

Material Safety Data for: Tetrahydrofuran

1. PRODUCT IDENTIFICATION

Name	1,4-epoxybutane
Synonyms	diethylene oxide, tetramethylene oxide, butylene oxide, cyclotetramethylene oxide
CAS#	109-99-9
Europe EC#	203-726-8
Product Uses	solvent for resins, coatings, inks, adhesives; reagent, and other uses

2. INGREDIENTS

	%	TWAEV / TLV ppm / mg/m ³	LD ₅₀ ORAL	(mg/kg) SKIN	LC ₅₀ ppm INHALATION
1,4-epoxybutane	100%	200 / 590	1650	not known	18,200

3. (a) HAZARDS SUMMARY

Hazards, Quick Guide: flammable liquid, heavy vapour may travel, distant ignition and flashback are possible; may form explosive peroxides; static accumulator; irritating to skin and eyes; central nervous depressant; absorbed through the skin

Canada – WHMIS

Key:

B 2, D 2B

B 2 – Flash Point <38°C, B 3 – Flash Point >38°C & <93°C

D 1 – Immediately Toxic, D 2 – Chronic Toxicity

C – Oxidising Substance, E – Corrosive

U.S.A. – HMIS

Key:

Health – 2, Fire – 3, Reactivity – 0

0=minimal, 1=slight, 2=moderate, 3=serious, 4=severe

3. (b) HAZARDS – TOXICITY

Effects, Acute Exposure

Skin Contact	little to no effect on most people, although it appears to irritate skin in rabbits
Skin Absorption	yes; low toxicity suggests that no toxic effects are likely by this route
Eye Contact	may be severely irritating
Inhalation	anaesthetic affecting breathing and blood pressure at 25,000ppm & loss of consciousness
Ingestion	not known – not a route of industrial exposure

Effects, Chronic Exposure

General	prolonged exposure may cause drying leading to dermatitis
Sensitising	not a sensitiser in humans or animals
Carcinogen/Tumorigen	not considered a tumorigen or carcinogen in humans; ACGIH – animal carcinogen, A 3
Reproductive Effect	no known effect in humans or animals
Mutagen	no known effect on humans or animals
Synergistic With	not known
LD ₅₀ (oral)	1650 & 2050mg/kg (rat), 2300mg/kg (guinea pig)
LD ₅₀ (skin)	not known
LC ₅₀ (inhalation)	18,200 & 24,800ppm (rat)

Please ensure that this MSDS is given to, and explained to people using this product.

(Tetrahydrofuran, cont'd)

4. FIRST AID

- SKIN: Wash with plenty of water. Remove contaminated clothing and do not reuse until thoroughly laundered.
 EYES: Wash eyes with plenty of water, holding eyelids open. Seek medical assistance promptly if there is irritation.
 INHALATION: Remove from contaminated area promptly. **CAUTION: Rescuer must not endanger himself!** If breathing stops, administer artificial respiration and seek medical aid promptly.
 INGESTION: Give plenty of water to dilute product. Do not induce vomiting (NOTE below). Keep victim quiet. If vomiting occurs, lower victim's head below hips to prevent inhalation of vomited material. Seek medical help promptly.

Inadvertent inhalation of vomited material may seriously damage the lungs. The danger of this is greater than the risk of poisoning through absorption of this relatively low-toxicity substance. The stomach should only be emptied under medical supervision, and after the installation of an airway to protect the lungs.

5. PHYSICAL PROPERTIES

Odour & Appearance	clear, colourless, mobile liquid with mild ether-like odour
Odour Threshold	~3.5ppm
Vapour Pressure	above 132mmHg / 17.5kPa (20°C / 68°F)
Evaporation Rate (<i>Butyl Acetate = 1</i>)	8
Vapour Density (air = 1)	2.5
Boiling Range	66°C / 151°F
Freezing Point	-108°C / -163°F
Specific Gravity	0.89 (20/20°C)
Water Solubility	~300 grams per litre
Also soluble in	most organic solvents
Viscosity	not known – thin mobile liquid
pH	none – (<i>does not liberate hydrogen ions when dissolved</i>)
Conversion Factor	1ppm = 2.9mg/m ³
Molecular Weight	72grams per mole

