



TotalEnergies Petrochemicals & Refining USA, Inc.

Product Summary: Toluene

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Product Overview

Toluene is a clear, colorless, flammable liquid with a scent similar to paint thinner. It is an aromatic hydrocarbon, and it occurs both naturally and due to human activity. Naturally occurring toluene was first isolated from a perfume-like aromatic resin, tolu balsam, produced by the tolu tree. Toluene is also a naturally occurring constituent of crude oil. Man-made toluene may be a manufactured product, or it may be recovered for use as a by-product of processes in the steel and petroleum industries.

Chemical Identity

Trade Name: Toluene

Also known as: methylbenzene, methylbenzol, phenylmethane and toluol

CAS¹ Registry Number: 108-88-3

Uses

Toluene plays a role in the creation of many valuable consumer products. Non-isolated (unpurified) toluene is added to gasoline to improve combustion and reduce engine “knock”. Most isolated (purified) toluene is used as a starting material to produce common products such as plastics, while a smaller percentage is used as a solvent. Toluene is also a raw material for the manufacture of chemical intermediate substances.

Benefits of Products Manufactured from Toluene

Products manufactured using toluene add convenience and quality to daily life. Some typical products that may contain toluene include:

- Gasoline
- Carburetor cleaner
- Some paints and paint thinner
- Solvent for some types of coatings
- Some adhesives (rubber cement, airplane glue)

Physical/chemical properties

Specific Gravity: 0.867 (Water = 1) at 20°C

Appearance: colorless liquid

Boiling Point: 110.6°C (231°F)

Flash Point: closed cup: 4.4°C (40°F) (Tagliabue), open cup: 4°C (39.2°F).

Autoignition Temperature: 480°C (896°F)

¹ CAS Registry Number is a Registered Trademark of the American Chemical Society.

Vapor Pressure: 28.4 mm of Hg (@ 25°C)
Solubility in water: 5.1 mg/100 mL at 20°C
Odor Threshold: 2.5 ppm (9.6 mg/m³)

Physical Hazards

Toluene is classified as a flammable liquid (GHS Flammable Liquid – Category 2) based on OSHA Hazard Communication regulations (29 CFR 1910.1200) and by the United States Department of Transportation (DOT). Toluene vapors are heavier than air, and travel across the ground. When released as a liquid, it will float on water. Care must be taken to prevent ignition of these vapors, even at normal working temperatures.

Health Effects

Short (also called acute) exposures to extremely high levels of toluene in air can result in death. The National Institute for Occupational Safety and Health (NIOSH) lists the “Immediately Dangerous to Life or Health” (IDLH) concentration for toluene as 500 ppm.² Intentional misuse involving prolonged inhalation exposure to high concentrations of toluene vapor can result in death.

Exposure to lower, but still high, levels of toluene in air can cause central nervous system (CNS) effects such as headache, dizziness, fatigue, muscular weakness, drowsiness, disorientation, and in extreme cases, unconsciousness. People may recover from these effects quickly when they breathe fresh air. Exposure to toluene vapors may also cause irritation to the eyes and respiratory system. Ingestion of toluene causes the same CNS effects seen with inhalation and may be fatal. When toluene is swallowed or vomited, it may enter the lungs (aspiration), causing damage and possible pneumonia. Skin contact with toluene may cause irritation such as redness, itching, or blistering.

Acute Toxicity Values for toluene are provided in the table below.

Acute Toxicity Values for Toluene

LD50 oral (rat)	LD50 dermal (rabbit)	LC50 inhalation (rat)
> 5000 mg/kg ³	> 5000 mg/kg ⁴	> 28 - 49 mg/L ⁵

Long-term (also called chronic) exposure involving intentional misuse by repeated and prolonged inhalation to high concentrations of toluene vapors can result in CNS damage and eventually death. Birth defects and fertility problems have been reported following intentional misuse and exposure to very high levels of toluene.

Long-term exposure to lower levels may cause CNS effects, irritation to the eyes and upper respiratory system, and hearing loss. Color vision changes may occur with long term exposure to toluene. Prolonged or repeated skin contact can remove the natural oils (defat) in the skin and lead to irritation, cracking and/or dermatitis.

