SECTION 1: IDENTIFICATION

Product Name: ETHYL TERTIARY BUTYL ETHER
Product Number: 000000000000011582
Internal ID: 3251
Chemical Family: Alkyl ethers
CAS Number: 637-92-3
Chemical Name: Tert-Butyl Ethyl Ether
Synonyms: Tert-Butyl Ethyl Ether, ETBE-1 (Expected Composition in Ship/Vessel)
Type of Use: Octane enhancer

Manufacturer
Lyondell Chemie Nederland, B.V.
Weenaptop D, Weena 762
3014 DA Rotterdam  The Netherlands

Business Contact
Service Center Europe 31 (0) 10 275 55 00

24 Hour Emergency Contact
Service Centre Europe 31 (0) 10 275 57 77

SECTION 2 : COMPOSITION/INFORMATION ON INGREDIENTS

<table>
<thead>
<tr>
<th>Component Name</th>
<th>CAS #</th>
<th>EU Inventory</th>
<th>Concentration Wt.%*</th>
<th>Risk</th>
<th>Symbol</th>
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</thead>
<tbody>
<tr>
<td>Ethyl Tertiary Butyl Ether</td>
<td>637-92-3</td>
<td>211-309-7</td>
<td>83.0</td>
<td>None</td>
<td>None</td>
</tr>
<tr>
<td>t-Butyl Methyl Ether</td>
<td>1634-04-4</td>
<td>216-653-1</td>
<td>12.3</td>
<td>R11, R38</td>
<td>F, Xi</td>
</tr>
<tr>
<td>Ethyl alcohol</td>
<td>64-17-5</td>
<td>200-578-6</td>
<td>2.2</td>
<td>R11</td>
<td>F</td>
</tr>
<tr>
<td>tert-Butyl Alcohol</td>
<td>75-65-0</td>
<td>200-889-7</td>
<td>1.2</td>
<td>R11, R20</td>
<td>F, Xn</td>
</tr>
</tbody>
</table>

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

SECTION 3: HAZARD IDENTIFICATION

Emergency Overview

Hazards
Highly flammable. Complementary Information: May impart an unpleasant taste and odor in water.

R-Phrases
R11 - Highly flammable. R52 - Harmful to aquatic organisms.

Physical State
Liquid.

Color
Clear, colorless to slightly yellow.

Odor
Terpene-like odor.

Odor Threshold
13 ppm / Odor is not an adequate warning of potentially hazardous ambient air concentrations. May impart an unpleasant taste and odor in water. The odor threshold for ETBE detection in air approximately 13 ppm. The taste threshold for ETBE
in water is approximately 47 ppb.

**Potential Health Effects**

**Routes of Exposure**
- Skin
- Eye
- Inhalation

**Signs and Symptoms of Acute Exposure**
See component summary.

- **Ethyl Tertiary Butyl Ether**  637-92-3
  Overexposure may cause coughing, shortness of breath, dizziness, central nervous system depression, intoxication and collapse. May be irritating to the eyes. Slight - moderate skin irritant. Not expected to be a sensitizer. Not a skin absorption hazard. 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).

- **t-Butyl Methyl Ether**  1634-04-4
  Eye irritant. Moderate skin irritant. Not a skin absorption hazard. Mucous membrane irritant. Overexposure may produce anesthetic or narcotic effects. Aspiration hazard.

- **Ethyl alcohol**  64-17-5
  May cause eye and upper respiratory tract irritation. Short-term overexposure above 1,000 ppm by the inhalation route may cause central nervous system (CNS) effects such as headache and irritation of eyes, nose and throat. If continued for more than an hour additional CNS effects may occur such as: dizziness, drowsiness, loss of appetite, and an inability to concentrate. Gastrointestinal (stomach) effects may occur with symptoms such as nausea and vomiting.

- **tert-Butyl Alcohol**  75-65-0
  Moderate to severe eye irritant. Mildly irritating to the skin but not a skin sensitizer. Breathing mist or vapors may cause mucous membrane or upper respiratory tract irritation. Overexposure may cause coughing, shortness of breath, dizziness, central nervous system depression, intoxication and collapse. Ingestion would likely cause gastrointestinal tract irritation. May produce symptoms of nervous system depression including headache, dizziness, nausea, loss of sense of balance, drowsiness, and visual disturbances.

**Skin**
- Slight - moderate skin irritant. Extensive/prolonged or repeated exposure to this material can result in significant absorption. Not expected to be a skin absorption hazard. Not expected to be a sensitizer.

**Inhalation**
- May be irritating to respiratory system. 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.

**Eye**
- May cause mild eye irritation. Effects of eye irritation are reversible.

**Ingestion**
- This material may be a slight health hazard if ingested in large quantities. 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).

**Chronic Health Effects**
See component summary.

- **Ethyl Tertiary Butyl Ether**  637-92-3
  Prolonged or repeated breathing of high concentrations may cause symptoms of central nervous system depression. Symptoms include headache, dizziness, weakness, loss of coordination and sleep, and in extreme cases unconsciousness.

