Common Name: ETHYLENE OXIDE

Synonyms: Dimethylene Oxide; 1,2-Epoxyethane; ETO
Chemical Name: Oxirane
Date: November 2009    Revision: August 2016

Description and Use
Ethylene Oxide is a colorless gas or liquid with an Ether-like odor. It is used to make other chemicals, and as a sterilant and fumigant.

▲ ODOR THRESHOLD = 257 to 690 ppm
▲ Odor thresholds vary greatly. Do not rely on odor alone to determine potentially hazardous exposures.

Reasons for Citation
▲ Ethylene Oxide is on the Right to Know Hazardous Substance List because it is cited by OSHA, ACGIH, DOT, NIOSH, NTP, DEP, IARC, NFPA and EPA.
▲ This chemical is on the Special Health Hazard Substance List.

FIRST AID
Eye Contact
▲ Immediately flush with large amounts of water for at least 30 minutes, lifting upper and lower lids. Remove contact lenses, if worn, while flushing. Seek medical attention.

Skin Contact
▲ Quickly remove contaminated clothing. Immediately wash contaminated skin with large amounts of soap and water.
▲ Immense affected part in warm water. Seek medical attention.

Inhalation
▲ Remove the person from exposure.
▲ Begin rescue breathing (using universal precautions) if breathing has stopped and CPR if heart action has stopped.
▲ Transfer promptly to a medical facility.
▲ Medical observation is recommended for 24 to 48 hours after overexposure, as pulmonary edema may be delayed.

EMERGENCY NUMBERS
Poison Control: 1-800-222-1222
CHEMTREC: 1-800-424-9300
NJDEP Hotline: 1-877-927-6337
National Response Center: 1-800-424-8802

Hazard Summary

<table>
<thead>
<tr>
<th>Hazard Rating</th>
<th>NJDHSS</th>
<th>NFPA</th>
</tr>
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<tbody>
<tr>
<td>HEALTH</td>
<td>-</td>
<td>3</td>
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<tr>
<td>FLAMMABILITY</td>
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<td>4</td>
</tr>
<tr>
<td>REACTIVITY</td>
<td>-</td>
<td>3</td>
</tr>
</tbody>
</table>

Carcinogen and Teratogen
Flammable and Reactive
Poisonous gases are produced in fire. Containers may explode in fire.

Hazard Rating Key: 0=minimal; 1=slight; 2=moderate; 3=serious; 4=severe

▲ Ethylene Oxide can affect you when inhaled and by passing through the skin.
▲ Ethylene Oxide is a CARCINOGEN, MUTAGEN and TERATOGEN. HANDLE WITH EXTREME CAUTION.
▲ Contact can severely irritate and burn the skin and eyes.
▲ Contact with undiluted liquid can cause frostbite.
▲ Exposure to Ethylene Oxide can irritate the nose and throat.
▲ Inhaling Ethylene Oxide can irritate the lungs. Higher exposures may cause a build-up of fluid in the lungs (pulmonary edema), a medical emergency.
▲ Exposure can cause headache, nausea, vomiting, dizziness, twitching, and seizures.
▲ Ethylene Oxide may cause a skin allergy.
▲ High or repeated exposure may damage the nervous system.
▲ Ethylene Oxide may damage the liver and kidneys.
▲ Ethylene Oxide is FLAMMABLE and REACTIVE and a DANGEROUS FIRE and EXPLOSION HAZARD.
▲ Ethylene Oxide may polymerize (self-react) violently.

Workplace Exposure Limits
OSHA: The legal airborne permissible exposure limit (PEL) is 1 ppm averaged over an 8-hour workshift and 5 ppm.

NIOSH: The recommended airborne exposure limit (REL) is less than 0.1 ppm and 5 ppm.

ACGIH: The threshold limit value (TLV) is 1 ppm averaged over an 8-hour workshift.

