

Praxair Material Safety Data Sheet

1. Chemical Product and Company Identification

Product Name: Ethylene Oxide	Trade Name: Ethylene Oxide
Product Use: Many.	
Chemical Name: Ethylene Oxide	Synonym: Dihydrooxirine, dimethylene oxide, oxane, oxacyclopropane, oxidoethane, oxiran, oxirane, 1,2 epoxyethane
Chemical Formula: C ₂ H ₄ O	Chemical Family: Alkyl epoxide
Telephone: Emergencies: * 1-800-363-0042	Supplier /Manufacture: Praxair Canada Inc. 1 City Centre Drive Suite 1200 Mississauga, ON L5B 1M2 Phone: 905-803-1600 Fax: 905-803-1682

**Call emergency numbers 24 hours a day only for spills, leaks, fire, exposure, or accidents involving this product. For routine information, contact your supplier or Praxair sales representative.*

2. Composition and Information on Ingredients

INGREDIENTS	% (VOL)	CAS NUMBER	LD ₅₀ (Species & Routes)	LC ₅₀ (Rat, 4 hrs.)	TLV-TWA (ACGIH)
Ethylene oxide	100	75-21-8	72 mg/kg	1462 ppm	1 ppm

3. Hazards Identification

Emergency Overview

DANGER! Cancer hazard and reproductive hazard. Toxic, extremely flammable liquid and gas under pressure. Can form explosive mixtures with air. Can cause eye and skin burns. Can irritate the respiratory tract. May cause nervous system damage and cataracts. Liquid may cause frostbite. May cause dizziness and drowsiness. Symptoms of exposure may be delayed. Self-contained breathing apparatus must be worn by rescue workers. Ethylene Oxide is highly reactive.

ROUTES OF EXPOSURE:

Inhalation. Swallowing. Skin Absorption. Skin contact. Eye contact.

EFFECTS OF A SINGLE (ACUTE) OVEREXPOSURE:

INHALATION:

May be fatal if inhaled in high concentration. Causes irritation of the respiratory tract. Depending on the degree of exposure, there may be stinging of the nose and throat, coughing, chest tightness, headache, nausea, vomiting, diarrhea, weakness, drowsiness, cyanosis, loss of coordination, convulsions and coma. May cause lung injury and the delayed onset of pulmonary edema.

SKIN CONTACT:

With liquid or solutions in water, there may occur a local erythema, edema, and formation of

vesicles. There may be a latent period of several hours to the onset of these signs. Large volumes of ethylene oxide spilled onto the skin may produce a frostbite-like effect.

SKIN ABSORPTION: Sustained contact with the skin is unlikely, but can cause headache, dizziness, nausea and vomiting.

SWALLOWING: A highly unlikely route of exposure. Will cause severe irritation and ulceration of the mouth and throat, abdominal pain, nausea, vomiting, collapse and coma.

EYE CONTACT: Severe irritation with corneal injury from liquid. Moderate irritation from high concentrations of vapour.

EFFECTS OF REPEATED (CHRONIC) OVEREXPOSURE:

Allergic contact dermatitis may occur in small proportion of exposed workers. In various reports involving recurrent exposures to high concentrations of ethylene oxide vapour, peripheral neurotoxic effects and, in some cases, indications of central nervous system toxicity, were described. In most cases, there was marked improvement on removal from further exposure. A few cases of cataract formation have also been linked to such exposures. Although one epidemiological study has suggested that ethylene oxide exposed women may have an increased incidence of abortions, the laboratory findings indicate that if adverse reproductive effects are produced by ethylene oxide, these occur only at high exposure concentrations. Several studies on ethylene oxide exposed workers have demonstrated an increased incidence of chromosomal aberrations and sister chromatid exchanges; the relevance of such effects to human health hazard evaluation is currently uncertain. OSHA considers that, at excessive levels, ethylene oxide may present reproductive, mutagenic, genotoxic, neurologic and sensitization hazards

OTHER EFFECTS OF OVEREXPOSURE:

May cause cataracts. For other effects see below.