- **t-Butyl Methyl Ether**  1634-04-4
  Breathing mist or vapors may cause mucous membrane or upper respiratory tract irritation. Prolonged exposure may produce anesthetic and narcotic effects. Repeated or prolonged contact with skin may cause defatting and drying of the skin which may result in dermatitis. Chronic animal toxicity studies exposing rats and mice to MTBE have been performed.
A description of these studies and an assessment of their results is presented elsewhere in this document. See section 11.

- **Ethyl alcohol 64-17-5**
  Long-term exposure can also cause loss of appetite, weight loss, nervousness, memory loss, mental retardation and liver damage. May cause dermatitis by defatting the skin from prolonged or repeated contact. Alcoholic beverages are carcinogenic to humans. Ethanol is a developmental toxin and various effects have been associated with ethanol intake. Examples of chronic ethanol abuse effects include physical dependence, malnutrition, amnesia, dementia, somnolence, cardiac myopathy, hepatotoxicity, GI bleeding and pancreatitis. Combined exposure to ethanol and certain other chemicals may result in increased toxic effects.

- **tert-Butyl Alcohol 75-65-0**
  Prolonged or repeated breathing of high concentrations may cause symptoms of central nervous system depression. May cause dermatitis by defatting the skin from prolonged or repeated contact. This material has been shown to induce tumors in laboratory animals. These findings are not likely relevant to humans. May be toxic to the developing embryo and fetus.

**Conditions Aggravated by Exposure**
Any pre-existing disorders or diseases of the nervous system, respiratory system, skin, and eyes.

**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**
Immediately remove contaminated clothing. Wash skin thoroughly with mild soap and water. Flush with lukewarm water for 15 minutes. 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 emergency medical attention. Prompt action is essential.

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

**Note to Physician**
Continue to rinse eye with clean water for 20-30 minutes, retracting eyelids often. Contact ophthalmologist immediately. Treat symptomatically.

**SECTION 5: FIRE FIGHTING MEASURES**

**Flammable Properties**

**Classification**
Highly flammable liquid.

**Flash Point:**
~ -25 °C (-13 °F) (Estimated)

**Auto-Ignition Temperature**
~ 310 °C (590 °F)

**Lower Flammable Limit**
~ 1.42 vol% (Estimated)
ETHYL TERTIARY BUTYL ETHER

Upper Flammable Limit
~ 10.08 vol% (Estimated)

Extinguishing Media

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: Releases flammable vapors below normal ambient temperatures. When mixed with air and exposed to ignition source, vapors can burn in open or explode if confined. Flammable 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. Cool containers with flooding quantities of water until well after fire is out. Move containers from fire area if you can do it without risk. 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: 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.

This substance is highly volatile, partially water soluble and has only a minimal tendency to adhere to soil particles. Even small volumes can pose a threat to the environment and nearby water resources. Surface spills can reach groundwater through porous soil or cracked surfaces. All efforts should be made to prevent any leaks or spills, and to protect water resources. Where spills are possible, a comprehensive spill response plan should be developed and implemented. If a leak or spill reaches the groundwater, the groundwater may become contaminated. If the groundwater is a source of drinking water, the associated drinking water well(s) could become contaminated. This substance may impart an unpleasant taste and odor to water.

SECTION 7: HANDLING AND STORAGE

Handling
Keep container tightly closed when not in use. It is recommended that any liquid product exposed to air not be highly concentrated by evaporation without first assuring that no peroxide is present. Alternately, positive steps should be taken to reduce any accumulated peroxides to a safe level before concentrating the liquid. Use only non-sparking tools. Carefully vent any internal pressure before removing closure. Containers must be properly grounded before beginning transfer. All equipment must conform to applicable electrical code. Handle empty containers with care; vapor residue may be flammable/explosive. Isolate, vent, drain, wash and purge systems or equipment before maintenance or repair. Extinguish all ignition sources. Check atmosphere for explosiveness and oxygen deficiencies. Wear recommended personal protective equipment. Observe precautions pertaining to confined space entry.

Storage
Store only in tightly closed, properly vented containers away from heat, sparks, open flame and strong oxidizing agents. Storage under nitrogen atmosphere is recommended to minimize possible formation of highly reactive peroxides. Vapor space above stored liquid may be flammable/explosive unless blanketed with inert gas. Store closed drums with bung in up position.

SECTION 8: EXPOSURE CONTROLS AND PERSONAL PROTECTION
ETHYL TERTIARY BUTYL ETHER

Engineering Controls
Provide local exhaust or general room ventilation to minimize dust and/or vapor concentrations. Electrical equipment should be grounded and conform to applicable electrical code.

Personal Protection
Inhalation  If exposure exceeds the exposure limit(s), use respiratory equipment recommended or approved by appropriate local, state or international agency.

Skin  Wear chemical resistant gloves such as:  4H(tm)(PE/EVAL). When skin contact is possible, protective clothing including gloves, apron, sleeves, boots, head and face protection should be worn. The equipment must be cleaned thoroughly after each use.

