>
<tr>
<td>-----------</td>
</tr>
<tr>
<td>Toluene</td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td>Remarks</td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td></td>
</tr>
</tbody>
</table>
### USA. NIOSH Recommended Exposure Limits

<table>
<thead>
<tr>
<th>Parameters</th>
<th>Value</th>
<th>USA. NIOSH Recommended Exposure Limits</th>
</tr>
</thead>
<tbody>
<tr>
<td>TWA</td>
<td>100 ppm</td>
<td>375 mg/m³</td>
</tr>
<tr>
<td>ST</td>
<td>150 ppm</td>
<td>560 mg/m³</td>
</tr>
</tbody>
</table>

### Biological occupational exposure limits

<table>
<thead>
<tr>
<th>Component</th>
<th>CAS-No.</th>
<th>Parameters</th>
<th>Value</th>
<th>Biological specimen</th>
<th>Basis</th>
</tr>
</thead>
<tbody>
<tr>
<td>Toluene</td>
<td>108-88-3</td>
<td>Toluene</td>
<td>0.02 mg/l</td>
<td>In blood</td>
<td>ACGIH - Biological Exposure Indices (BEI)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Remarks</td>
<td></td>
<td></td>
<td>Prior to last shift of workweek</td>
</tr>
<tr>
<td>Toluene</td>
<td>108-88-3</td>
<td>Toluene</td>
<td>0.03 mg/l</td>
<td>Urine</td>
<td>ACGIH - Biological Exposure Indices (BEI)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>End of shift (As soon as possible after exposure ceases)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>o-Cresol</td>
<td></td>
<td>0.3 mg/g creatinin</td>
<td></td>
<td>Urine</td>
<td>ACGIH - Biological Exposure Indices (BEI)</td>
</tr>
</tbody>
</table>

### Derived No Effect Level (DNEL)

<table>
<thead>
<tr>
<th>Application Area</th>
<th>Routes of exposure</th>
<th>Health effect</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Workers</td>
<td>Inhalation</td>
<td>Acute systemic effects</td>
<td>384 mg/m³</td>
</tr>
<tr>
<td>Workers</td>
<td>Inhalation</td>
<td>Acute local effects</td>
<td>384 mg/m³</td>
</tr>
<tr>
<td>Workers</td>
<td>Skin contact</td>
<td>Long-term systemic effects</td>
<td>384 mg/kg BW/d</td>
</tr>
<tr>
<td>Workers</td>
<td>Inhalation</td>
<td>Long-term systemic effects</td>
<td>192 mg/m³</td>
</tr>
<tr>
<td>Workers</td>
<td>Inhalation</td>
<td>Long-term local effects</td>
<td>192 mg/m³</td>
</tr>
<tr>
<td>Consumers</td>
<td>Inhalation</td>
<td>Acute systemic effects</td>
<td>226 mg/m³</td>
</tr>
<tr>
<td>Consumers</td>
<td>Inhalation</td>
<td>Acute local effects</td>
<td>226 mg/m³</td>
</tr>
<tr>
<td>Consumers</td>
<td>Skin contact</td>
<td>Long-term systemic effects</td>
<td>226 mg/kg BW/d</td>
</tr>
<tr>
<td>Consumers</td>
<td>Inhalation</td>
<td>Long-term systemic effects</td>
<td>56.5 mg/m³</td>
</tr>
<tr>
<td>Consumers</td>
<td>Ingestion</td>
<td>Long-term systemic effects</td>
<td>8.13 mg/kg BW/d</td>
</tr>
</tbody>
</table>

