

**BRENNTAG
TETRAHYDROFURAN**

HEALTH: 2
FLAMMABILITY: 3
REACTIVITY: 1



Material Safety Data Sheet

MSDS No.: BE266
Variant: U.S.A.-EN
Version No: 1.3
Validation Date: 04/16/2004

TETRAHYDROFURAN

SECTION 1: IDENTIFICATION

Product Name: TETRAHYDROFURAN

Product Number: 00000000000499269

Internal ID: 281

Chemical Family: Oxygen substituted cyclic hydrocarbons

CAS Number: 109-99-9

Chemical Name: Tetrahydrofuran

Synonyms: Tetramethylene Oxide, THF

Manufacturer
Lyondell Chemical Company
One Houston Center, Suite 1600
1221 McKinney St.
P.O. Box 2583
Houston Texas 77262-2583

Business Contact
Customer Service 888 777-0232
Product Safety 800 700-0946

24 Hour Emergency Contact
CHEMTREC 800 424-9300
LYONDELL 800-245-4532

SECTION 2 : COMPOSITION/INFORMATION ON INGREDIENTS

<u>Component Name</u>	<u>CAS #</u>	<u>EU Inventory</u>	<u>Concentration Wt.%*</u>	<u>Risk</u>	<u>Symbol</u>
Tetrahydrofuran	109-99-9	203-726-8	> 99.0	R11, R19, R36/37	F, Xi
Butylated Hydroxy Toluene	128-37-0	204-881-4	< 0.1	None	None

* Concentration of gaseous products or materials is given in Mole %
Compositions given are typical values not specifications.

SECTION 3: HAZARD IDENTIFICATION

Emergency Overview

This material is HAZARDOUS by OSHA Hazard Communication definition.

Signal Word
DANGER.

Hazards
Highly flammable. Avoid oxidizing agents. May be reactive if not inhibited. Avoid prolonged or repeated breathing of gases, vapors, or mists. Severe skin irritant. Slight skin absorption is expected, but there are no data to indicate if sufficient quantities can be absorbed to result in systemic effects. Eye irritant. Central nervous system effects. Mucous membrane irritant. Irritating to gastrointestinal tract.



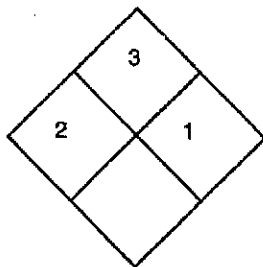
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NFPA®

HMIS®



Health	*	2
Flammability		3
Reactivity		1

Physical State

Liquid.

Color

Clear, colorless.

Odor

Ether-like odor.

Odor Threshold

No value available.

Potential Health Effects**Routes of Exposure**

Inhalation Eye Skin.

Signs and Symptoms of Acute Exposure

See component summary.

- *Tetrahydrofuran 109-99-9*

Severe skin irritant. Slight skin absorption is expected, but there are no data to indicate if sufficient quantities can be absorbed to result in systemic effects. Not expected to be a sensitizer. Eye irritant. Inhalation hazard. Overexposure may cause coughing, shortness of breath, dizziness, central nervous system depression, intoxication and collapse. Ingestion hazard. May produce symptoms of nervous system depression including headache, dizziness, nausea, loss of sense of balance, drowsiness, and visual disturbances.

- *Butylated Hydroxy Toluene 128-37-0*

Moderate skin irritant. Severe eye irritant.

Skin

Severe skin irritant. Not expected to be a sensitizer. Slight skin absorption is expected, but there are no data to indicate if sufficient quantities can be absorbed to result in systemic effects.

Inhalation

High vapor concentrations may cause central nervous system (CNS) depression with symptoms such as nausea, dizziness, weakness, headache, loss of coordination, loss of consciousness, coma and death. It may cause irritation to the respiratory tract and to other mucous membranes.

Eye

Liquid and vapor is irritating to eyes.