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

Additional Remarks
Selection of appropriate personal protective equipment should be based on an evaluation of the performance characteristics of the protective equipment relative to the task(s) to be performed, conditions present, duration of use, and the hazards and/or potential hazards that may be encountered during use. Emergency eye wash fountains and safety showers should be available in the immediate vicinity of any potential exposure. Use good personal hygiene practices. Wash hands before eating, drinking, smoking, or using toilet facilities. Promptly remove soiled clothing/wash thoroughly before reuse. Shower after work using plenty of soap and water.

Occupational Exposure Limits

<table>
<thead>
<tr>
<th>Component Name</th>
<th>Source / Date</th>
<th>Value</th>
<th>Type</th>
<th>Notation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ethyl Tertiary Butyl Ether</td>
<td>US (ACGIH) / 2003</td>
<td>5 ppm</td>
<td>8 HRS/TWA</td>
<td>Skin.</td>
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<td>OEL (IT) / 2003</td>
<td>5 ppm</td>
<td>8 HRS/TWA</td>
<td>Skin.</td>
</tr>
<tr>
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<td>VLA (ES) / 2003</td>
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<td>8 HRS/TWA</td>
<td>No</td>
</tr>
<tr>
<td>t-Butyl Methyl Ether</td>
<td>US (ACGIH) / 2003</td>
<td>50 ppm</td>
<td>8 HRS/TWA</td>
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<td>MAK (AT) / 2001</td>
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</tr>
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<td>MAK (AT) / 2001</td>
<td>100 ppm</td>
<td>15 MIN/STEL</td>
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<td>OEL (BE) / 1999</td>
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<td>ELV (FI) / 2002</td>
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<td>8 HRS/TWA</td>
<td>No</td>
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<tr>
<td></td>
<td>OEL (IT) / 2003</td>
<td>50 ppm</td>
<td>8 HRS/TWA</td>
<td>No</td>
</tr>
<tr>
<td></td>
<td>MAC (NL) / 2003</td>
<td>50 ppm</td>
<td>8 HRS/TWA</td>
<td>No</td>
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<td></td>
<td>MAC (NL) / 2003</td>
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<td>15 MIN/STEL</td>
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<td></td>
<td>VLA (ES) / 2003</td>
<td>40 ppm</td>
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<td>TLV (SE) / 2000</td>
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<td>SUVA (CH) / 2001</td>
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<td>SUVA (CH) / 2001</td>
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<td>HSE (UK) / 2002</td>
<td>75 ppm</td>
<td>15 MIN/STEL</td>
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</table>
## Ethyl tertiary butyl ether

| Compounds          | US (ACGIH) | MAK (AT) | MAK (AT) | OEL (BE) | MAK (DA) | ELV (FI) | ELV (FI) | INRS (FR) | INRS (FR) | MAK (DE) | ELV (IE) | OEL (IT) | MAC (NL) | ELV (NO) | VLA (ES) | TLV (SE) | TLV (SE) | SUVA (CH) | SUVA (CH) | HSE (UK) | OEL (IT) |
|--------------------|------------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|
| Ethyl alcohol      | 1,000 ppm  | 1,000 ppm| 2,000 ppm| 1,000 ppm| 1,000 ppm| 1,000 ppm| 1,300 ppm| 1,000 ppm| 5,000 ppm| 500 ppm  | 1,000 ppm| 1,000 ppm| 500 ppm  | 500 ppm  | 1,000 ppm| 500 ppm  | 1,000 ppm| 1,000 ppm| 1,000 ppm| 100 ppm  | 100 ppm  |
| tert-Butyl Alcohol | 100 ppm    | 20 ppm   | 80 ppm   | 100 ppm  | 100 ppm  | 50 ppm   | 50 ppm   | 100 ppm  | 100 ppm  | 20 ppm   | 75 ppm   | 50 ppm   | 80 ppm   | 100 ppm  | 50 ppm   | 20 ppm   | 100 ppm  | 150 ppm  | 100 ppm  | 100 ppm  |