▲ Ethylene Oxide is a CARCINOGEN and TERATOGEN in humans. There may be no safe level of exposure to a carcinogen, so all contact should be reduced to the lowest possible level.
▲ The above exposure limits are for air levels only. When skin contact also occurs, you may be overexposed, even though air levels are less than the limits listed above.
ETHYLENE OXIDE

Determining Your Exposure

- Read the product manufacturer’s Material Safety Data Sheet (MSDS) and the label to determine product ingredients and important safety and health information about the product mixture.
- For each individual hazardous ingredient, read the New Jersey Department of Health and Senior Services Hazardous Substance Fact Sheet, available on the RTK Program website (http://www.state.nj.us/health/workplacehealthandsafety/right-to-know/) or in your facility’s RTK Central File or Hazard Communication Standard file.
- You have a right to this information under the New Jersey Worker and Community Right to Know Act, and the Public Employees Occupational Safety and Health (PEOSH) Act if you are a public worker in New Jersey, and under the federal Occupational Safety and Health Act (OSHA) if you are a private worker.
- The New Jersey Right to Know Act requires most employers to label chemicals in the workplace and requires public employers to provide their employees with information concerning chemical hazards and controls. The federal OSHA Hazard Communication Standard (29 CFR 1910.1200) and the PEOSH Hazard Communication Standard (N.J.A.C. 12:100-7) require employers to provide similar information and training to their employees.

This Fact Sheet is a summary of available information regarding the health hazards that may result from exposure. Duration of exposure, concentration of the substance and other factors will affect your susceptibility to any of the potential effects described below.

Health Hazard Information

Acute Health Effects
The following acute (short-term) health effects may occur immediately or shortly after exposure to Ethylene Oxide:

- Contact can severely irritate and burn the skin and eyes with possible eye damage.
- Contact with undiluted liquid can cause frostbite.
- Exposure to Ethylene Oxide can irritate the nose and throat.
- Inhaling Ethylene Oxide can irritate the lungs causing coughing and/or shortness of breath. Higher exposures may cause a build-up of fluid in the lungs (pulmonary edema), a medical emergency, with severe shortness of breath.
- Exposure can cause headache, nausea, vomiting, dizziness, twitching, and seizures.

Chronic Health Effects
The following chronic (long-term) health effects may occur at some time after exposure to Ethylene Oxide and can last for months or years:

Cancer Hazard
- Ethylene Oxide is a CARCINOGEN in humans. There is evidence that it causes leukemia in humans and it has been shown to cause blood, stomach, lung, and other types of cancer in animals.

- Many scientists believe there is no safe level of exposure to a carcinogen.

Reproductive Hazard
- Ethylene Oxide may be a TERATOGEN in humans since it is a teratogen in animals.
- There is limited evidence that Ethylene Oxide causes spontaneous abortions.
- Ethylene Oxide may damage the developing fetus.
- Ethylene Oxide may damage the testes (male reproductive glands).

Other Effects
- Ethylene Oxide may cause a skin allergy. If allergy develops, very low future exposure can cause itching and a skin rash.
- Ethylene Oxide can irritate the lungs. Repeated exposure may cause bronchitis to develop with coughing, phlegm, and/or shortness of breath.
- High or repeated exposure may damage the nerves causing weakness, “pins and needles,” and poor coordination in the arms and legs.
- Ethylene Oxide may damage the liver and kidneys.

Medical

Medical Testing
Before first exposure and every 12 months thereafter, OSHA requires your employer to provide (for persons exposed to 0.5 ppm of Ethylene Oxide) a work and medical history and exam, which shall include:

- Chest x-ray and lung function tests
- Exam of the nervous system

If symptoms develop or overexposure is suspected, the following are recommended:

- Evaluation by a qualified allergist can help diagnose skin allergy
- Consider chest x-ray after acute overexposure
- Liver and kidney function tests

OSHA requires your employer to provide you and your doctor with a copy of the OSHA Ethylene Oxide Standard (29 CFR 1910.1047).

Any evaluation should include a careful history of past and present symptoms with an exam. Medical tests that look for damage already done are not a substitute for controlling exposure.

Request copies of your medical testing. You have a legal right to this information under the OSHA Access to Employee Exposure and Medical Records Standard (29 CFR 1910.1020).