MEDICAL CONDITIONS AGGRAVATED BY OVEREXPOSURE:

A knowledge of the available toxicology information and the physical and chemical properties of the material suggest that overexposure is unlikely to aggravate existing medical conditions.

SIGNIFICANT LABORATORY DATA WITH POSSIBLE RELEVANCE TO HUMAN HEALTH HAZARD EVALUATION:

Ethylene Oxide: This component has been shown to produce mutagenic and cytogenic effects in a variety of test systems. Animals exposed to ethylene oxide vapour for up to two years have shown an increase in the incidence of certain malignant tumors in comparison to no-exposed controls.

In humans, an increased occurrence of leukemia and stomach cancer has been reported by one group of investigators who pooled results from three Swedish facilities producing or using ethylene oxide, among other materials. Based on experimental and observational data ethylene oxide is a suspect cancer hazard, and should be treated as possibly causing cancer in humans. Laboratory studies with mice have shown that acute exposure to ethylene oxide vapour at concentrations of 30 ppm and above cause testicular injury as evidenced by concentration-related increased embryonic deaths following the mating of exposed males to non-exposed females. (Dominant Lethal Test). A recently completed NIOSH study of sterilant workers found an elevated risk of blood cancers among men and breast cancers among women. The elevated risk occurred only at high exposures as defined by a combination of exposure level and years worked. The study showed no elevated cancer or disease risk for sterilant workers overall as compared to the general U.S. population.

In a developmental toxicity study with rats exposed to 225, 125, or 50 ppm of ethylene oxide vapor, there was a maternal toxicity at 225 ppm and at 125 ppm. Fetotoxicity was present as reduced fetal body weight at all concentrations, and increased incidents of skeletal variants at 225 indications of embryotoxicity or malformations. In a two-generation oxide vapor for 6 hr/day, 5 day/week, there was a parental toxicity at 33 and 100 ppm. The no-observed-effects concentrations for adult toxicity, offspring effects, and reproductive effects was 10 ppm.

CARCINOGENICITY:

OSHA considers ethylene oxide to pose a human cancer hazard and a human reproductive hazard. The IARC assigns it to Group 1, "Carcinogenic to humans". The NTP classifies it as "known to be a human carcinogen".

MUTAGENIC EFFECTS: Classified PROVEN for human.

DEVELOPMENTAL TOXICITY: Classified Reproductive system/toxin/female, Reproductive system/toxin/male [PROVEN].

Causes damage to the following organs: the reproductive system.

May cause damage to the following organs: the nervous system, skin, eyes.

4. First Aid Measures

INHALATION:

If inhaled, remove to fresh air. If not breathing, give artificial respiration. If breathing is difficult, give oxygen. Get medical attention.

SKIN CONTACT:

Immediately flush affected areas with water for at least 15 minutes while removing contaminated clothing and shoes. Wash with soap and water. Discard clothing and shoes. Call a physician.

SWALLOWING:

Give two glasses of water. Do not induce vomiting. Call a physician.

EYE CONTACT:

Flush with plenty of water for at least 15 minutes, occasionally lifting the upper and lower eyelids. See a physician, preferably an ophthalmologist, immediately.

NOTES TO PHYSICIAN:

(1) Persons exposed to ethylene oxide may develop severe and intractable vomiting, requiring the use of intimates given intravenously. (2) Prolonged or high vapour concentration exposure may result in the development of pulmonary edema after a latent phase of several hours. Also, respiratory tract injury caused by ethylene oxide may predispose to the development of a secondary respiratory infection. Individuals exposed to moderately high vapour concentration of ethylene oxide should be retained for observation. (3) Following skin contact, primary irritation and blister formation may be delayed in onset. (4) When introduced directly into the blood stream, ethylene oxide may act as a hapten and lead to the development of anaphylactoid reactions of varying severity. This has been noted in a few haemodialysis and plasmapheresis patients due to desorption of ethylene oxide from the sterilized equipment. There appears to be a close association to the presence of IgE antibodies to albumin/ethylene oxide conjugates.