- **US (ACGIH)**: 1,000 ppm 8 HRS/TWA
- **MAK (AT)**: 1,000 ppm 8 HRS/TWA
- **MAK (AT)**: 2,000 ppm CEILING
- **OEL (BE)**: 1,000 ppm 8 HRS/TWA
- **MAK (DA)**: 1,000 ppm 8 HRS/TWA
- **ELV (FI)**: 1,000 ppm 8 HRS/TWA
- **ELV (FI)**: 1,300 ppm 15 MIN/STEL
- **INRS (FR)**: 1,000 ppm 8 HRS/TWA
- **INRS (FR)**: 5,000 ppm 15 MIN/STEL
- **MAK (DE)**: 500 ppm CEILING
- **ELV (IE)**: 1,000 ppm 8 HRS/TWA
- **OEL (IT)**: 1,000 ppm 8 HRS/TWA
- **MAC (NL)**: 500 ppm 8 HRS/TWA
- **ELV (NO)**: 500 ppm 8 HRS/TWA
- **VLA (ES)**: 1,000 ppm 8 HRS/TWA
- **TLV (SE)**: 500 ppm 8 HRS/TWA
- **TLV (SE)**: 1,000 ppm 15 MIN/STEL
- **SUVA (CH)**: 500 ppm 8 HRS/TWA
- **SUVA (CH)**: 1,000 ppm 15 MIN/STEL
- **HSE (UK)**: 1,000 ppm 8 HRS/TWA
- **US (ACGIH)**: 100 ppm 8 HRS/TWA
- **MAK (AT)**: 20 ppm 8 HRS/TWA
- **MAK (AT)**: 80 ppm 15 MIN/STEL
- **OEL (BE)**: 100 ppm 8 HRS/TWA
- **MAK (DA)**: 50 ppm 8 HRS/TWA
- **INRS (FR)**: 100 ppm 8 HRS/TWA
- **ELV (FI)**: 50 ppm 8 HRS/TWA
- **ELV (FI)**: 75 ppm 15 MIN/STEL
- **MAK (DE)**: 20 ppm 8 HRS/TWA
- **MAK (DE)**: 80 ppm 15 MIN/STEL
- **ELV (IE)**: 100 ppm 8 HRS/TWA
- **ELV (IE)**: 150 ppm 15 MIN/STEL
- **OEL (IT)**: 100 ppm 8 HRS/TWA
SECTION 9: PHYSICAL AND CHEMICAL PROPERTIES

**Appearance:** Liquid. Clear, colorless to slightly yellow.

**Odor:** Terpene-like odor.

**Odor Threshold:** 13 ppm Odor is not an adequate warning of potentially hazardous ambient air concentrations. May impart an unpleasant taste and odor in water. The odor threshold for ETBE detection in air approximately 13 ppm. The taste threshold for ETBE in water is approximately 47 ppb.

**pH:** ~ 6.4

**Boiling Point/Boiling Range:** ~ 66.9 °C (152.42 °F) @ 760 mm Hg(Estimated)

**Freezing Point/Melting Point:** ~ -94 °C (-137.2 °F)

**Flash Point:** ~ -25 °C (-13 °F) (Estimated)

**Auto-ignition:** ~ 310 °C (590 °F)

**Flammability:** Highly flammable liquid.

**Lower Flammable Limit:** ~ 1.42 vol% (Estimated)

**Upper Flammable Limit:** ~ 10.08 vol% (Estimated)

**Explosive Properties:** No Data Available.

**Oxidizing Properties:** No Data Available.

**Vapor Pressure:** ~ 158 mm Hg @ 25 °C (77 °F)

**Evaporation Rate:** No Data Available.

**Relative Density:** ~ 0.77(Water = 1.0 at 4°C (39.2°F))
**Relative Vapor Density:** \~ 3.5 @ 15 - 32 °C (59 - 89.6 °F) (Air = 1.0)

**Viscosity:** \~ 0.4 mPa.s

**Solubility (Water):** \~ 2.3 g/l @ 20 °C (68 °F)

**Partition Coefficient (Kow):** Log Kow = 1.48 - 1.56 Estimated.

**Remarks:** Actual physical properties depend on ratio of MTBE to ETBE.

### SECTION 10: STABILITY AND REACTIVITY

**Chemical Stability**
Stable.

**Conditions to Avoid**
Heat, sparks, open flame, other ignition sources, and oxidizing conditions.

**Substances to Avoid**
This material will decompose to ethanol and isobutylene in the presence of strong acids which could lead to the risk of closed containers rupturing. Strong alkalies. Strong oxidizing agents.

**Decomposition Products**
Carbon Monoxide and other toxic vapors. Contact with strong acids can decompose this material and generate extremely flammable isobutylene.

**Hazardous Polymerization**
Not expected to occur.

**Reactions with Air and Water**
May react with oxygen to form peroxides.

### SECTION 11: TOXICOLOGICAL INFORMATION

**PRODUCT INFORMATION**

**Product Summary**
Ethyl tert-buty ether (ETBE) has low acute toxicity in experimental animals following oral, inhalation, or dermal exposure. Acute or repeated inhalation exposures of high doses may result in nervous system depression. Liver enlargement without evidence of structural damage was seen in mice after repeated exposure, while male rats exhibited sex- and species-specific kidney effects. ETBE is not selectively toxic to the fetus and does not adversely affect reproductive function. ETBE is not genotoxic. ETBE has not been tested for carcinogenicity, however it is metabolized to t-butanol which induced kidney tumors in male rats and thyroid tumors in female mice by mechanisms that most likely are not relevant to humans.

**COMPONENT INFORMATION**

- **Ethyl Tertiary Butyl Ether** 637-92-3

**Acute Toxicity - Lethal Doses**

<table>
<thead>
<tr>
<th>LC50 (Inh)</th>
<th>Rat</th>
<th>&gt; 1450 PPM (VAPOR)</th>
<th>4 HOURS</th>
</tr>
</thead>
<tbody>
<tr>
<td>LD50 (Oral)</td>
<td>Rat</td>
<td>&gt; 5000 MG/KG BWT</td>
<td></td>
</tr>
</tbody>
</table>
LD50 (Skin) Rabbit > 2000 MG/KG BWT

Irritation
Skin Slight - moderate skin irritant. No significant signs or symptoms indicative of any health hazard are expected to occur as a result of skin absorption exposure. Not expected to be a sensitizer.