6. FLAMMABILITY & FIRE FIGHTING

Flash Point	-17°C / 1°F (closed cup); also -14°C / 6°F
Autoignition Temperature	224°C / 435°F; also 321°C / 610°F
Flammable Limits	1.8% – 11.8%
Combustion Products	carbon monoxide, nitrogen oxides, smoke, part oxidised hydrocarbon fragments
Fire Fighting Precautions	foam, dry chemical, CO ₂ ; water fog or spray to cool & dilute, product floats on water – water jet spreads flames; fire fighters must wear SCBA
Static Charge Accumulation	<i>readily accumulates a static charge on agitation or pumping</i>

7. STABILITY / REACTIVITY

Dangerously Reactive With	strong oxidising agents; strong alkalies
Also Reactive With	bromine reacts vigorously; attacks some rubbers and plastics
Stability	stable if oxidation inhibitors are present; will not polymerize
Decomposes in Presence of	oxygen
Decomposition Products	forms explosive peroxides on prolonged contact with air
Sensitive to Mechanical Impact	no

Please ensure that this MSDS is given to, and explained to people using this product.

(Tetrahydrofuran, cont'd)

Page 3

8. PROTECTIVE EQUIPMENT / EXPOSURE CONTROL

ACGIH TLV	50ppm / 145mg/m ³ ; STEL	100ppm / 290mg/m ³
OSHA PEL	200ppm / 590mg/m ³ ; STEL	250ppm / 737mg/m ³
Ventilation	mechanical ventilation may be required to maintain airborne titre below TWAEV; a respirator with organic vapour cartridge should be available for each worker in the area for "escape" purposes, should ventilation fail; <i>Store respirator in a sealed container ("Tupperware" or "ZipLock") to maintain cartridge "freshness".</i>	
Hands	"Barrier", "Silver Shield", "Responder" gloves recommended – <i>other types may also protect; consult supplier to confirm suitability</i>	
Eyes	safety glasses with side shields – <i>always protect the eyes</i>	
Clothing	wear impermeable (above) apron, boots, & long sleeves if there is any danger of splashing	

9. HANDLING & STORAGE

Store in a cool, dry environment, away from sources of ignition, heat and oxidising agents. ***Always use non-sparking bronze or aluminium hand tools. All electrical and mechanical equipment (including lighting, switchgear and forklift trucks) used with or around this product must be explosion-proof.***

This product retains a static charge on agitation or transfer from one container to another. Always ground or electrically bond both the source container and the receiving container, and transfer pump before transferring contents. Avoid splashing by ensuring that the product nozzle is below the surface in the receiving container.

This product may react with oxygen in the air to form explosive or flammable peroxides. (*An oxidation inhibitor may have been added to the product to prevent this.*) Ensure that containers are full and tightly sealed. If prolonged storage of a part container is anticipated, flush headspace with dry nitrogen gas prior to sealing. Empty containers may contain a flammable / explosive vapour. Always ensure that containers, whether empty or full, or part full, are tightly sealed unless in use.

Avoid breathing product vapour. Use with adequate ventilation. If dealing with a spill, and ventilation is impossible or impractical, wear a suitable respirator with organic vapour cartridge.

Never cut, drill, weld or grind on or near this container. Avoid contact with skin and wash work clothes frequently. An eye bath and safety shower must be available near the workplace.

10. SPILL PROCEDURES

Serious Fire Potential: blanket spill with foam as a precaution against accidental ignition. Take extreme care to avoid sparks – do not operate (turn on OR off) electrical appliances near spill, unless explosion proof.

Leak Precaution	dyke to control spillage and prevent environmental contamination
Handling Spill	ventilate contaminated area; recover free liquid with suitable pumps; absorb residue on an inert sorbent, sweep & pick up using plastic or aluminium shovel, & store in closed containers for recycling or disposal

11. DISPOSAL

Waste Disposal	do not flush to sewer , recycle solvent if possible, may be incinerated in approved facility
Containers	Drums should be reused. Recondition and pressure test by a licensed reconditioner prior to re-use. Pails must be vented and thoroughly dried prior to crushing and recycling. IBCs (intermediate bulk containers): polyethylene bottle must be pressure tested & recertified at 30 months. Replace at 60 months (5yrs). Steel containers must be inspected, pressure tested & recertified every 5 years. <i>Never cut, drill, weld or grind on or near this container, even if empty</i>

Please ensure that this MSDS is given to, and explained to people using this product.