5. Fire Fighting Measures

FLAMMABLE : Yes.	IF YES, UNDER WHAT CONDITIONS?	Extremely flammable. Extremely explosive in presence of oxidizing materials and air.
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FLASH POINT (test method)	CLOSED CUP: -17.8°C (0°F). (Tag) OPEN CUP: -17.8°C (0°F). (Tag).	AUTOIGNITION TEMPERATURE 570°C (1058°F)
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FLAMMABLE LIMITS IN AIR, % by volume:	LOWER: 3	UPPER: 100
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EXTINGUISHING MEDIA:

In case of fire, use water spray (fog), foam, dry chemical, or CO₂. Use alcohol foam, water spray or fog.

SPECIAL FIRE FIGHTING PROCEDURES:

DANGER! Evacuate all personnel from danger area. Immediately cool cylinders with water spray from maximum distance taking care not to extinguish flames. Remove ignition source if without risk. If flames are accidentally extinguished, explosive re-ignition may occur; therefore, appropriate measures should be taken; e.g., total evacuation. Reapproach with extreme caution. Use self-contained breathing apparatus. Stop flow of gas if without risk while continuing cooling water spray. Remove all containers from area if without risk. Allow fire to burn out. Dilution of ethylene oxide with 23 volumes of water renders it nonflammable, the manufacturer recommends dilution with 100 volumes of water as an additional safe practice. Shut off source of fuel if possible. Withdraw immediately in case of rising sound from tank car safety valve.

UNUSUAL FIRE AND EXPLOSION HAZARD:

Flammable gas. Forms explosive mixtures with air and oxidizing agents. Container may rupture due to heat of fire. Do not extinguish flames due to possibility of explosive re-ignition. Vapours form from this product and may travel or be moved by air currents and ignited by pilot lights, other flames, smoking, sparks, heaters, electrical equipment, static discharges, or other ignition sources at locations distant from product handling point. Explosive atmospheres may linger. Before entering area, especially confined areas, check atmosphere with approved device. No part of a container should be subjected to temperature higher than 52 C. Most containers are provided with a pressure relief device designed to vent contents when they are exposed to elevated temperature.

HAZARDOUS COMBUSTION PRODUCTS:

These products are carbon oxides (CO, CO₂).

SENSITIVITY TO IMPACT:

Avoid impact against container.

SENSITIVITY TO STATIC DISCHARGE:

Possible, ground containers.

6. Accidental Release Measures

STEPS TO BE TAKEN IF MATERIAL IS RELEASED OR SPILLED:

DANGER! May form explosive mixtures with air. Immediately evacuate all personnel from danger area. Wear self-contained breathing apparatus operated in the pressure demand mode and protective clothing. Remove all sources of ignition if without risk. Reduce vapours with fog or fine water spray. Shut off leak if without risk. Ventilate area of leak or move leaking assembly to well ventilated area. Flood spills with water spray. Prevent runoff, collect for disposal. Neither ethylene oxide nor its aqueous solutions should be discharged to streams or sewers. Flammable vapours may spread from spill. Before entering area, especially confined areas, check atmosphere with appropriate device. Contingency planning is recommended for handling releases, spills and emergencies.

WASTE DISPOSAL METHOD:

Prevent waste from contaminating the surrounding environment. Keep personnel away. Discard any product, residue, disposable container, or liner in an environmentally acceptable manner, in full compliance with federal, provincial, and local regulations. If necessary, call your local supplier for assistance.