Eye May cause minor eye irritation. Effects of eye irritation are reversible.

Target Organ Effects
Skin. Eye. Respiratory system. Central nervous system.

Repeated Dose Toxicity
Repeated exposure to high vapor concentrations may cause nervous system depression (fatigue, dizziness, and possibly loss of concentration, with collapse, coma and death in cases of severe over-exposure). Kidney effects specific to male rats (hyaline droplet nephropathy) and liver enlargement with no evidence of structural damage in mice were reported following repeated exposure to ETBE vapor.

Reproductive Effects
In a preliminary reproductive toxicity study, no adverse effects on reproductive function were seen in male and female rats exposed orally to 1000 mg/kg bwt ETBE.

Developmental Effects
ETBE is not selectively toxic to the fetus. No adverse developmental effects were reported in rats exposed to high concentrations (1000 mg/kg bwt) during pregnancy despite the occurrence of maternal toxicity (decreased maternal body weight gain).

Genetic Toxicity
Negative for genotoxicity both in vitro and in vivo tests.

Carcinogenicity
No laboratory animal carcinogenicity studies have been conducted for ETBE. ETBE is metabolized to t-butanol which induced benign kidney tumors in male rats and benign thyroid tumors in female mice. The t-butanol induced male rat kidney tumors occurred by an a-2u-globulin mode of action, a tumor mechanism not relevant for humans, and the mouse thyroid tumors are postulated to be related to thyroid hormone metabolism and are also not likely relevant to humans. ETBE is not listed as a carcinogen by OSHA, NTP, IARC or EPA.

• t-Butyl Methyl Ether 1634-04-4

Acute Toxicity - Lethal Doses
LC50 (Inhl) Rat 23,800 - 39,800 4 HOURS PPM
LD50 (Oral) Rat 3800 MG/KG BWT
LD50 (Skin) Rabbit > 10,000 MG/KG BWT

Target Organ Effects
Skin. Eye. Respiratory system. CNS depressant.

Repeated Dose Toxicity
No evidence of adverse systemic effects was seen in rodents exposed repeatedly to low concentrations of MTBE vapor, however higher exposures were associated with an accumulation of protein droplets in the kidney of male rats (a male rat-specific response), with liver enlargement (but no adverse histopathological lesions) in rats and mice of both sexes. A decreased incidence of cystic endometrial hyperplasia and changes in other estrogen-sensitive tissues were reported in female mice exposed to 28.6 mg/l (8,000 ppm) MTBE vapor, however serum estrogen levels and estrogen receptor functions were unaffected. There are inconsistent reports of minor subjective neurological symptoms in humans regularly exposed to low levels of MTBE vapor. It is unclear, however, if these are causally-related to MTBE or where triggered by its odor. Some individuals find the odor of MTBE objectionable (threshold for detection 0.0002 mg/l; 0.053 ppm).

Reproductive Effects
No adverse effect on reproductive function or gonad histopathology seen in male and female rats exposed to 28.6 mg/l (8,000 ppm) MTBE vapor over two generations.

Developmental Effects
MTBE is not selectively toxic to the fetus. No adverse developmental effects were reported in rabbits exposed to high concentrations during pregnancy, despite the occurrence of maternal toxicity (CNS effects, significantly lower food intake, significantly lower maternal body weight). Similar maternal signs were noted in mice exposed under similar conditions, however in this instance an increased incidence of cleft palate was apparent in the offspring. Cleft palate is a stress-related phenomenon in the mouse hence this observation was considered secondary to maternal toxicity in this species.

Genetic Toxicity
MTBE has been tested extensively for genotoxic activity in a range of in vitro and in vivo tests. While the majority of results are negative, weak positive findings (consistent with the metabolism of MTBE to formaldehyde by S9 fraction in vitro) have been obtained with Salmonella typhimurium TA102 and L5178Y TK+/- mouse lymphoma cells. Consistently negative results have been obtained from in vivo tests, however, and indicate that formation of free formaldehyde in the body is negligible. Overall, the weight of evidence indicates that MTBE is not a genotoxin.

Carcinogenicity
Studies in experimental animals have found only limited evidence for the carcinogenicity for MTBE, with tumors occurring in tissues or via mechanisms considered not relevant to humans. Female mice exposed by inhalation to up to 28.6 mg/l (8,000 ppm) MTBE vapor responded with an increased incidence of liver tumors, while male rats developed tumors in testis and kidney under similar conditions. Mechanistic studies have shown important differences in the disposition and fate of MTBE in rodents and humans, suggesting that these findings after long-term inhalation exposure are not indicative of a risk to health. Results are also available from a life-time study of non-standard design, which reported an increased incidence of combined lymphoma/leukemia in female rats given MTBE by gavage, however inadequacies in the design and reporting of this investigation limit confidence in the result. Critically, MTBE is not genotoxic indicating that a direct effect on DNA is unlikely. Listed by IARC as not classifiable as to its carcinogenicity to humans (Group 3). This listing is based on inadequate evidence in humans and limited evidence of carcinogenicity in experimental animals.