### Predicted No Effect Concentration (PNEC)

<table>
<thead>
<tr>
<th>Compartment</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Soil</td>
<td>2.89 mg/kg</td>
</tr>
<tr>
<td>Sea water</td>
<td>0.68 mg/l</td>
</tr>
<tr>
<td>Fresh water</td>
<td>0.68 mg/l</td>
</tr>
<tr>
<td>Sea sediment</td>
<td>16.39 mg/kg</td>
</tr>
<tr>
<td>Fresh water sediment</td>
<td>16.39 mg/kg</td>
</tr>
<tr>
<td>Sewage treatment plant</td>
<td>13.61 mg/l</td>
</tr>
<tr>
<td>Aquatic intermittent release</td>
<td>0.68 mg/l</td>
</tr>
</tbody>
</table>
8.2 Exposure controls

**Appropriate engineering controls**
Immediately change contaminated clothing. Apply preventive skin protection. Wash hands and face after working with substance.

**Personal protective equipment**

**Eye/face protection**
Use equipment for eye protection tested and approved under appropriate government standards such as NIOSH (US) or EN 166(EU). Safety glasses

**Skin protection**
This recommendation applies only to the product stated in the safety data sheet, supplied by us and for the designated use. When dissolving in or mixing with other substances and under conditions deviating from those stated in EN 16523-1 please contact the supplier of CE-approved gloves (e.g. KCL GmbH, D-36124 Eichenzell, Internet: www.kcl.de).
Full contact
Material: Viton®
Minimum layer thickness: 0.7 mm
Break through time: 480 min
Material tested: Vitoject® (KCL 890 / Aldrich Z677698, Size M)

This recommendation applies only to the product stated in the safety data sheet, supplied by us and for the designated use. When dissolving in or mixing with other substances and under conditions deviating from those stated in EN 16523-1 please contact the supplier of CE-approved gloves (e.g. KCL GmbH, D-36124 Eichenzell, Internet: www.kcl.de).
Splash contact
Material: Viton®
Minimum layer thickness: 0.7 mm
Break through time: 480 min
Material tested: Vitoject® (KCL 890 / Aldrich Z677698, Size M)

**Body Protection**
Flame retardant antistatic protective clothing.

**Respiratory protection**
Recommended Filter type: Filter A (acc. to DIN 3181) for vapours of organic compounds
The entrepreneur has to ensure that maintenance, cleaning and testing of respiratory protective devices are carried out according to the instructions of the producer. These measures have to be properly documented.

required when vapours/aerosols are generated. Our recommendations on filtering respiratory protection are based on the following standards: DIN EN 143, DIN 14387 and other accompanying standards relating to the used respiratory protection system.

**Control of environmental exposure**
Do not let product enter drains. Risk of explosion.
SECTION 9: Physical and chemical properties

9.1 Information on basic physical and chemical properties

a) Appearance
   Form: liquid

b) Odor
   benzene-like

c) Odor Threshold
   0.2 ppm

d) pH
   Not applicable

e) Melting point/freezing point
   Melting point/range: -93 °C (-135 °F)

f) Initial boiling point and boiling range
   110 - 111 °C 230 - 232 °F

g) Flash point
   4.4 °C (39.9 °F) - closed cup

h) Evaporation rate
   No data available

i) Flammability (solid, gas)
   No data available

j) Upper/lower flammability or explosive limits
   Upper explosion limit: 7.1 %(V)
   Lower explosion limit: 1.2 %(V)

k) Vapor pressure
   30.88 hPa at 21.1 °C (70.0 °F)

l) Vapor density
   3.18

m) Density
   0.865 g/mL at 25 °C (77 °F)
   Relative density
   0.8720 °C

n) Water solubility
   0.58 g/l at 25 °C (77 °F) - partly soluble

o) Partition coefficient: n-octanol/water
   log Pow: 2.73 at 20 °C (68 °F) - Bioaccumulation is not expected.

p) Autoignition temperature
   535.0 °C (995.0 °F)

q) Decomposition temperature
   No data available

r) Viscosity
   No data available

s) Explosive properties
   No data available

t) Oxidizing properties
   none

9.2 Other safety information

   Conductivity
   < 0.01 μS/cm

   Surface tension
   27.73 mN/m at 0.516g/l at 25 °C (77 °F)