Mixed Exposures
- Smoking can cause heart disease, lung cancer, emphysema, and other respiratory problems. It may worsen respiratory conditions caused by chemical exposure. Even if you have smoked for a long time, stopping now will reduce your risk of developing health problems.
- More than light alcohol consumption can cause liver damage. Drinking alcohol can increase the liver damage caused by Ethylene Oxide.
Workplace Controls and Practices
Very toxic chemicals, or those that are reproductive hazards or sensitizers, require expert advice on control measures if a less toxic chemical cannot be substituted. Control measures include: (1) enclosing chemical processes for severely irritating and corrosive chemicals, (2) using local exhaust ventilation for chemicals that may be harmful with a single exposure, and (3) using general ventilation to control exposures to skin and eye irritants. For further information on workplace controls, consult the NIOSH document on Control Banding at www.cdc.gov/niosh/topics/ctrlbanding/.

The following work practices are also recommended:

- Label process containers.
- Provide employees with hazard information and training.
- Monitor airborne chemical concentrations.
- Use engineering controls if concentrations exceed recommended exposure levels.
- Provide eye wash fountains and emergency showers.
- Wash or shower if skin comes in contact with a hazardous material.
- Always wash at the end of the workshift.
- Change into clean clothing if clothing becomes contaminated.
- Do not take contaminated clothing home.
- Get special training to wash contaminated clothing.
- Do not eat, smoke, or drink in areas where chemicals are being handled, processed or stored.
- Wash hands carefully before eating, smoking, drinking, applying cosmetics or using the toilet.

In addition, the following may be useful or required:

- Specific actions are required for this chemical by OSHA. Refer to the OSHA Ethylene Oxide Standard (29 CFR 1910.1047) and the Compressed gases Standard (29 CFR 1920.101).
- Before entering a confined space where Ethylene Oxide may be present, check to make sure that an explosive concentration does not exist.
- Where possible, transfer Ethylene Oxide from cylinders or other containers to process containers in an enclosed system.

Personal Protective Equipment
The OSHA Personal Protective Equipment Standard (29 CFR 1910.132) requires employers to determine the appropriate personal protective equipment for each hazard and to train employees on how and when to use protective equipment.

The following recommendations are only guidelines and may not apply to every situation.

Gloves and Clothing
- Avoid skin contact with Ethylene Oxide. Wear personal protective equipment made from material which can not be permeated or degraded by this substance. Safety equipment suppliers and manufacturers can provide recommendations on the most protective glove and clothing material for your operation.

- Safety equipment manufacturers recommend Butyl and Silver Shield®/4H® for gloves, and CPF 3, BR, Responder®, and TK; and Trellchem® HPS and VPS, or the equivalent, as protective materials for clothing.
- All protective clothing (suits, gloves, footwear, headgear) should be clean, available each day, and put on before work.

Eye Protection
- Wear non-vented, impact resistant goggles when working with fumes, gases, or vapors.
- Wear a face shield along with goggles when working with corrosive, highly irritating or toxic substances.
- Do not wear contact lenses when working with this substance.

Respiratory Protection
Improper use of respirators is dangerous. Respirators should only be used if the employer has implemented a written program that takes into account workplace conditions, requirements for worker training, respirator fit testing, and medical exams, as described in the OSHA Respiratory Protection Standard (29 CFR 1910.134).

- Where the potential exists for exposure over 1 ppm, use a NIOSH approved supplied-air respirator with a full facepiece operated in a pressure-demand or other positive-pressure mode. For increased protection use in combination with an auxiliary self-contained breathing apparatus or an emergency escape air cylinder.
- Exposure to 800 ppm is immediately dangerous to life and health. If the possibility of exposure above 800 ppm exists, use a NIOSH approved self-contained breathing apparatus with a full facepiece operated in a pressure-demand or other positive-pressure mode equipped with an emergency escape air cylinder.

Fire Hazards
If employees are expected to fight fires, they must be trained and equipped as stated in the OSHA Fire Brigades Standard (29 CFR 1910.156).