- Ethyl alcohol 64-17-5

<table>
<thead>
<tr>
<th>Acute Toxicity - Lethal Doses</th>
<th>Rat</th>
<th>LD50 (Oral)</th>
<th>7060 MG/KG BWT</th>
<th>LDLo (Oral)</th>
<th>1400 MG/KG BWT</th>
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</thead>
<tbody>
<tr>
<td>LC50 (Inhli)</td>
<td>20000 PPM</td>
<td>10 HOURS</td>
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Irritation
Skin: Defatting of the skin with irritation, dryness and cracking. Standard Draize skin test (rabbit) - Dose: 20 mg/24 hrs Reaction: Moderate

Eye: Eye exposure to Ethanol generally causes transient pain, irritation, and reflex lid closure. A foreign-body sensation may persist for one to two days. Vapors produce transient stinging and tearing, but no apparent adverse effects. Transiently impaired preception of color may occur with acute ingestion or chronic alcoholism. Standard Draize eye test (rabbit) - Dose: 500 mg Reaction: Severe Dose: 500 mg/24 hrs Reaction: Mild

Repeated Dose Toxicity
Exposure to over 1000 ppm may cause headache, drowsiness and lassitude, loss of appetite, inability to concentrate and irritation of the throat.

Reproductive Effects
Excessive consumption of alcoholic beverages during pregnancy can cause fetal alcohol syndrome. The development of physical and mental manifestation in the offspring; it may also cause defects in the central nervous system, heart, kidney and limbs. Moderate consumption can be associated with reduced birthweight and behavioral defects, but effects generally have not been observed with an intake of about one drink per day.

Carcinogenicity
The International Agency for Research on Cancer (IARC) has determined alcoholic beverages are carcinogenic to humans (Group 1) and the occurrence of malignant tumors of the oral cavity, pharynx, larynx, esophagus and liver is causally related to the consumption of alcoholic beverages in humans. The American Conference of Governmental Industrial Hygienists (ACGIH) list ethyl alcohol as an A4 - Not classifiable as a Human Carcinogen. These are agents, which cause concern that they are carcinogenic for humans, but which cannot be assessed conclusively because of a lack of data. Animal studies do not provide indications carcinogenicity which are sufficient to classify the agent into one of their other categories.

- tert-Butyl Alcohol 75-65-0

**Acute Toxicity - Lethal Doses**

<table>
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<th>Parameter</th>
<th>Species</th>
<th>Dose</th>
<th>Duration</th>
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</thead>
<tbody>
<tr>
<td>LC50 (Inh)</td>
<td>Rat</td>
<td>&gt; 14,100 PPM</td>
<td>4 HOURS</td>
</tr>
<tr>
<td>LD50 (Oral)</td>
<td>Rat</td>
<td>2,733 MG/KG BWT</td>
<td></td>
</tr>
<tr>
<td>LD50 (Skin)</td>
<td>Rabbit</td>
<td>&gt; 2000 MG/KG BWT</td>
<td></td>
</tr>
</tbody>
</table>

**Irritation**

- **Skin**: May be irritating to the skin. No significant signs or symptoms indicative of any health hazard are expected to occur as a result of skin absorption exposure. Not expected to be a sensitizer.
- **Eye**: Neat liquid may produce moderate to severe, reversible eye irritation. Washing the eyes after 30 seconds did not significantly reduce the irritation.

**Target Organ Effects**

- Skin. Respiratory system. Central nervous system.

**Repeated Dose Toxicity**

Subchronic and chronic administration of t-butanol in the drinking water of male rats at concentrations of 1.25 mg/ml (estimated at 90 mg/kg bwt and higher) resulted in kidney pathology. The kidney pathology is mediated through the α-2u-globulin mode of action. In male and female rats that received 90 mg/kg bwt and higher t-butanol, there was an increase in the severity of chronic progressive nephropathy, a disease not relevant for humans. In male and female mice at concentrations in drinking water of 10 mg/ml (~1000 mg/kg bwt), an increased incidence of thyroid follicular cell hyperplasia was observed, and at ~2000 mg/kg bwt, the mice exhibited an increased inflammation of the urinary bladder resulting in hyperplasia.

**Reproductive Effects**

T-butanol had no effect on fertility in a one-generation screening study. At maternally toxic doses (1000 mg/kg), there were fewer live pups per litter and lower birth weight, which continued through gestation. No adverse effects on testes and ovary structure were seen in rats that received repeated high oral doses (up to 8200 mg/kg bwt). No studies assessing fertility effects are currently available.

**Developmental Effects**

Results from studies in pregnant rats and mice indicate that t-butanol is not teratogenic but at high oral doses (1550 mg/kg bwt) produces embryo/fetotoxicity and developmental delay.

**Genetic Toxicity**

Negative for genotoxicity both in vitro and in vivo tests.

**Carcinogenicity**

In a drinking water study, t-butanol induced benign kidney tumors in male rats via an α-2u-globulin mode of action, a tumor mechanism not relevant to humans. In female mice, there was an increased incidence of benign thyroid tumors. t-Butanol is not classified as to carcinogenicity by OSHA, NTP, IARC or EPA.