(Tetrahydrofuran, cont'd)

page 4

12. ENVIRONMENTAL INFORMATION

Bioaccumulation this product is not a bioaccumulator; biological half-life is ~30 minutes
Biodegradation this product degrades readily in the presence of oxygen; 34-39% in 28 days; anaerobic digestion slow
Abiotic Degradation this product reacts with atmospheric hydroxyl radicals; estimated ½-life in air is 3 days
Mobility in soil, water this product is water soluble; moves readily in soil & water; volatilisation removes much material before it moves far

Aquatic Toxicity

LC₅₀ (Fish, 96hr) 2160, 3600 & 3800mg/litre (Pimephelas promelas), and others (low toxicity in all tests)
EC₅₀ (Crustacea, 24hr) >10,000mg/litre (Daphnia magna), 8900mg/litre (Daphnia pulex)
EC₂₀ (Bacteria) 800mg/litre (domestic sewage sludge), EC₁₀ – >1000mg/litre (domestic sewage sludge)

13. TRANSPORT REGULATIONS

Canada TDG	PIN	UN-2056
AND	Shipping Name	tetrahydrofuran
U.S.A. 49 CFR	Class	3
	Packing Group	II
Marine Pollutant		not a marine pollutant

14. EMERGENCY INFORMATION

Canada	Call CANUTEC (collect)	(613) 996-6666
U.S.A.	Call CHEMTREC	(800) 424-9300

15. REGULATIONS

Canada DSL	on inventory
U.S.A. TSCA	on inventory
Europe EINECS	on inventory

Immediately Dangerous to Life or Health: 2000 ppm (Based on 10% of the lower explosion limit for safety considerations even though the relevant toxicological data indicated that irreversible health effects or impairment of escape existed only at higher concentrations.)
OSHA Standards: Permissible Exposure Limit: Table Z-1 8-hr Time Weighted Avg: 200 ppm (590 mg/cu m). Vacated 1989 OSHA PEL TWA 200 ppm (590 mg/cu m); STEL 250 ppm (735 mg/cu m) is still enforced in some states.
NIOSH Recommendations: Recommended Exposure Limit: 10 Hr Time-Weighted Avg: 200 ppm (590 mg/cu m). Recommended Exposure Limit: 15 Min Short-Term Exposure Limit: 250 ppm (735 mg/cu m).
Threshold Limit Values: 8 hr Time Weighted Avg (TWA): 50 ppm; 15 min Short Term Exposure Limit (STEL): 100 ppm. Skin. A3; Confirmed animal carcinogen with unknown relevance to humans.
State Drinking Water Guidelines: Massachusetts 1300 ug/l, New Hampshire 150 ug/l, Wisconsin 50 ug/l, Maine 70 ug/l, Florida 4.6 ug/l
CERCLA Reportable Quantities: Persons in charge of vessels or facilities are required to notify the National Response Center (NRC) immediately, when there is a release of this designated hazardous substance, in an amount equal to or greater than its reportable quantity of 1000 lb or 454 kg. The toll free number of the NRC is (800) 424-8802; In the Washington D.C. metropolitan area (202) 426-2675. The rule for determining when notification is required is stated in 40 CFR 302.4 (section IV. D.3.b).
TSCA Requirements: Section 8(a) of TSCA requires manufacturers of this chemical substance to report preliminary assessment information concerned with production, exposure, and use to EPA as cited in the preamble in 51 FR 41329. Pursuant to section 8(d) of TSCA, EPA promulgated a model Health and Safety Data Reporting Rule. The section 8(d) model rule requires manufacturers, importers, and processors of listed chemical substances and mixtures to submit to EPA copies and lists of unpublished health and safety studies. Tetrahydrofuran is included on this list. A testing consent order is in effect for tetrahydrofuran for health effects testing. FR citation: 1/23/95.
RCRA Requirements: As stipulated in 40 CFR 261.33, when tetrahydrofuran, as a commercial chemical product or manufacturing chemical intermediate or an off-specification commercial chemical product or a manufacturing chemical intermediate, becomes a waste, it must be managed according to Federal and/or State hazardous waste regulations. Also defined as a hazardous waste is any residue, contaminated soil, water, or other debris resulting from the cleanup of a spill, into water or on dry land, of this waste. Generators of small quantities of this waste may qualify for partial exclusion from hazardous waste regulations (40 CFR 261.5).
FDA Requirements: Tetrahydrofuran is an indirect food additive for use only as a component of adhesives.

16. PREPARATION INFORMATION

Prepared for Megaloid Laboratories by Peter Bursztyn, (705) 734-1577
With data from RTECS, Haz. Substance Data Base, Cheminfo (CCOHS), IUCLID Datasheets (European Chem. Substance Info. System), & others, as available
Preparation Date: **March 2004** Revision Date: **May 2007, May 2010**

Please ensure that this MSDS is given to, and explained to people using this product.