Ingestion

Ingestion of high doses may cause discomfort and irritation of the gastrointestinal tract and CNS depression (fatigue, dizziness and possibly loss of concentration, with collapse, coma and death in cases of severe over-exposure).



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TETRAHYDROFURAN**Chronic Health Effects**

See component summary.

- *Tetrahydrofuran 109-99-9*

May produce symptoms of central nervous system depression including headache, dizziness, nausea, euphoria, loss of equilibrium, drowsiness, visual disturbances, fatigue, unconsciousness and respiratory arrest. May cause dermatitis by defatting the skin from prolonged or repeated contact. Repeated or prolonged exposure may result in liver damage.

- *Butylated Hydroxy Toluene 128-37-0*

No adverse chronic human health effects have been reported for this material.

Conditions Aggravated by Exposure

This material may aggravate pulmonary/bronchial disease and/or cause breathing difficulty.

SECTION 4: FIRST AID MEASURES**General**

Take proper precautions to ensure your own health and safety before attempting rescue and providing first aid. For specific information refer to the Emergency Overview in Section 3 of this MSDS.

Skin

Promptly remove soiled clothing/wash thoroughly before reuse. Wash skin thoroughly with mild soap and water. If sticky, use waterless cleaner first. Seek medical attention if ill effect or irritation develops.

Inhalation

If overcome by exposure, remove victim to fresh air immediately. Give oxygen or artificial respiration as needed. Obtain medical attention if breathing difficulty persists.

Eye

Immediately flush the eyes with large amounts of clean low-pressure water for at least 15 minutes, occasionally lifting the upper and lower lids. If pain or irritation persists, promptly obtain medical attention.

Ingestion

Do not induce vomiting. Risk of damage to lungs exceeds poisoning risk. If large quantity swallowed, give lukewarm water (pint/ 1/2 litre) if victim completely conscious/alert. Obtain emergency medical attention.

Note to Physician

Treat symptomatically. Treatment of overexposure should be directed at the control of symptoms and the clinical condition of the patient.

SECTION 5: FIRE FIGHTING MEASURES**Flammable Properties****Classification**

OSHA/NFPA Class IB Flammable Liquid.

Flash Point:

-14 °C (6.8 °F) (TCC)

Auto-ignition Temperature

~ 321 °C (609.8 °F)

Lower Flammable Limit

~ 2 vol%

Upper Flammable Limit

~ 11 vol%

Extinguishing Media



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Suitable: SMALL FIRE: Use dry chemicals, CO2, water spray or alcohol-resistant foam LARGE FIRE: Use water spray, water fog or alcohol-resistant foam

Unsuitable: Do not use solid water stream.

Protection of Firefighters

Protective Equipment/Clothing: Wear positive pressure self-contained breathing apparatus (SCBA). Structural firefighters protective clothing will only provide limited protection.

Fire Fighting Guidance: Fine sprays/mists may be combustible at temperatures below normal flash point. When mixed with air and exposed to ignition source, vapors can burn in open or explode if confined. Vapors may be heavier than air. May travel long distances along the ground before igniting and flashing back to vapor source. Fight fire from maximum distance or use unmanned hose holders or monitor nozzles. Move containers from fire area if you can do it without risk. Cool containers with flooding quantities of water until well after fire is out. Withdraw immediately in case of rising sound from venting safety devices or discoloration of tank. Always stay away from tanks engulfed in fire. For massive fire, use unmanned hose holders or monitor nozzles; if this is impossible, withdraw from area and let fire burn.

Hazardous Combustion Products: Thermal decomposition may produce carbon monoxide and other toxic vapors.

SECTION 6: ACCIDENTAL RELEASE MEASURES**Release Response**

Eliminate all sources of ignition. All equipment used when handling this product must be grounded. Do not touch or walk through spilled material. Stop leak if you can do it without risk. Prevent entry into waterways, sewers, basements or confined areas. A vapor suppressing foam may be used to reduce vapors. Absorb or cover with dry earth, sand or other non-combustible material and transfer to containers. Use clean non-sparking tools to collect absorbed material.

