

MIOSHA Fact Sheet



Ethylene Oxide (EtO)

What is ethylene oxide (EtO)?

EtO is a colorless gas with a sweet odor similar to ether when air concentrations are at or above the odor threshold, which varies between 260 and 700 parts per million of air (ppm). The odor thresholds are well above permissible employee exposure limits. It also exists as a colorless liquid if the temperature is below 10 degrees Celsius. EtO gas, and liquid solutions with greater than 4% EtO, are extremely flammable. EtO gas is slightly heavier than air, may spread long distances if released, and can form an explosive mixture with air. Distant ignition from a spark or static charge and flashback are possible. EtO can also polymerize or decompose violently when exposed to high temperatures or other chemicals such as oxidizing agents, acids, bases, alcohols, or metals.

EtO is used as an intermediate in manufacturing other chemicals such as textiles, detergents, polyurethane foam, antifreeze, solvents, adhesives, and other related products. It is also used as a fumigant in some agricultural products and as a sterilizing agent for food (spices) or cosmetics and used in hospitals or medical/dental clinics to sterilize a variety of medical equipment that cannot be sterilized by steam.

In addition to fire or explosion hazards, how can exposure to EtO affect me?

EtO is a known cancer and reproductive hazard. Acute exposures to EtO may result in respiratory irritation and lung injury, headache, nausea, vomiting, diarrhea, shortness of breath, and cyanosis (blue or purplish skin coloring due to lack of oxygen in the blood). Acute exposures to high concentrations can cause a buildup of fluid in the lungs (pulmonary edema) which is a medical emergency. Chronic exposure has been associated with cancer, reproductive effects, mutagenic changes, nerve

damage, and sensitization. Contact with liquid EtO can result in skin/eye irritation or burns, damage to the cornea, or frostbite. Ingestion can result in gastric irritation or liver damage.

How does exposure to EtO occur?

Inhalation is the main route for occupational exposure to EtO. Skin or eye contact is second. Ingestion may be a route of occupational exposure if proper hygiene practices are not followed.

Is employee exposure to EtO regulated?

Yes, MIOSHA General Industry and Construction Safety and Health Standard, [Part 304. Ethylene Oxide](#) (Part 304) regulates occupational exposures to EtO. This standard contains rules that apply to all occupational exposures to ethylene oxide (EtO), except as provided in subrule (2) of the scope. This standard includes the following employer requirements for EtO:

- **Permissible exposure limits (PELs)** for EtO. The action level (AL) is 0.5 parts per million parts of air (ppm), as averaged over an eight-hour time period (8-hr TWA). The time-weighted average (TWA) is 1 ppm, 8-hr TWA. The employer shall also ensure that no employee is exposed to an airborne concentration of EtO in excess of 5 parts of EtO per million parts of air (5 ppm) as averaged over a sampling period of fifteen (15) minutes. This is considered the excursion limit. Perform **initial air monitoring** to accurately determine employee exposures to EtO.
- Perform **periodic air monitoring** at least quarterly if initial monitoring indicates that employee exposures are at or above either the TWA or the excursion limit. Perform periodic air monitoring at least every 6 months, when initial monitoring shows employee exposures are at or

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above the action level but below the 8-hour TWA.

- Establish a **regulated area** when employee exposures may exceed either the TWA or the excursion limit. Limit access to authorized personnel (people who have to work or be present in the area). Post warning signs and use container labeling as per 1910.1047(j).
- Institute all **feasible engineering or work practice controls** to reduce employee exposure below the established PELs. This may include local exhaust ventilation and safe employee work practices but does **not include** employee job rotation.
- If TWA or excursion limits are exceeded, establish and implement a **written compliance program** to reduce and maintain employee exposures at or below the PELs. In addition, provide at least full-face **respiratory protection** in accordance with General Industry and Construction Safety and Health Standard [Part 451. Respiratory Protection](#), and according to Part 304, whenever the PELs are exceeded, and feasible controls cannot reduce exposures below the PELs.
- Provide and ensure that employees wear **personal protective clothing or equipment** if there is potential exposure to the eyes or skin due to contact with EtO or EtO solutions.
- Develop and implement a **written plan for emergency situations** if EtO is used in a workplace. The written emergency plan must comply with Occupational Safety and Health Administration [29 CFR 1910.38](#) and [29 CFR 1910.39](#) Employee Emergency Plans and Fire Prevention Plans.
- Provide **information and training** in all workplaces where there is potential exposure to airborne EtO at or above the AL or the excursion limit.

Training is required at the time of initial assignment and at least annually after that for each exposed employee.

- **Medical surveillance** provided by a licensed physician and without employee cost is required for all employees who are or may be exposed to EtO at or above the action level, without regard to the use of respirators, for at least 30 days a year. Medical surveillance is also required for employees who are exposed during an emergency.
- The following **records** must be kept:
 - all air monitoring documentation and results.
 - any objective data relied upon to meet the standard's requirements such as materials, operations, processes, etc.
 - all employee medical surveillance records.

Additional information

Please visit the MIOSHA website at www.michigan.gov/mioshapublications where additional information may be available or contact the Consultation Education and Training Division at (517) 284-7720.

The **Agency for Toxic Substances and Disease Registry (ATSDR)**, based in Atlanta, Georgia, is a federal public health agency of the **U.S. Department of Health and Human Services**. This is an additional resource on the toxicology of EtO. **ATSDR ToxFacts sheet on EtO:** <https://www.atsdr.cdc.gov/toxfaqs/tfacts137.pdf>