7. Handling and Storage

PRECAUTIONS TO BE TAKEN IN STORAGE:

Store and use with adequate ventilation. Separate flammable cylinders from oxygen, chlorine, and other oxidizers by at least 6 m or use a barricade of non-combustible material. This barricade should be at least 1.5 m high and have a fire resistance rating of at least ½ hour. Firmly secure cylinders upright to keep them from falling or being knocked over. Screw valve protection cap firmly in place by hand. Post "No Smoking or Open Flames" signs in storage and use areas. There must be no sources of ignition. All electrical equipment in storage areas must be explosion-proof. Storage areas must meet national electric codes for Class 1 hazardous areas. Store only where temperature will not exceed 52 C. Store full and empty cylinders separately. Use a first-in, first-out inventory system to prevent storing full cylinders for long periods.

PRECAUTIONS TO BE TAKEN IN HANDLING:

Protect cylinders from damage. Use a suitable hand truck to move cylinders; do not drag, roll, slide, or drop. Never attempt to lift a cylinder by its cap; the cap is intended solely to protect the valve. Never insert an object (e.g., wrench, screwdriver, pry bar) into cap openings; doing so may damage the valve and cause a leak. Use an adjustable strap wrench to remove over-tight or rusted caps. Open valve slowly. If valve is hard to open, discontinue use and contact your supplier. For other precautions, see Section 16.

For additional information on storage and handling, refer to Compressed Gas Association (CGA) pamphlet P-1, *Safe Handling of Compressed Gases in Containers*, available from the CGA. Refer to Section 16 for the address and phone number along with a list of other available publications.

OTHER HAZARDOUS CONDITIONS OF HANDLING, STORAGE, AND USE:

Extremely flammable liquid and gas under pressure. Do not get liquid or vapours in eyes, on skin, or clothing. Safety showers and eyewash fountains should be immediately available. Use only in a closed system. Use piping and equipment adequately designed to withstand pressures to be encountered. Use only spark-proof tools and explosion-proof equipment. Keep away from heat, sparks, and open flame. **Forms explosive mixtures with air.** Ground all equipment. Store and use with adequate ventilation at all times. Close valve after each use; keep closed even when empty. **Prevent reverse flow.** Reverse flow into cylinder may cause rupture. Use a check valve or other protective device in any line or piping from the cylinder. **When returning cylinder to supplier, be sure valve is closed, then install valve outlet plug tightly. Never work on a pressurized system.** If there is a leak, close the cylinder valve. Vent the system down in a safe and environmentally sound manner in compliance with all federal, provincial, and local laws; then repair the leak. **Never place a compressed gas cylinder where it may become part of an electrical circuit.**

8. Exposure Controls/Personal Protection

VENTILATION/ENGINEERING CONTROLS:

LOCAL EXHAUST: See SPECIAL.

MECHANICAL (general): See SPECIAL.

SPECIAL: This product must be confined within vapour-tight equipment and stored under pressurized nitrogen or other suitable inert gas. Confined in this manner, vapours should not be released and general (mechanical) room ventilation is expected to be satisfactory. Venting of material must be in compliance with federal, provincial, and local regulations. Ventilation should be designed in manner no person is exposed to concentrations of ethylene oxide exceeding the TLV of 1 ppm.

OTHER: See SPECIAL.

PERSONAL PROTECTION:

RESPIRATORY PROTECTION: Positive pressure, full face-piece supplied air respirator is recommended for up to 2000 ppm. Be sure to use an approved/certified respirator or equivalent. Wear appropriate respirator when ventilation is inadequate.

Select in accordance with provincial regulations, local bylaws or guidelines. Selection should also be based on the current CSA standard Z94.4, "Selection, Care and Use of Respirators". Respirators should also be approved by NIOSH and MSHA.

SKIN PROTECTION: Butyl rubber. Gloves have a lifetime of approximately one half to one hour after contact with liquid ethylene oxide.

EYE PROTECTION: Full face shield and safety glasses or goggles.