   Relative vapor density
   3.18
SECTION 10: Stability and reactivity

10.1 Reactivity
Vapors may form explosive mixture with air.

10.2 Chemical stability
The product is chemically stable under standard ambient conditions (room temperature).

10.3 Possibility of hazardous reactions
Risk of explosion with:
- fuming sulfuric acid
- Nitric acid
- silver
- perchlorates
- nitrogen dioxide
- nonmetallic halides
- halogen-halogen compounds
- uranium hexafluoride
- organic nitro compounds
Violent reactions possible with:
- Strong acids
- Strong oxidizing agents
- sulfur
- with
Heat.

10.4 Conditions to avoid
Warming.

10.5 Incompatible materials
rubber, various plastics

10.6 Hazardous decomposition products
In the event of fire: see section 5

SECTION 11: Toxicological information

11.1 Information on toxicological effects

Acute toxicity
- LD50 Oral - Rat - male - 5,580 mg/kg
  (Tested according to Directive 92/69/EEC.)
- LC50 Inhalation - Rat - male and female - 4 h - 25.7 mg/l - vapor
  (OECD Test Guideline 403)
- LD50 Dermal - Rabbit - > 5,000 mg/kg
Remarks: (ECHA)
No data available
Skin corrosion/irritation
Skin - Rabbit
Result: irritating - 4 h
Remarks: (ECHA)

Serious eye damage/eye irritation
Eyes - Rabbit
Result: slight irritation
(OECD Test Guideline 405)

Respiratory or skin sensitization
Maximization Test - Guinea pig
Result: negative

Germ cell mutagenicity
Test Type: In vitro mammalian cell gene mutation test
Test system: Mouse lymphoma test
Metabolic activation: with and without metabolic activation
Method: OECD Test Guideline 476
Result: negative
Test Type: Ames test
Test system: S. typhimurium
Metabolic activation: with and without metabolic activation
Method: Mutagenicity (Salmonella typhimurium - reverse mutation assay)
Result: negative

Test Type: Chromosome aberration test
Species: Rat
Cell type: Bone marrow
Application Route: i.p.
Result: negative
Remarks: (ECHA)

Carcinogenicity
No data available
IARC: No ingredient of this product present at levels greater than or equal to 0.1% is identified as probable, possible or confirmed human carcinogen by IARC.
NTP: No ingredient of this product present at levels greater than or equal to 0.1% is identified as a known or anticipated carcinogen by NTP.
OSHA: No component of this product present at levels greater than or equal to 0.1% is on OSHA’s list of regulated carcinogens.

Reproductive toxicity
Suspected of damaging the unborn child.

Specific target organ toxicity - single exposure
May cause drowsiness or dizziness. - Central nervous system

Specific target organ toxicity - repeated exposure
May cause damage to organs through prolonged or repeated exposure.
- Central nervous system
**Aspiration hazard**
Aspiration hazard, Aspiration may cause pulmonary edema and pneumonitis.

### 11.2 Additional Information

RTECS: XS5250000
Drowsiness, irritant effects, Dizziness, Convulsions, Headache, Nausea, Vomiting, Circulatory collapse, somnolence, inebriation, Unconsciousness, respiratory arrest, CNS disorders, respiratory paralysis, death
To the best of our knowledge, the chemical, physical, and toxicological properties have not been thoroughly investigated.
Stomach - Irregularities - Based on Human Evidence

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**SECTION 12: Ecological information**

### 12.1 Toxicity

**Toxicity to fish**
flow-through test LC50 - Oncorhynchus kisutch (coho salmon) - 5.5 mg/l - 96 h
Remarks: (ECHA)

**Toxicity to daphnia and other aquatic invertebrates**
EC50 - Ceriodaphnia dubia (water flea) - 3.78 mg/l - 48 h (US-EPA)