- Ethylene Oxide is a FLAMMABLE GAS.
- Use dry chemical, CO₂, water spray, alcohol-resistant foam or other foam as extinguishing agents.
- Let fire burn if it cannot be stopped.
- Ethylene Oxide must be diluted with 24 parts water to 1 part Ethylene Oxide to stop flammability.
- POISONOUS GASES ARE PRODUCED IN FIRE.
- CONTAINERS MAY EXPLODE IN FIRE.
- Use water spray to keep fire-exposed containers cool.
- Vapor is heavier than air and may travel a distance to cause a fire or explosion far from the source.
- Ethylene Oxide forms an ignitable vapor/air mixture in closed tanks or containers.
- Heat or contamination may cause Ethylene Oxide to Polymerize (self-react) violently.
ETHYLENE OXIDE

Spills and Emergencies
If employees are required to clean-up spills, they must be properly trained and equipped. The OSHA Hazardous Waste Operations and Emergency Response Standard (29 CFR 1910.120) may apply.

If liquid Ethylene Oxide is spilled or leaked, take the following steps:
- Evacuate personnel and secure and control entrance to the area.
- Eliminate all ignition sources.
- Absorb liquids in vermiculite, dry sand, earth, or a similar material and place into sealed containers for disposal.

If Ethylene Oxide gas is leaked, take the following steps:
- Evacuate personnel and secure and control entrance to the area.
- Eliminate ignition sources.
- Ventilate area of leak to disperse the gas.
- Stop flow of gas. If source of leak is a cylinder and the leak cannot be stopped in place, remove the leaking cylinder to a safe place in the open air, and repair leak or allow cylinder to empty.
- Ventilate area of spill or leak.
- Keep Ethylene Oxide out of confined spaces, such as sewers, because of the possibility of an explosion.
- Turn leaking cylinder with leak up to prevent escape of gas in the liquid state.
- It may be necessary to contain and dispose of Ethylene Oxide as a HAZARDOUS WASTE. Contact your state Department of Environmental Protection (DEP) or your regional office of the federal Environmental Protection Agency (EPA) for specific recommendations.

Handling and Storage
Prior to working with Ethylene Oxide you should be trained on its proper handling and storage.
- Ethylene Oxide polymerizes (self-reacts) violently on contact with HEAT; STRONG ACIDS (such as HYDROCHLORIC, SULFURIC and NITRIC); STRONG BASES (such as SODIUM HYDROXIDE and POTASSIUM HYDROXIDE); METAL CHLORIDES (such as FERRIC CHLORIDE and MAGNESIUM CHLORIDE); and METAL OXIDES (such as ALUMINUM OXIDE and COPPER OXIDE).
- Ethylene Oxide is extremely explosive in the presence of OXIDIZING AGENTS (such as PERCHLORATES, PEROXIDES, PERMANGANATES, CHLORATES, NITRATES, CHLORINE, BROMINE and FLUORINE) and AIR.
- Ethylene Oxide is not compatible with AMMONIA; METALS (such as POTASSIUM, SILVER and MERCURY); ALCOHOLS; MERCAPTANS; CYANIDES; AMINES; and HALOGENATED HYDROCARBONS (such as METHYLENE CHLORIDE and TRICHLOROETHYLENE).
- Store in tightly closed containers in a cool, well-ventilated area away from SUNLIGHT and COMBUSTIBLES.
- Sources of ignition, such as smoking and open flames, are prohibited where Ethylene Oxide is used, handled, or stored.

- Metal containers involving the transfer of Ethylene Oxide should be grounded and bonded.
- Use explosion-proof electrical equipment and fittings wherever Ethylene Oxide is used, handled, manufactured, or stored.
- Use only non-sparking tools and equipment, especially when opening and closing containers of Ethylene Oxide.
- Avoid using Ethylene Oxide in systems with METAL FITTINGS containing COPPER, SILVER or MERCURY.

Occupational Health Information Resources
The New Jersey Department of Health and Senior Services, Occupational Health Service, offers multiple services in occupational health. These services include providing informational resources, educational materials, public presentations, and industrial hygiene and medical investigations and evaluations.