² <https://www.cdc.gov/niosh/idlh/108883.html>

³ **LD50 (oral, rat) = 5580 mg/kg** Toxicology 4, 5-15, 1975, Withey and Hall, The joint toxic action of perchloroethylene with benzene or toluene in rats; **LD50 (oral, rat) > 5000 mg/kg** Toxicology and Applied Pharmacology, 19, 699-704, 1971, Kimura, Ebert & Dodge, Acute toxicity and limits of solvent residue for sixteen organic solvents

⁴ AIHAAP American Industrial Hygiene Association Journal. (AIHA, 475 Wolf Ledges Pkwy., Akron, OH 44311) V.19-1958- Volume(issue)/page/year: 30,470,1969

⁵ **LC50 (inhalation, rat) = 28.1 mg/L** ECHA - unpublished report (in German) Year1980; **LC50 (inhalation, rat) = 49 mg/L** Gigiena Truda i Professional'nye Zabolevaniya. Labor Hygiene and Occupational Diseases. (V/O Mezhdunarodnaya Kniga, 113095 Moscow, USSR) V.1-36, 1957-1992. Exposure detail: 4 hours

Toluene may rapidly enter the bloodstream after breathing toluene vapors, eating or drinking materials contaminated with toluene, or getting toluene on your skin. Once in the bloodstream, it travels throughout the body. Toluene may leave the body in the air breathed out, or in urine. It may be released unchanged or be converted into other less harmful chemicals. In general, after a short term or acute exposure more than 75% of the toluene is removed from the body within 12 hours. Many factors such as age, sex, body composition, and health status may affect what happens to toluene once it enters your body. Pre-existing disorders involving the kidneys, liver, heart, respiratory tract, skin, eyes, CNS, blood, lungs, and brain may be aggravated by exposure to high levels of toluene.

Many governmental and non-governmental agencies rate the cancer-causing potential (carcinogenicity) of select chemicals. Some results for toluene include:

Agency	Carcinogenicity of Toluene
International Agency for Research on Cancer (IARC)	Classified as 3 (not classifiable as to its carcinogenicity to humans)
National Toxicity Program (NTP)	Not a known carcinogen
American Conference of Governmental Industrial Hygienists (ACGIH)	Classified A4 (not classifiable as a human carcinogen)
Occupational Safety and Health Administration (OSHA)	Not a known carcinogen

Increased rates of spontaneous abortion have been reported in several studies related to toluene exposure.

Toluene is available in several grades based on its degree of purity, and may contain small amounts of ethylbenzene, xylene, and/or benzene as impurities. These impurities possess their own unique human health and environmental effects, and they may have different exposure limits than purified toluene. Ethylbenzene is classified as a possible human carcinogen (2B) by IARC and as an animal carcinogen (A3) by ACGIH. Benzene is a known human carcinogen.

The GHS health hazard classifications based on OSHA Hazard Communication regulations (29 CFR 1910.1200)⁶ for toluene are provided in the table below. GHS classification for different grades of toluene can vary depending on the purity of the toluene. A toluene product which contains 0.1% benzene or more may have a GHS Carcinogenic Classification of 1 (“May cause cancer.”). Grades of toluene which contain less than 0.1% of benzene and of ethylbenzene generally are not GHS classified for carcinogenicity. For additional information including GHS hazard statements, precautionary statements, and information on specific target organ toxicity (STOT), the safety data sheet for the specific product should be consulted.

OSHA GHS Health Hazard Classifications	Toluene (Benzene ≥ 0.1%, Ethylbenzene ≥ 0.1 %)
Skin corrosion/irritation	Cat. 2
Serious eye damage/eye irritation	Cat. 2A
Germ cell mutagenicity	1B [†]

⁶ OSHA does not provide GHS hazard classifications for a chemical or a substance. OSHA places the responsibility of GHS hazard classification upon the manufacturers (or importers) of the chemical (see 21 CFR 1910.1200(d)). Therefore, GHS hazard classification in the United States may differ from manufacturer (or importer) to manufacturer (or importer). Additionally, these GHS hazard classifications may differ from other internationally established GHS classifications, such as those in the Europe Union or Japan. The provided GHS classifications are current as of the date of this document. However, the GHS classifications are subject to change as new information is obtained. The user should always refer to the most recent product SDS to confirm the GHS classifications.