**Toxicity to bacteria**
static test EC50 - Bacteria - 84 mg/l - 24 h
Remarks: (ECHA)

**Toxicity to fish (Chronic toxicity)**
flow-through test NOEC - Oncorhynchus kisutch (coho salmon) - 1.39 mg/l - 40 d
Remarks: (ECHA)

**Toxicity to daphnia and other aquatic invertebrates (Chronic toxicity)**
NOEC - Ceriodaphnia dubia (water flea) - 0.74 mg/l - 7 d (US-EPA)

### 12.2 Persistence and degradability

**Biodegradability**
aerobic - Exposure time 20 d
Result: 86 % - Readily biodegradable.
Remarks: (IUCLID)

### 12.3 Bioaccumulative potential

**Bioaccumulation**
Leuciscus idus (Golden orfe) - 3 d
- 0.05 mg/l(Toluene)

Bioconcentration factor (BCF): 90

### 12.4 Mobility in soil

No data available
12.5 **Results of PBT and vPvB assessment**
PBT/vPvB assessment not available as chemical safety assessment not required/not conducted

12.6 **Endocrine disrupting properties**
No data available

12.7 **Other adverse effects**
No data available

**SECTION 13: Disposal considerations**

13.1 **Waste treatment methods**

**Product**
Waste material must be disposed of in accordance with the national and local regulations. Leave chemicals in original containers. No mixing with other waste. Handle uncleaned containers like the product itself.

**SECTION 14: Transport information**

**DOT (US)**
- UN number: 1294  
- Class: 3  
- Toluene  
- Reportable Quantity (RQ): 1000 lbs  
- Poison Inhalation Hazard: No  
- Packing group: II

**IMDG**
- UN number: 1294  
- Class: 3  
- ToLUENE  
- Packing group: II  
- EMS-No: F-E, S-D

**IATA**
- UN number: 1294  
- Class: 3  
- Toluene  
- Packing group: II

**SECTION 15: Regulatory information**

**SARA 302 Components**
This material does not contain any components with a section 302 EHS TPQ.

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

<table>
<thead>
<tr>
<th>Component</th>
<th>CAS-No.</th>
<th>Revision Date</th>
</tr>
</thead>
<tbody>
<tr>
<td>Toluene</td>
<td>108-88-3</td>
<td>2007-07-01</td>
</tr>
</tbody>
</table>

**SARA 311/312 Hazards**
Fire Hazard, Acute Health Hazard, Chronic Health Hazard
Massachusetts Right To Know Components

<table>
<thead>
<tr>
<th>Component</th>
<th>CAS-No.</th>
<th>Revision Date</th>
</tr>
</thead>
<tbody>
<tr>
<td>Toluene</td>
<td>108-88-3</td>
<td>2007-07-01</td>
</tr>
</tbody>
</table>

Pennsylvania Right To Know Components

<table>
<thead>
<tr>
<th>Component</th>
<th>CAS-No.</th>
<th>Revision Date</th>
</tr>
</thead>
<tbody>
<tr>
<td>Toluene</td>
<td>108-88-3</td>
<td>2007-07-01</td>
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</tbody>
</table>

California Prop. 65 Components

<table>
<thead>
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<th>CAS-No.</th>
<th>Revision Date</th>
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</thead>
<tbody>
<tr>
<td>Toluene</td>
<td>108-88-3</td>
<td>2009-02-01</td>
</tr>
</tbody>
</table>

, which is/are known to the State of California to cause birth defects or other reproductive harm. For more information go to www.P65Warnings.ca.gov.Toluene

SECTION 16: Other information

Further information

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 Corporation and its Affiliates shall not be held liable for any damage resulting from handling or from contact with the above product. See www.sigma-aldrich.com and/or the reverse side of invoice or packing slip for additional terms and conditions of sale.

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Version: 6.21 Revision Date: 08/23/2023 Print Date: 10/21/2023