Select in accordance with the current CSA standard Z94.3, "Industrial Eye and Face Protection", and any provincial regulations, local bylaws or guidelines.

OTHER PROTECTIVE EQUIPMENT: Metatarsal shoes for cylinder handling. Protective clothing where needed. Cuffless trousers should be worn outside the shoes. Select in accordance with the current CSA standard Z195, "Protective Foot Wear", and any provincial regulations, local bylaws or guidelines.

9. Physical and Chemical Properties

PHYSICAL STATE: Gas. (Compressed Gas.)	FREEZING POINT: -112.6°C (-170.7°F)	pH: Not applicable.
BOILING POINT: 10.4°C (50.7°F)	VAPOUR PRESSURE: 151.6 kPa (@ 20°C)	MOLECULAR WEIGHT: 44.05 g/mole
SPECIFIC GRAVITY: LIQUID (Water = 1) 0.87	SOLUBILITY IN WATER: Complete.	
SPECIFIC GRAVITY: VAPOUR (air = 1) 1.52	EVAPORATION RATE (Butyl Acetate=1): >1 compared to (Butyl Acetate=1)	COEFFICIENT OF WATER/OIL DISTRIBUTION: Not available.
VAPOUR DENSITY: 0.002804 g/ml @ 21.1 C	% VOLATILES BY VOLUME: 100% (v/v).	ODOUR THRESHOLD: Not available.
APPEARANCE & ODOUR: Colourless. Odour: Ethereal.		

10. Stability and Reactivity

STABILITY:	The product is stable.
CONDITIONS OF CHEMICAL INSTABILITY:	Pure ethylene oxide will decompose violently if exposed to a high enough temperature. Commonly accepted to be above 560 C at atmospheric pressure. This temperature can vary depending upon time, pressure, and conditions of the system. The temperature required for the decomposition is reduced as pressure and volume-to-surface ratios are increased. Ethylene oxide is stable at ordinary conditions of temperature and pressure and in ordinary use, handling, and storage.
INCOMPATIBILITY (materials to avoid):	Because of the highly reactive nature of ethylene oxide dangerous runaway reactions can result from contact with copper, silver, magnesium, mercury, and their salts, oxidizers of all types, alkalines and acids, alcohols, mercaptans, and alkali metals, or a wide variety of organic and inorganic materials.
HAZARDOUS DECOMPOSITION PRODUCTS:	Thermal decomposition or burning may produce carbon monoxide/carbon dioxide.
HAZARDOUS POLYMERIZATION:	Yes.
CONDITIONS OF REACTIVITY:	Pure ethylene oxide will polymerize violently if contaminated with aqueous alkalies, mineral acids, amines, metal chloride or metal oxides. Avoid contamination of ethylene oxide with trace amounts of other minerals. Avoid exposing stored ethylene oxide to heat or source of ignition. Ethylene oxide will not polymerize spontaneously under normal conditions of temperature, pressure, etc.

11. Toxicological Information

See section 3.

12. Ecological Information

No adverse ecological effects expected. This product does not contain any Class I or Class II ozone-depleting chemicals. The components of this mixture are not listed as marine pollutants by TDG Regulations.

13. Disposal Considerations

WASTE DISPOSAL METHOD: Do not attempt to dispose of residual or unused quantities. Return cylinder to supplier.

14. Transport Information

TDG/IMO SHIPPING NAME: Ethylene oxide

HAZARD CLASS:	IDENTIFICATION #:	PRODUCT REPORTABLE QUANTITY (PRQ):
Class 2.3: Toxic gas. Class 2.1: Flammable gas.	UN1040	Any accidental release in a quantity that could pose a danger to public safety or any sustained release of 10 minutes or more.

SHIPPING LABEL(s): Toxic gas, Flammable gas

PLACARD (when required): Toxic gas

SPECIAL SHIPPING INFORMATION:

Cylinders should be transported in a secure position, in a well-ventilated vehicle. Cylinders transported in an enclosed, non-ventilated compartment of a vehicle can present serious safety hazards.