SECTION 7: HANDLING AND STORAGE**Handling**

For industrial use only. Keep container tightly closed when not in use. Extinguish all ignition sources. Wear recommended personal protective equipment. Containers must be properly grounded before beginning transfer. All electrical equipment should be grounded and conform to applicable electric codes and regulatory requirements. Check atmosphere for explosiveness and oxygen deficiencies. Observe precautions pertaining to confined space entry. Check periodically to confirm inhibitor content. If below desired level, add extra inhibitor/mix well to be effective. Use only non-sparking tools. Carefully vent any internal pressure before removing closure. Isolate, vent, drain, wash and purge systems or equipment before maintenance or repair. Handle empty containers with care; vapor/residue may be flammable.

Storage

Store closed drums with bung in up position. Store only in tightly closed, properly vented containers away from heat, sparks, open flame and strong oxidizing agents. Vapor space above stored liquid may be flammable/explosive unless blanketed with inert gas. Can self-react/polymerize/liberate heat/raising temperature, pressure/possibly rupture container unless properly inhibited.

SECTION 8: EXPOSURE CONTROLS AND PERSONAL PROTECTION**Engineering Controls**

Electrical equipment should be grounded and conform to applicable electrical code. Provide local exhaust or general room ventilation to minimize exposure to vapors. Both local exhaust and good general room ventilation must be provided not only to control exposure but also to prevent formation of flammable mixtures.

Personal Protection

Inhalation If exposure can potentially exceed the exposure limit(s), respiratory protection recommended or approved by appropriate local, state or international agency must be used.

Skin Depending on the conditions of use, protective gloves, apron, boots, head and face protection should be worn.

Eye Eye protection such as chemical splash goggles and/or face shield must be worn when possibility exists for eye contact due to splashing or spraying liquid, airborne particles, or vapor.



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Additional Remarks

Emergency eye wash fountains and safety showers should be available in the immediate vicinity of any potential exposure. Wash hands before eating, drinking, smoking, or using toilet facilities. Use good personal hygiene practices. Promptly remove soiled clothing/wash thoroughly before reuse.

Occupational Exposure Limits

Component Name	Source / Date	Value	Type	Notation
Tetrahydrofuran	US (ACGIH) / 2003	200 ppm	8 HRS/TWA	No
	US (ACGIH) / 2003	250 ppm	15 MIN/STEL	No
	US (OSHA) / 2003	200 ppm	8 HRS/TWA	No
Butylated Hydroxy Toluene	US (ACGIH) / 2003	2 mg/m ³ Aerosol	8 HRS/TWA	No
	US (OSHA) / 2003	NL		

SECTION 9: PHYSICAL AND CHEMICAL PROPERTIES

Appearance: Liquid. Clear, colorless.

Odor: Ether-like odor.

Odor Threshold: No value available.

pH: ~ 7

Boiling Point/Boiling Range: ~ 66 °C (150.8 °F) @ 760 mm Hg

Freezing Point/Melting Point: -108.5 °C (-163.3 °F)

Flash Point: -14 °C (6.8 °F) (TCC)

Auto-ignition: ~ 321 °C (609.8 °F)

Flammability: OSHA/NFPA Class IB Flammable Liquid.

Lower Flammable Limit: ~ 2 vol%

Upper Flammable Limit: ~ 11 vol%

Explosive Properties: No Data Available.

Oxidizing Properties: No Data Available.

Vapor Pressure: ~ 155 mm Hg @ 25 °C (77 °F)

Evaporation Rate: No Data Available.

Relative Density: 0.886 - 0.889

Relative Vapor Density: ~ 2.5 @ 25 °C (77 °F) (Air = 1.0)

Viscosity: ~ 0.46 mPa.s @ 25 °C (77 °F) (Brookfield).