Carcinogenicity	Cat 1A†
Reproductive toxicity	Cat. 2
STOT (Single Exposure) – Respiratory irritation	Cat. 3
STOT (Single Exposure) – Narcotic effects	Cat. 3
STOT (Repeated Exposure)	Cat. 1
Aspiration Hazard	Cat. 1

† Classification based on benzene content

Potential for Exposure

Environmental Exposure

While toluene is harmful or toxic to many aquatic organisms, it is not expected to accumulate in the food chain. Toluene has very low solubility in water and, if released as a liquid, most will rapidly evaporate from the water and soil surface to the air. Toluene will degrade naturally at different rates in the environment depending on the conditions to which it is exposed. The federal government has set limits for the allowable amount of toluene in water through the EPA's Clean Water Act.

Industrial Worker Exposure

The risk of occupational exposure to toluene is generally highest among workers employed where toluene is used as a solvent. Toluene is a recognized toxic substance with established limits, or standards, for workplace exposure. In the U.S., OSHA regulates the exposure to toluene. Ventilation must be provided for industrial workers in order to keep exposure levels below established standards. If inhalation above established standards is possible, an appropriate respirator must be worn. Additionally, workers are required to wear splash goggles, safety glasses, fire retardant clothing covering the entire body, and chemical resistant gloves, as appropriate for the work being done.

Consumer/General Public Exposure

Toluene may be released to the environment during the production, transport, storage, and use of gasoline or other industrial and consumer products containing toluene. The largest potential source of toluene released to the environment is gasoline, which typically contains 5-7% toluene by weight. Of less significance are natural sources of toluene, which include gases released from volcanoes and forest fires, and crude oil and natural gas deposits. While toluene is emitted to the environment by various activities including industrial and natural sources in the U.S., it is generally found in low concentrations in the environment due to natural degradation.

Exposure to toluene to the public occurs primarily through breathing contaminated air; intake from food and water contributes a much smaller amount. Automobile emissions are the main source of toluene in air. Therefore, air levels are generally higher in suburban and urban areas than in rural areas. Because most people spend a large portion of their day inside, indoor air may be a significant source of toluene exposure. Indoor exposure varies depending on the presence of toluene-containing paints, thinners, adhesives, and cigarette smoke.

Storing and Transporting Toluene

Bulk quantities of toluene should be stored in tanks equipped with floating roofs to reduce emissions. Storage containers for toluene should be made of steel. Storage tanks should be engineered to prevent contact with water resources, as this material could contaminate the water resources. Surface spills can reach groundwater through porous soil or cracked surfaces. The storage tanks should be monitored regularly for leaks. Facilities which store these products should have a comprehensive response plan for spills or leaks. Small containers may be made of glass. Plastic storage containers should not be used.

Toluene is transported mainly by sea or inland waterway and is subject to a number of international guidelines for safe handling of cargoes. These include the International Maritime Dangerous Goods (IMDG) from the International Maritime Organization (IMO), the International Safety Guidelines for Oil Tankers and Terminals (ISGOTT) and the ADNR (Accord europeen relatif au transport international des marchandises Dangereuses par voie de Navigation interieure au Rhine) regulations. In the US, marine transport must comply with the US Coast Guard regulations. Toluene may also be transported commercially by rail, truck, and pipeline, which are regulated by the DOT in the US.

Static charges can accumulate during shipping, unloading, pouring, or transferring operations. To avoid fire or explosion, dissipate static electricity during transfer by grounding and bonding containers and equipment before transferring material.

Pesticide Applications

TotalEnergies Petrochemicals & Refining USA, Inc. does not market toluene for use in the formulation of pesticide products.

Product Stewardship Contact Information:

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Additional Information

TotalEnergies Petrochemicals & Refining USA, Inc. Material Safety Data Sheets for Toluene
<https://corporate.totalenergies.us/product-stewardship>

Agency for Toxic Substances and Disease Registry (ATSDR) summary for toluene
<https://wwwn.cdc.gov/TSP/ToxProfiles/ToxProfiles.aspx?id=161&tid=29>

Environmental Protection Agency (EPA). 2005. Toxicological Review of Toluene (CAS No. 108-88-3) In Support of Summary Information on the Integrated Risk Information System (IRIS). Washington D.C.: U.S. Environmental Protection Agency.
Available at https://cfpub.epa.gov/ncea/iris2/chemicalLanding.cfm?substance_nmbr=118

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