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, Inhalation (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>
</table>

**Signal Word**  
Danger

**Hazard Statements**
- **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 if inhaled.
- **H401**: Toxic to aquatic life.
- **H412**: Harmful to aquatic life with long lasting effects.

**Precautionary Statements**
- **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

SECTION 3: Composition/information on ingredients

3.1 Substances

<table>
<thead>
<tr>
<th>Component</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
Foam Carbon dioxide (CO2) 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

Ingredients with workplace control parameters

<table>
<thead>
<tr>
<th>Component</th>
<th>CAS-No.</th>
<th>Value</th>
<th>Control parameters</th>
<th>Basis</th>
</tr>
</thead>
<tbody>
<tr>
<td>Toluene</td>
<td>108-88-3</td>
<td>TWA</td>
<td>100 ppm 375 mg/m$^3$</td>
<td>USA. Table Z-1-A Limits for Air Contaminants (1989 vacated values)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>STEL</td>
<td>150 ppm 560 mg/m$^3$</td>
<td>USA. Table Z-1-A Limits for Air Contaminants (1989 vacated values)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>TWA</td>
<td>200 ppm</td>
<td>USA. Occupational Exposure Limits (OSHA) - Table Z-2</td>
</tr>
<tr>
<td>Remarks</td>
<td>Z37.12-1967</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CEIL</td>
<td></td>
<td>300 ppm</td>
<td></td>
<td>USA. Occupational Exposure Limits (OSHA) - Table Z-2</td>
</tr>
<tr>
<td>Peak</td>
<td></td>
<td>500 ppm</td>
<td></td>
<td>USA. Occupational Exposure Limits (OSHA) - Table Z-2</td>
</tr>
</tbody>
</table>

Sigma-Aldrich - 244511

The life science business of Merck KGaA, Darmstadt, Germany operates as MilliporeSigma in the US and Canada
<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></td>
<td></td>
<td></td>
<td>Remarks: Prior to last shift of workweek</td>
</tr>
<tr>
<td></td>
<td></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>o-Cresol</td>
<td>0.3 mg/g creatinine</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>Substance</td>
<td>Concentration</td>
</tr>
<tr>
<td>----------------------------</td>
<td>---------------</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.
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 No data available
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 No data available
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 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
No data available

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
LC50 Inhalation - Rat - male - 4 h - 25.7 mg/l - vapor
LD50 Dermal - Rabbit - male - > 5,000 mg/kg
Remarks: (ECHA)

**Skin corrosion/irritation**
Skin - Rabbit
Result: irritant - 4 h

**Serious eye damage/eye irritation**
Eyes - Rabbit
Result: No eye 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
Result: negative

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

**Carcinogenicity**
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**
Inhalation - May cause drowsiness or dizziness. - Central nervous system
Remarks: Classified according to Regulation (EU) 1272/2008, Annex VI (Table 3.1/3.2)
Specific target organ toxicity - repeated exposure
Inhalation - May cause damage to organs through prolonged or repeated exposure.
- Central nervous system
Remarks: Classified according to Regulation (EU) 1272/2008, Annex VI (Table 3.1/3.2)

Aspiration hazard
Aspiration may cause pulmonary edema and pneumonitis.

11.2 Additional Information
Repeated dose toxicity - Rat - male and female - Oral - 13 Weeks - NOAEL (No observed adverse effect level) - 625 mg/kg - LOAEL (Lowest observed adverse effect level) - 1,250 mg/kg
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

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
- Packing group: II
- Proper shipping name: Toluene
- Reportable Quantity (RQ): 1000 lbs
- Poison Inhalation Hazard: No

**IMDG**
- UN number: 1294
- Class: 3
- Packing group: II
- EMS-No: F-E, S-D
- Proper shipping name: TOLUENE

**IATA**
- UN number: 1294
- Class: 3
- Packing group: II
- Proper shipping name: Toluene
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>
</tr>
</tbody>
</table>

**California Prop. 65 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>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 information is believed to be correct but is not exhaustive and will be used solely as a guideline, which is based on current knowledge of the chemical substance or mixture and is applicable to appropriate safety precautions for the product. 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. Copyright 2020 Sigma-Aldrich Co. LLC. License granted to make unlimited paper copies for internal use only.

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Version: 6.22   Revision Date: 01/10/2024   Print Date: 01/10/2024