Solubility (Water): Complete (In All Proportions).



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Partition Coefficient (Kow): Log Kow = 0.46

Additional Physical and Chemical Properties: Additional properties may be listed in Sections 3 and 5.

SECTION 10: STABILITY AND REACTIVITY

Chemical Stability

This product is stable with an appropriate level of Butylated Hydroxy Toluene Inhibitor (minimum 200 ppm), but reactive (unstable) without. Contact a company sales representative for information regarding adequate inhibitor levels and methods of making inhibitor level determinations.

Conditions to Avoid

Heat, sparks, open flame, other ignition sources, and oxidizing conditions.

Substances to Avoid

Reacts vigorously with strong oxidizers and acids.

Decomposition Products

No additional information available.

Hazardous Polymerization

May occur.

Reactions with Air and Water

May form peroxides in the presence of air. May react with oxygen to form unstable peroxides. Peroxides are thermally unstable and shock sensitive.

SECTION 11: TOXICOLOGICAL INFORMATION

PRODUCT INFORMATION

Product Summary

Tetrahydrofuran (THF) is practically non-toxic following acute inhalation exposure and no more than slightly toxic by oral exposure. THF is irritating to the eyes and severely irritating to skin. Repeated exposure by inhalation did not result in toxicity or adverse effects at levels that were not sedating. At high and repeated doses, rats and mice exhibited species- and sex-specific changes in the kidney and liver, respectively, with minimal effects at lower doses. THF was not genotoxic in a battery of in vitro and in vivo assays. THF induced an increase in liver tumors in female mice, by non-genotoxic mode of action related to liver necrosis and sustained cell replication. THF induced an increase in kidney tumors in male rats; mechanistic studies demonstrated increased accumulation of alpha-2micro-globulin and increased cell proliferation in male rat kidneys. THF is not selectively toxic to reproduction and development.

COMPONENT INFORMATION

- Tetrahydrofuran 109-99-9

Acute Toxicity - Lethal Doses

<u>LC50 (Inhl)</u>	Rat	18,000 PPM (VAPOR)	4 HOUR
<u>LD50 (Oral)</u>	Rat	3240 MG/KG BWT	

Acute Toxicity - Effects

Skin Contact Slight skin absorption is expected, but there are no data to indicate if sufficient quantities can be absorbed to result in systemic effects.

Irritation



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Skin Severe skin irritant.

Eye Liquid and vapor is irritating to eyes.

Sensitization

Not expected to be a sensitizer.

Target Organ Effects

Skin. Eye. Central nervous system effects. Liver.

Repeated Dose Toxicity

Repeated exposures to tetrahydrofuran at less than sedating concentrations are not expected to result in systemic toxicity. At 1800 ppm for 6 hours/day, mice experienced narcosis and had liver necrosis; no effect on liver was seen at lower concentrations. Male rat-specific a-2m-globulin was seen in male F344 rats exposed to THF by inhalation for 105 weeks.

Reproductive Effects

No effects on fertility or reproduction were found in rats administered high doses of tetrahydrofuran in drinking water. General systemic toxicity was evident in parental animals at high drinking water doses that were correlated with reduced body weights and developmental delays in their offspring.

Developmental Effects

Results from animal studies demonstrate that this material is not a teratogen, nor is it toxic to the developing embryo or fetus at non-maternally toxic doses.

Genetic Toxicity

Negative for genotoxicity both in vitro and in vivo tests.

Carcinogenicity

High life-time exposures of tetrahydrofuran induced liver tumors in female mice by a non-genotoxic mode of action. At exposures that do not produce sustained liver injury, tumor development is of low concern. Increased kidney tumors in male rats occurred by a mode of action not relevant for human health. Not listed by IARC, NTP, or OSHA.