**SECTION 12: ECOLOGICAL INFORMATION**

**Ecotoxicity**
This material is classified as harmful to invertebrates. This material is not classified as harmful or toxic to fish. See component summary.

WGK
Not classified.

Environmental Fate and Pathway
Expected to have high mobility in soils. Volatilization from moist soil surfaces may occur. Expected to volatilize rapidly from surface waters with an estimated half-life in a model river of 1.5 hours and in a model lake of 101 hours. May adsorb to suspended solids and sediment in water. Undergoes photo-oxidation with hydroxyl groups in air with a half-life of 17 hours. This substance presents a potential concern to groundwater supplies. Small amounts of this substance or gasoline blended with this substance may impart an unpleasant odor and taste to the groundwater, which can render such groundwater unsuitable for consumption. Therefore, care should be used when handling, storing or transferring this substance or gasoline blended with this substance to ensure that such product is not released into the environment and is not allowed to migrate to groundwater. Because this substance has a low solubility in water and a relatively low organic carbon partitioning coefficient, every release into the environment has the potential for damaging groundwater supplies. Once in the groundwater, this substance is expected to migrate faster and farther than most other hydrocarbons and be present at the leading edge of a groundwater contaminant plume. This substance may not biodegrade as promptly as other gasoline constituents and may require additional and more costly remediation procedures.

Persistence and Degradability
Biodegradation: Inherently biodegradable by adapted microorganisms under aerobic conditions. May biodegrade under anaerobic conditions.
Bioaccumulation: This material is not expected to bioaccumulate.

Other Adverse Effects
This material does not adhere readily to soil particles and may travel rapidly and extensively in a groundwater plume. Therefore, groundwater remediation efforts may be difficult and extensive.

COMPONENT INFORMATION

- Ethyl Tertiary Butyl Ether 637-92-3

Ecotoxicity
Acute toxicity to fish
LC50 / 96 HOUR sheepshead minnow. > 2,500 mg/l

Acute toxicity to aquatic invertebrates
EC50 / 96 HOUR common shrimp (mysid) 37 mg/l
EC50 / 48 HOUR daphnia 110 mg/l

Toxicity to aquatic plants
EC50 / 72 HOUR green algae 1,100 mg/l

Toxicity to microorganisms

Summary: No Data Available.

Chronic toxicity to fish

Summary: No Data Available.
Chronic toxicity to aquatic invertebrates

Summary: No Data Available.

Environmental Fate and Pathway

Expected to have high mobility in soils. Volatilization from moist soil surfaces may occur. Expected to volatilize rapidly from surface waters with an estimated half-life in a model river of 1.5 hours and in a model lake of 101 hours. May adsorb to suspended solids and sediment in water. Undergoes photo-oxidation with hydroxyl groups in air with a half-life of 17 hours.

Persistence and Degradability

Biodegradation: Inherently biodegradable by adapted microorganisms under aerobic conditions. May biodegrade under anaerobic conditions.

Bioaccumulation: This material is not expected to bioaccumulate. BCF = 6.0  Log Kow = 1.48 - 1.56 (estimated).

Ecotoxicity

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

Acute toxicity to fish
LC50 / 96 HOURS fathead minnow 672 - 980 mg/l
LC50 / 96 HOUR rainbow trout 887 mg/l
LC50 / 96 HOUR bluegill sunfish 1,054 mg/l
LC50 / 96 HOUR silverside minnow 574 mg/l
LC50 / 96 HOUR sheepshead minnow 1,358 mg/l

Acute toxicity to aquatic invertebrates
EC50 / 48 HOUR Daphnia magna 472 - 681 mg/l
LC50 / 48 HOUR waterflea 340 mg/l
EC50 / 96 HOUR saltwater mysid 136 - 187 mg/l

Toxicity to aquatic plants
IC50 / 96 HOUR green algae (Selenastrum) 491 mg/l

Toxicity to microorganisms

Summary: No Data Available.

Chronic toxicity to fish
IC50 / 31 DAY fathead minnow 279 mg/l

Chronic toxicity to aquatic invertebrates
NOEC50 / 28 DAY saltwater mysid 26 mg/l

Summary: May pose slight chronic toxicity in specific invertebrates.

Environmental Fate and Pathway
MTBE presents a potential concern to groundwater supplies. Small amounts (by some accounts in the below one part per billion range) of MTBE or gasoline blended with MTBE may impart an unpleasant and distasteful odor and taste to groundwater which can render such groundwater unsuitable for consumption. Therefore, care should be used when handling, storing or transferring MTBE or gasoline blended with MTBE to insure that such product is not released into the environment and is not allowed to migrate to groundwater. Because of its solubility in water (4.3%) and relatively low organic carbon partitioning coefficient (Koc=11), MTBE is mobile in soil and, accordingly, every release into the environment has the potential for damaging groundwater supplies. Once in the groundwater, MTBE tends to migrate faster and farther than most other hydrocarbons and is typically present at the leading edge of a groundwater contaminant plume. MTBE may not biodegrade as promptly as other gasoline constituents and may require additional and more costly remediation procedures. Other information regarding MTBE is available through the Chemical Abstracts Service, American Petroleum Institute publications, the U.S. Environmental Protection Agency and elsewhere.