For more information, please contact:

New Jersey Department of Health & Senior Services
Right to Know Program
PO Box 368
Trenton, NJ 08625-0368
Phone: 609-984-2202
Fax: 609-984-7407
E-mail: rtk@doh.nj.gov
Web address:
http://www.state.nj.us/health/workplacehealthandsafety/right-to-know/

The Right to Know Hazardous Substance Fact Sheets are not intended to be copied and sold for commercial purposes.
**ETHYLENE OXIDE**

**GLOSSARY**

**ACGIH** is the American Conference of Governmental Industrial Hygienists. They publish guidelines called Threshold Limit Values (TLVs) for exposure to workplace chemicals.

**Acute Exposure Guideline Levels (AEGLs)** are established by the EPA. They describe the risk to humans resulting from once-in-a-lifetime, or rare, exposure to airborne chemicals.

**Boiling point** is the temperature at which a substance can change its physical state from a liquid to a gas.

A **cancer** is a substance that causes cancer.

The **critical temperature** is the temperature above which a gas cannot be liquefied, regardless of the pressure applied.

**DEP** is the New Jersey Department of Environmental Protection.

**DOT** is the Department of Transportation, the federal agency that regulates the transportation of chemicals.

**EPA** is the Environmental Protection Agency, the federal agency responsible for regulating environmental hazards.

**ERG** is the Emergency Response Guidebook. It is a guide for emergency responders for transportation emergencies involving hazardous substances.

**Emergency Response Planning Guideline (ERPG) values** provide estimates of concentration ranges where one reasonably might anticipate observing adverse effects.

A **fetus** is an unborn human or animal.

A **flammable** substance is a solid, liquid, vapor or gas that will ignite easily and burn rapidly.

The **flash point** is the temperature at which a liquid or solid gives off vapor that can form a flammable mixture with air.

**IARC** is the International Agency for Research on Cancer, a scientific group.

**Ionization Potential** is the amount of energy needed to remove an electron from an atom or molecule. It is measured in electron volts.

**IRIS** is the Integrated Risk Information System database on human health effects that may result from exposure to various chemicals, maintained by federal EPA.

**LEL** or **Lower Explosive Limit**, is the lowest concentration of a combustible substance (gas or vapor) in the air capable of continuing an explosion.

A **mutagen** is a substance that causes mutations. A **mutation** is a change in the genetic material in a body cell. Mutations can lead to birth defects, miscarriages, or cancer.

**NFPA** is the National Fire Protection Association. It classifies substances according to their fire and explosion hazard.

**NTP** is the National Toxicology Program which tests chemicals and reviews evidence for cancer.

**OSHA** is the federal Occupational Safety and Health Administration, which adopts and enforces health and safety standards.

**PEOSHA** is the New Jersey Public Employees Occupational Safety and Health Act, which adopts and enforces health and safety standards in public workplaces.

**Permeated** is the movement of chemicals through protective materials.

**ppm** means parts of a substance per million parts of air. It is a measure of concentration by volume in air.

**Protective Action Criteria (PAC)** are values established by the Department of Energy and are based on AEGLs and ERPGs. They are used for emergency planning of chemical release events.

A **reactive** substance is a solid, liquid or gas that releases energy under certain conditions.

**STEL** is a Short Term Exposure Limit which is usually a 15-minute exposure that should not be exceeded at any time during a work day.

A **teratogen** is a substance that causes birth defects by damaging the fetus.

**UEL** or **Upper Explosive Limit** is the highest concentration in air above which there is too much fuel (gas or vapor) to begin a reaction or explosion.

**Vapor Density** is the ratio of the weight of a given volume of one gas to the weight of another (usually Air), at the same temperature and pressure.