- *Butylated Hydroxy Toluene 128-37-0*

Acute Toxicity - Lethal Doses

<u>LD50 (Oral)</u>	Rat	890 MG/KG
	Mouse	650 MG/KG

Carcinogenicity

When administered to rats by stomach tube, Butylated Hydroxy Toluene (BHT) produced tumors of the forestomach. On the basis of this information an International Agency for Research on Cancer (IARC) working group concluded that there is 'limited evidence' for the carcinogenicity of Butylated Hydroxy Toluene in laboratory animals. No case report or epidemiological study of carcinogenicity to humans was available to the working group; thus, no evaluation could be made of the carcinogenicity of Butylated Hydroxy Toluene to humans. The International Agency for Research on Cancer (IARC) has evaluated this material as an IARC Group 3 not classifiable as to carcinogenicity in humans. Limited data in animals and inadequate data in humans.

SECTION 12: ECOLOGICAL INFORMATION**PRODUCT INFORMATION****Ecotoxicity**

This material is expected to be non-hazardous to aquatic species. See component summary.

Environmental Fate and Pathway**Mobility**

Transport between environmental compartments: This material is expected to remain in the environmental compartment where released.



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Persistence and Degradability

Biodegradation: Biodegradable under aerobic conditions. Degrades abiotically in air.

Bioaccumulation: This material is not expected to bioaccumulate.

COMPONENT INFORMATION

- *Tetrahydrofuran 109-99-9*

Ecotoxicity

This material is expected to be non-hazardous to aquatic species.

Acute toxicity to fish

LC50 / 96 HOURS fathead minnow 2,160 mg/l

Summary: This material is not classified as harmful or toxic to fish.

Acute toxicity to aquatic invertebrates

EC50 / 24 HOURS daphnia 5,930 mg/l

Summary: This material is not classified as harmful or toxic to invertebrates.

Toxicity to aquatic plants

NOEC / 8 DAY algae 3,700 mg/l

Summary: This material is not classified as harmful or toxic to algae or higher aquatic plants.

Toxicity to microorganisms

Summary: No Data Available.

Chronic toxicity to fish

NOEC / fathead minnow 216 mg/l

Summary: early life stage

Chronic toxicity to aquatic invertebrates

Summary: No Data Available.

Environmental Fate and Pathway

Mobility

Transport between environmental compartments: This material is expected to remain in the environmental compartment where released.

Persistence and Degradability

Biodegradation: Biodegradable under aerobic conditions. Degrades abiotically in air.

Bioaccumulation: This material is not expected to bioaccumulate.

- *Butylated Hydroxy Toluene 128-37-0*

Ecotoxicity

No Data Available.



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Environmental Fate and Pathway

No Data Available.

SECTION 13: DISPOSAL CONSIDERATIONS

Contaminated product/soil/water may be U.S. Resource Conservation and Recovery Act (RCRA)/U.S. Occupational Safety and Health Administration (OSHA) hazardous waste due to potentially low flash point. (See 40 U.S. Code of Federal Regulations (CFR) 261 and 29 CFR 1910). Comply with federal, state, or local regulations for disposal.

SECTION 14: TRANSPORT INFORMATION

Special Requirements

If you reformulate or further process this material, you should consider re-evaluation of the regulatory status of the components listed in the composition section of this sheet, based on final composition of your product.

Proper Shipping Name

CFR_RAIL Tetrahydrofuran
 IMDG TETRAHYDROFURAN

RQ Tetrahydrofuran

ID No. CFR_RAIL UN2056
 ID No. IMDG UN2056

Hazard Class CFR_RAIL 3
 Hazard Class IMDG 3

PG CFR_RAIL II
 PG IMDG II

SECTION 15: REGULATORY INFORMATION

Regulatory Status

Country	Inventory		
Australia	AICS	X	<p>X = All components are included or are otherwise exempt from inclusion on this inventory.</p> <p>C = Contact Lyondell/Equistar by e-mail at product.safety@lyondell.com or product.safety@equistarchem.com for additional information.</p>
Canada	DSL	X	
Canada	NDSL		
China	IECS	X	
European Union	EINECS	X	
European Union	ELINCS		
European Union	NLP		
Japan	ENCS	X	
Korea	ECL	X	
Philippines	PICCS	X	
United States	TSCA	X	

If identified components of this product are listed under the TSCA 12(b) Export Notification rule, they will be listed below.