**Mobility**

Transport between environmental compartments: The atmosphere is the main environmental compartment for releases of MTBE. In water, volatilization will result in substantial losses to the atmosphere with a half-life of 5-6 days.

**Persistence and Degradability**

Biodegradation: Two OECD 301D studies (closed bottle test) showed negligible (0-2%) biodegradation after 28 days. Not readily biodegradable under aerobic conditions. However, degradation has been observed in non-standard tests using pure- and mixed bacterial cultures.

Bioaccumulation: Log Kow (Fish) <3 This material is not expected to bioaccumulate.

**Other Adverse Effects**

This material does not adhere readily to soil particles and may travel rapidly and extensively in a groundwater plume. Therefore, groundwater remediation efforts may be difficult and extensive. As a VOC, MTBE can contribute to the formation of photochemical smog in the presence of other VOC’s.

- **Ethyl alcohol  64-17-5**

**Ecotoxicity**

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

Acute toxicity to fish

- LC50 / 96 HOUR  rainbow trout. > 10,000 mg/l
- Summary: Static and/or flow-through LC50(96-hr)= 13,000-15,300 mg/l

- LC50 / 96 HOUR  fathead minnow  15,300 mg/l

Toxicity to aquatic plants

- Toxicity Threshold /  green algae. 1,450 mg/l
- Summary: growth inhibition

Toxicity to microorganisms

- Toxicity Threshold /  bacteria. 6,500 mg/l
- Summary: Inhibition of cell multiplication begins.

**Environmental Fate and Pathway**

When spilled on the land ethyl alcohol is apt to volatilize, biodegrade, and/or leach into the ground water. It is anticipated based on physical properties of ethyl alcohol including water solubility, vapor pressure, and octanol/water coefficient (log P= -0.31) that water will serve as the final media. Based on these factors it is anticipated that this substance will neither adsorb to soil nor bioconcentrate in aquatic organisms. Once in water photolysis, oxidation, hydrolysis, and biodegradation is anticipated to occur.

**Persistence and Degradability**

Biodegradation: This material is expected to be biodegradable.

Bioaccumulation: This material is not expected to bioaccumulate.
• tert-Butyl Alcohol  75-65-0

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

Acute toxicity to fish
LC50 / 96 HOUR  fathead minnow  > 961 mg/l

Acute toxicity to aquatic invertebrates
EC50 / 48 HOUR  waterflea. 5,504 mg/l

Toxicity to aquatic plants
EC50 /  green algae.  > 976 mg/l
Summary: growth inhibition

Toxicity to microorganisms
EC50 /  bacteria. 11,263 mg/l
EC0 /  bacteria. 13,560 mg/l
EC10 / 18 HOUR  bacteria. 2,050 mg/l

Chronic toxicity to fish
Summary: No Data Available.

Chronic toxicity to aquatic invertebrates
Summary: No Data Available.

Environmental Fate and Pathway
The product is volatile and will partition to air. Degraded in the atmosphere by reaction with photochemically produced hydroxyl radicals with an estimated half life ranging from 2.5 days to 25 days.

Persistence and Degradability
Stability in Water: Not expected to volatilize from surface waters. Not likely to adsorb to suspended solids and sediment in water.
Stability in Soil: Expected to have high mobility in soils. Volatilization from dry soil surfaces is expected. Volatilization from moist soil surfaces is expected.
Biodegradation: This material is expected to be inherently biodegradable.
Bioaccumulation: BCF < 5  This material is not expected to bioaccumulate.

SECTION 13: DISPOSAL CONSIDERATIONS
Contaminated product, soil, or water should be designated hazardous wastes due to potentially low flash point. Landfill solids at permitted sites. Use registered transporters. Burn concentrated liquids in systems designed for low flash point material. Assure emissions comply with applicable regulations. Avoid overloading/poisoning plant biomass. Assure effluent complies with applicable regulations.

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  ETHYL BUTYL ETHER
ETHYL TERTIARY BUTYL ETHER

ID No. UN1179

Hazard Class 3

REGULATORY INFORMATION

Regulatory Status

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<tr>
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</tbody>
</table>

X = All components are included or are otherwise exempt from inclusion on this inventory.

C = Contact Lyondell/Equistar by e-mail at product.safety@lyondell.com or product.safety@equistarchem.com for additional information.

Labeling Information

Symbol
Highly Flammable

R-Phrases
R11 - Highly flammable.
R52 - Harmful to aquatic organisms.

S-Phrases
S16 - Keep away from sources of ignition - No Smoking.
S23 - Do not breathe gas/fumes/vapor/spray.
S29 - Do not empty into drains.
S33 - Take precautionary measures against static discharges.

EU Labeling Information:

OTHER INFORMATION

Latest Revision(s)
First Edition Date of Initial Preparation: May 4 2004

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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
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