



Safety Data Sheet

1. PRODUCT IDENTIFICATION

Name	Tetrahydrofuran
Synonyms	1,4-epoxybutane, diethylene oxide, tetramethylene oxide, butylene oxide, cyclotetramethylene oxide, THF
CAS#	109-99-9
Europe EC#	203-726-8
Product Uses	solvent in coatings, adhesives, inks, etc.

EMERGENCY INFORMATION

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

2. HAZARDS

GHS Class (Category)	flammable liquid (2)	acute oral (4)	acute, eyes (2A)	carcinogenic (2)
Signal Words	DANGER	WARNING	WARNING	WARNING
Hazard Statements	highly flammable liquid & vapour (H225)	harmful if swallowed (H302)	causes serious eye irritation (H319)	suspected of causing cancer (H351)

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, **F** – Reactive Substance



3. COMPOSITION

	%	TWAEV / TLV mg/m ³	LD ₅₀ (mg/kg) ORAL	LD ₅₀ (mg/kg) SKIN	LC ₅₀ ppm INHALATION
1,4-epoxybutane	100%	50 / 145 (skin)	1650	not known	18,200

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.

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

5. FIRE FIGHTING & FLAMMABILITY

Flash Point	-17°C / 1°F (closed cup)
Autoignition Temperature	321°C / 610°F
Flammable Limits	1.8% – 11.8%
Combustion Products	carbon monoxide, nitrogen oxides, smoke, part oxidised hydrocarbon fragments
Firefighting Precautions	foam, dry chemical, water fog, water spray only to cool & dilute, product floats on water – water jet spreads flames; firefighters must wear SCBA
Static Charge Accumulation	readily accumulates a static charge on agitation or pumping

WHEN FILLING STORAGE TANKS WITH THIS PRODUCT, IN ADDITION TO NORMAL GROUNDING PROCEDURES, READ THE FOLLOWING:

This product may form an explosive mixture inside a bulk storage tank. Prior to filling a bulk storage tank with this product, consider ventilating the headspace with nitrogen. In addition, consider asking the supplier to put an anti-static additive in the product when you order. If the bulk tank has a floating product level indicator, this should be inspected regularly. The float **MUST HAVE** a firmly fixed ground wire, not a chain connecting it to its support cable. This connection must be free of corrosion.

Consult NFPA 77, 2007: “Recommended Practice on Static Electricity”

6. ACCIDENTAL RELEASE MEASURES

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

7. HANDLING & STORAGE

Keep cool, away from sources of ignition, heat & oxidising agents. Keep drums out of direct sun! Always use non-sparking bronze or aluminium hand tools. ***All electrical & mechanical equipment (including lighting, switchgear & forklift trucks) used around this product must be explosion-proof.*** This product may accumulate a static charge; ground or electrically bond the source container, receiving container & transfer pump before transferring. Avoid splashing; ensure 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 be added to suppress this.*) ***Never distil THF to dryness – this may concentrate any peroxides present to become an explosion hazard.*** Ensure that containers are full & tightly sealed. *If prolonged storage anticipated, flush headspace with dry nitrogen gas prior to sealing.* Empty containers may contain a flammable or explosive vapour.

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

* During prolonged storage tetrahydrofuran should be tested frequently for peroxides with starch-iodide paper. Accumulated peroxides can be removed from tetrahydrofuran using methods described in: Bretherick, L. *Bretherick's handbook of reactive chemical hazards*. 4th ed. Butterworths 1990. p466-468, 1746-1750

8. EXPOSURE CONTROL & PERSONAL PROTECTION

Ontario TWAEV	50ppm / 145mg/m ³ (skin)	Ontario STEV	100ppm / 290mg/m ³
ACGIH TLV	50ppm / 145mg/m ³ (skin)	ACGIH STEL	100ppm / 290mg/m ³
OSHA PEL	200ppm / 580mg/m ³ (skin)	OSHA STEL	250ppm / 725mg/m ³
Ventilation	mechanical ventilation may be required to control airborne titre to regulated limits		
Hands	“Barrier” or “Silver Shield” gloves – <i>other types may also protect; consult supplier for suitability</i>		
Eyes	safety glasses with side shields – <i>always protect the eyes</i>		
Clothing	no special protective clothing required		