The **vapor pressure** is a force exerted by the vapor in equilibrium with the solid or liquid phase of the same substance. The higher the vapor pressure the higher concentration of the substance in air.
**Right to Know Hazardous Substance Fact Sheet**

**Common Name:** ETHYLENE OXIDE

**Synonyms:** Dimethylene Oxide; 1,2-Epoxyethane; ETO; Oxirane

**CAS No:** 75-21-8

**Molecular Formula:** C₂H₄O

**RTK Substance No:** 0882

**Description:** Colorless gas or liquid with an Ether-like odor

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### HAZARD DATA

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<thead>
<tr>
<th>Hazard Rating</th>
<th>Firefighting</th>
<th>Reactivity</th>
</tr>
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<tbody>
<tr>
<td>3 - Health</td>
<td>FLAMMABLE AND REACTIVE GAS OR LIQUID</td>
<td>Ethylene Oxide polymerizes (self-reacts) violently on contact with HEAT; STRONG ACIDS (such as HYDROCHLORIC, SULFURIC and NITRIC); STRONG BASES (such as SODIUM HYDROXIDE and POTASSIUM HYDROXIDE); METAL CHLORIDES (such as FERRIC CHLORIDE and MAGNESIUM CHLORIDE); and METAL OXIDES (such as ALUMINUM OXIDE and COPPER OXIDE).</td>
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<td>Use dry chemical, CO₂, water spray, alcohol-resistant foam or other foam as extinguishing agents. Let fire burn if it cannot be stopped.</td>
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</tbody>
</table>

### SPILL/LEAKS

- **Isolation Distance:**
  - Small Spill: 30 meters (100 feet)
  - Large Spill: 150 meters (500 feet)

- **Exposure Limits:**
  - OSHA: 1 ppm, 8-hr TWA; 5 ppm, 15-min Excursion
  - NIOSH: <0.1 ppm, 10-hr TWA; 5 ppm, 10-min Ceiling
  - ACGIH: 1 ppm, 8-hr TWA

- **IDLH:** 800 ppm

| Hazard Class: 2.3 | (Poisonous gas) |

- Turn leaking cylinder over to prevent escape of gas in the liquid state.
- Use water spray to keep containers cool.
- Absorb liquids in vermiculite, dry sand, earth, or a similar material and place into sealed containers for disposal.
- Use only non-sparking tools and equipment, especially when opening and closing containers of Ethylene Oxide.
- Keep Ethylene Oxide out of confined spaces, such as sewers, because of the possibility of an explosion.
- Use water spray to keep containers cool.
- Turn leaking cylinder with leak up to prevent escape of gas in the liquid state.

- No adverse ecological effects are expected.

### PHYSICAL PROPERTIES

- **Odor Threshold:** 257 to 690 ppm
- **Flash Point:** -4°F (-20°C)
- **LEL:** 3%
- **UEL:** 100%
- **Auto Ignition Temp:** 804°F (429°C)
- **Vapor Density:** 1.5 (air = 1)
- **Vapor Pressure:** 1,095 mm Hg at 68°F (20°C)
- **Specific Gravity:** 0.87 (water = 1)
- **Water Solubility:** Miscible
- **Boiling Point:** 51°F (11°C)
- **Freezing Point:** -170°F (-112°C)
- **Ionization Potential:** 10.56 eV
- **Molecular Weight:** 44.06

### PROTECTIVE EQUIPMENT

- **Gloves:** Butyl and Silvershield®/4H® (<1-hr breakthrough)
- **Coveralls:** Tychem® BR, TK and Responder®, and Trellchem®
- **HPS and VPS (≥8-hr breakthrough):** At 10% of the LEL use turn-out gear or flash protection
- **Respirator:** SCBA

### HEALTH EFFECTS

| Eyes: | Severe irritation and burns |
| Skin: | Severe irritation and burns. Contact with liquid causes frostbite |
| Inhalation: | Nose, throat and lung irritation, with coughing, and severe shortness of breath (pulmonary edema) Headache, nausea, vomiting, dizziness, twitching, and seizures |
| Chronic: | Cancer (leukemia) in humans |

### FIRST AID AND DECONTAMINATION

- **First Aid:** Remove the person from exposure.
- **Flush** eyes with large amounts of water for at least 30 minutes. Remove contact lenses if worn. Seek medical attention.
- **Quickly** remove contaminated clothing and wash contaminated skin with large amounts of soap and water.
- **Immerse** affected part in warm water. Seek medical attention.
- **Begin** artificial respiration if breathing has stopped and CPR if necessary.
- **Transfer** promptly to a medical facility.
- **Medical** observation is recommended as symptoms may be delayed.

August 2016