SARA 302/304

This material contains a component(s) with known CAS numbers classified as hazardous substances subject to the reporting of CERCLA (40 CFR 302) and/or to the release reporting requirements of SARA (Section 302) based on reportable quantities (RQs).

Component

Tetrahydrofuran / CAS# 109-99-9.

RQ

1,000 lbs



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SARA 311/312

Based upon available information, this material is classified as the following health and/or physical hazards according to Section 311 & 312:

Immediate (Acute) Health Hazard.
 Delayed (Chronic) Health Hazard.
 Fire Hazard.

SARA 313

This material does not contain any chemical components with known CAS numbers that exceed the De Minimis reporting levels established by SARA Title III, Section 313 and 40 CFR 372.

ComponentReporting Threshold**State Reporting**

This material is not known to contain any chemicals with known CAS numbers that are currently listed as carcinogens or reproductive toxins under California Proposition 65 at levels which would be subject to the proposition. The Proposition 65 regulatory status of the remaining components of this material for which CAS numbers have not been established, has not been determined.

Massachusetts Substances List (MSL) - Hazardous substances on the MSL must be identified when present in materials at levels greater than state specified criterion. The criterion is: $\geq 1\%$. Components with CAS numbers present in this material at a level which could require reporting under the statute are:

- Tetrahydrofuran / CAS# 109-99-9.

Hazardous Substances listed by the State of Pennsylvania must be identified when present in materials at levels greater than the state specified criterion. The criterion is $\geq 1\%$. Components with CAS numbers in this material at a level which could require reporting under the statute are:

- Tetrahydrofuran / CAS# 109-99-9.

Environmentally Hazardous Substances listed by the State of Pennsylvania must be identified when present in materials at levels greater than the state specified criterion. The criterion is $\geq 1\%$. Components with CAS numbers in this material at a level which could require reporting under the statute are:

- Tetrahydrofuran / CAS# 109-99-9.

SECTION 16: OTHER INFORMATION**Latest Revision(s)**

Revised Section(s): 14 Date of Revision: December 4 2001 Revised Section(s): 3 9 11 12 15 Date of Revision: April 13 2004

DISCLAIMER OF RESPONSIBILITY

This document is generated for the purpose of distributing health, safety, and environmental data. It is not a specification sheet nor should any displayed data be construed as a specification. The information on this MSDS was obtained from sources which we believe are reliable. However, the information is provided without any warranty, expressed or implied, regarding its correctness. Some information presented and conclusions drawn herein are from sources other than direct



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test data on the substance itself. The conditions or methods of handling, storage, use and disposal of the product are beyond our control and may be beyond our knowledge. For this and other reasons, we do not assume responsibility and expressly disclaim liability for loss, damage, or expense arising out of or in any way connected with handling, storage, use, or disposal of this product. If the product is used as a component in another product, this MSDS information may not be applicable.

Numerical Data Presentation

The presentation of numerical data, such as that used for physical and chemical properties and toxicological values, is expressed using a comma (,) to separate digits into groups of three and a period (.) as the decimal marker. For example, 1,234.56 mg/kg = 1 234,56 mg/kg

Language Translations

The information presented in this document has been translated from English by a vendor Lyondell believes to be reliable. Lyondell and its vendor have made a good-faith effort to verify the accuracy of the translation, but assume no responsibility for any errors that may have occurred. Please refer to our web sites (www.lyondell.com and www.equistarchem.com) for the original document written in English.

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