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9. PHYSICAL PROPERTIES

Odour & Appearance	clear, colourless, thin liquid with pleasant ether odour
Odour Threshold	2.5-3.5 ppm
Vapour Pressure	132mmHg / 17.5kPa (20°C / 68°F)
Evaporation Rate (<i>Butyl Acetate</i> =1)	8
Vapour Density (air = 1)	2.5
Boiling Range	66°C / 151°F
Freezing Point	-109°C / -163°F
Specific Gravity	0.89 (20/20°C)
Water Solubility	300 grams per litre (25°C / 77°F)
Also soluble in	most organic solvents
Partition Coefficient (Octanol/H ₂ O)	0.46
Viscosity	not known – thin mobile liquid
pH	none – (<i>does not liberate hydrogen ions in solution</i>)
Conversion Factor	1ppm = 2.9mg/m ³
Molecular Weight	72grams per mole

10. REACTIVITY

Dangerously Reactive With	strong oxidising agents; reacts vigorously with bromine
Also Reactive With	strong alkalis – <i>any peroxide present may react violently with strong alkalis</i>
Chemical Stability	stable if oxidation inhibitors are present; will not polymerize
Decomposes in Presence of	oxygen, light
Decomposition Products	without inhibitors, may form explosive peroxides on prolonged contact with air
Mechanical Impact	not sensitive

11. TOXICITY**Effects, Acute Exposure**

Skin Contact	no apparent effect in humans; irritation has been observed in rabbits
Skin Absorption	yes; <i>toxic effects unlikely by this route unless a considerable area of skin is exposed</i>
Eye Contact	irritating to the eyes, may be severe in some
Inhalation	irritating to respiratory system; at 25,000ppm, anaesthetic effects, also stimulates breathing & lowers blood pressure
Ingestion	not known – not a route of industrial exposure

Effects, Chronic Exposure

General	prolonged exposure may cause drying and dermatitis
Sensitising	not a sensitiser in humans or animals
Carcinogen/Tumorigen	not considered a tumorigen or carcinogen in humans; animal carcinogen, <i>unknown relevance to human disease</i> (ACGIH – A3)
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, 2050-2850, 3000, 3300, 3780, 4430 & 6210mg/kg (rat), 2000 & 2300mg/litre (mouse), 2300 & 2600mg/kg (guinea pig), 3120mg/litre (rabbit) & <i>others</i>
LD ₅₀ (skin)	no data available*
LC ₅₀ (inhalation)	18,200ppm (rat & mouse), 18,585, 21,725 & 22,760ppm (rat) & <i>others</i>

* Skin absorption in rats & rabbits is rapid & can achieve a lethal blood concentration if ~10% of skin area is exposed.

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12. ECOLOGICAL INFORMATION

Bioaccumulation	not a bioaccumulator; biological ½-life ~30 minutes
Biodegradation	biodegrades in the presence of oxygen; rates from 34% in 28 days to 100% in 14 days
Abiotic Degradation	reacts with atmospheric hydroxyl radicals; estimated ½-life in air is 21-24 hours
Mobility in soil, water	water soluble; moves readily in soil and water
Aquatic Toxicity	
LC ₅₀ (Fish, 48hr)	2160 & 3800mg/litre (Pimephelas promelas, 96hr), 2400mg/litre (Carassius auratus & Cyprinus auratus), 4400mg/litre (Cyprinus carpio), 2820 & 2930mg/litre Leuciscus idus) 3800 & 5900mg/litre (Oryzias latipes), and others . . .
EC ₅₀ (Crustacea)	>10,000mg/litre (Daphnia magna), 8900mg/litre (Daphnia pulex)
EC ₁₀ (Algae)	>1000mg/litre (“plankton algae”)
EC ₂₀ (Bacteria)	>1000mg/litre (“activated sludge”)
EC ₁₀ (Bacteria)	800mg/litre (“activated sludge”), >1000mg/litre (“mixed bacterial population”)

13. 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>

14. TRANSPORT CLASSIFICATION

Canada TDG	PIN	UN - 2056
AND	Shipping Name	tetrahydrofuran
U.S.A. 49 CFR	Class & Packing Group	3 (II)
Marine Pollutant		not a marine pollutant
ERAP Required		NO

**15. REGULATIONS**

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

U.S.A. Regulations:

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.

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15. REGULATIONS, cont'd

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. 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. Effective date 3/11/94; Reporting date: 5/10/95. 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. Effective date 3/11/94; Sunset date: 6/30/98. 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. OTHER INFORMATION

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Data from RTECS, HSDB (Haz. Substance Data Base), Cheminfo (CCOHS), IUCLID Datasheets (ESIS – European Chem. Substance Info. System), & others.

*Preparation Date: **March 2004** Revision Date: **May 2007, May 2010, May 2013***

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