15. Regulatory Information

The following selected regulatory requirements may apply to this product. Not all such requirements are identified. Users of this product are solely responsible for compliance with all applicable federal, provincial, and local regulations.

DSL (Canada) This product is on the DSL list

WHMIS (Canada) CLASS A: Compressed gas.
 CLASS B-1: Flammable gas.
 CLASS D-1A: Material causing immediate and serious toxic effects (VERY TOXIC).
 Class D-2A: Material causing other toxic effects (VERY TOXIC).
 Class D-2B: Material causing other toxic effects (TOXIC).
 Class F: Dangerously reactive material.

International Regulations

EINECS Not available.

DSCL (EEC) R20- Harmful by inhalation.
 R45- May cause cancer.
 R46- May cause heritable genetic damage.
 R60- May impair fertility.

International Lists No products were found.

16. Other Information

MIXTURES:

When two or more gases, or liquefied gases are mixed, their hazardous properties may combine to create additional, unexpected hazards. Obtain and evaluate the safety information for each component before you produce the mixture. Consult an Industrial Hygienist, or other trained person when you make your safety evaluation of the end product. Remember, gases and liquids have properties which can cause serious injury or death.

HAZARD RATING SYSTEM:

HMIS RATINGS:

HEALTH 3 *

FLAMMABILITY 4

PHYSICAL HAZARD 3

*An Asterisk used in conjunction with HMIS health hazards ratings designates a carcinogenic or reproductive hazard.

STANDARD VALVE CONNECTIONS FOR U.S. AND CANADA:

THREADED:	CGA-510
PIN-INDEXED YOKE:	Not available.
ULTRA-HIGH-INTEGRITY CONNECTION:	Not available.

Use the proper CGA connections. **DO NOT USE ADAPTERS.** Additional limited-standard connections may apply. See CGA pamphlets V-1 and V-7 listed below.

Ask your supplier about free Praxair safety literature as referred to in this MSDS and on the label for this product. Further information about this product can be found in the following pamphlets published by the Compressed Gas Association, Inc. (CGA), 4221 Walney Road, 5th Floor, Chantilly, VA 20151-2923, Telephone (703) 788-2700, Fax (703) 961-1831, website: www.cganet.com.

AV-1	Safe Handling and Storage of Compressed Gas
P-1	Safe Handling of Compressed Gases in Containers
P-14	Accident Prevention in Oxygen-Rich, Oxygen-Deficient Atmosphere
SB-2	Oxygen-Deficient Atmospheres
V-1	Compressed Gas Cylinder Valve Inlet and Outlet Connections
V-7	Standard Method of Determining Cylinder Valve Outlet Connections for Industrial Gas Mixtures
---	Handbook of Compressed Gases, Fifth Edition

PREPARATION INFORMATION:

DATE:	October 15, 2016
DEPARTMENT:	Safety and Environmental Services
TELEPHONE:	905-803-1600

The opinions expressed herein are those of qualified experts within Praxair Canada Inc. We believe that the information contained herein is current as of the date of this Material Safety Data Sheet. Since the use of this information and the conditions of use of the product are not within the control of Praxair Canada Inc., it is the user's obligation to determine the conditions of safe use of the product.

Praxair Canada Inc. requests the users of this product to study this Material Data Sheet (MSDS) and become aware of product hazards and safety information. To promote safe use of this product, a user should (1) notify its employees, agents and contractors of the information on this MSDS and any product hazards and safety information, (2) furnish this same information to each of its customers for the product, and (3) request such customers to notify their employees and customers for the product of the same product hazards and safety information.

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Product Name: Ethylene Oxide

MSDS# E-4798-N

Date: Oct. 15, 2016



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Praxair Canada Inc.
1 City Centre Drive
Suite 1200
Mississauga, ON L5B 1M2

Page 9 of 9