

Ethylene Oxide (EtO)

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What is EtO?

- Chemical used to sterilize sensitive instruments and materials that are not suited for other sterilization methods
 - ◆ Steam may damage sensitive equipment
 - ◆ Liquid disinfectants may not kill all microorganisms
- EtO kills all known viruses, bacteria, bacterial spores without damaging the material



EtO Sterilizers



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EtO use is regulated by:

- OSHA Standard 29 CFR 1910.1047
- Standard requires and establishes:
 - ◆ Permissible exposure limits
 - ◆ Exposure monitoring
 - ◆ Control measures
 - ★ Engineering controls
 - ★ Administrative & work practice controls
 - ◆ Medical surveillance
 - ◆ Training



■ Material Safety Data Sheet

- **Chemical Name:** Ethylene Oxide
- **Weight By %:** 84 to 97%
- **Chemical Family:** Epoxide
- **Formula:** (CH₂)₂O
- **Molecular Weight:** 44.06 gms/mole
- **CAS Number:** 75-21-8
- **CAS Name:** Oxirane
- **Synonyms:** EO, EtO, Dihydroxirene, 1-2 Epoxyethane, Dimethylene Oxide, Oxane, Oxirane, Alkene Oxide, Alpha/Beta-Oxidoethane, Oxacyclopropane.
- **Product Uses:** Chemical intermediate for production of antifreeze, polyester resins, non-ionic surfactants and specialty solvents; sterilizing agent for controlling microorganisms in health care applications; fumigant for controlling insect infestation in whole and ground spices and cosmetics.
- **Exposure Limits:**
 - NIOSH REL: Ca TWA <0.1 ppm (0.18 mg/m³) C 5 ppm (9 mg/m³) [10-min/day] [See Appendix A](#)
 - OSHA PEL: [1910.1047] TWA 1 ppm 5 ppm [15-minute Excursion] IDLH Ca [800 ppm] See: [75218](#) Conversion 1 ppm = 1.80 mg/m³
- **Physical Description**
 - Colorless gas or liquid (below 51°F) with an ether-like odor.
 - MW: 44.1 BP: 51°F FRZ: -171°F
 - Sol: Miscible VP: 1.46 atm IP: 10.56 eV
 - RGasD: 1.49 Sp.Gr: 0.82 (Liquid at 50°F)
 - F.I.P: NA (Gas) -20°F (Liquid) UEL: 100% LEL: 3.0%
 - Flammable Gas
- **Incompatibilities & Reactivities**

Strong acids, alkalis & oxidizers; chlorides of iron, aluminum & tin; oxides of iron & aluminum; water



Physical Characteristics of EtO

- Volatile- gas at room temperature
- Flammable- flash point -0.4 degrees F
- Reactive- polymerizes upon exposure to heat, acids, bases
- Odor- ether like odor at 200-700 ppm
 - ◆ Permissible exposure limit = 1 ppm
 - ◆ Inadequate warning properties



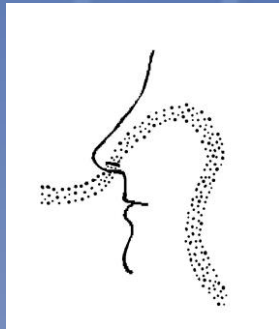
Health Hazards

- Acute exposures (short term)
 - ◆ Irritating to eyes, nose, respiratory tract
 - ◆ Skin-severe irritation and blistering
 - ◆ Inhalation may cause headache, nausea, pulmonary edema
- Chronic exposures (long term)
 - ◆ Cancer (carcinogen)
 - ◆ Reproductive hazards (mutagen, teratogen)

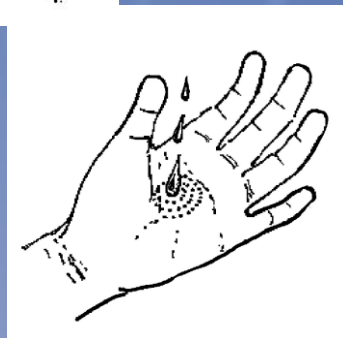


How can you be exposed?

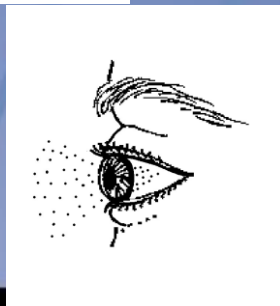
Routes of Exposure



- Inhalation



- Skin contact



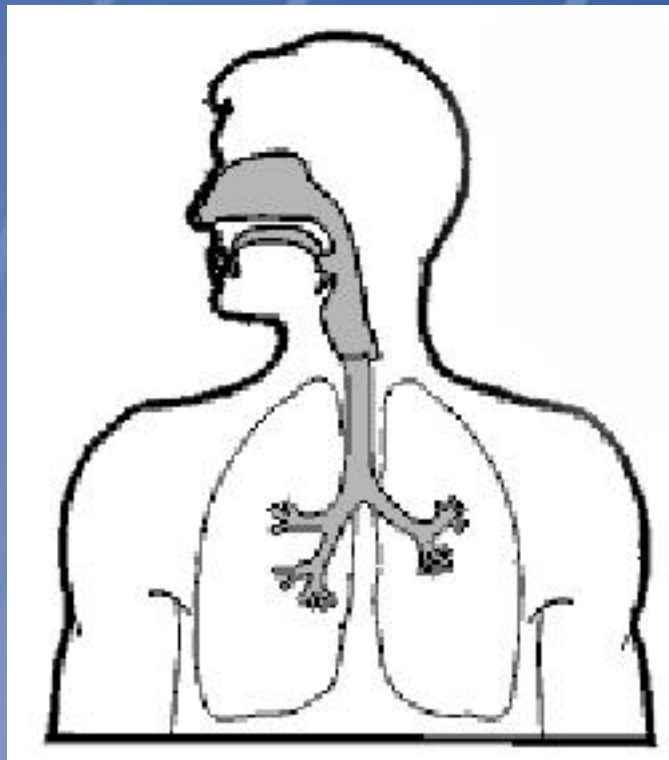
- Eye contact



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Inhalation is Primary Route of Exposure



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EtO Exposure limits

- OSHA
 - ◆ Permissible exposure limit (PEL- 8 hr TWA)= 1ppm
 - ◆ Action level = 0.5 ppm
 - ◆ Excursion limit (15 minutes) = 5 ppm
- ACGIH TLV = 1 ppm
- NIOSH IDLH (immediately dangerous to life and health) level= 800 ppm



Methods to detect presence of chemicals

- Warning properties
 - ◆ Odor (odor threshold)- Inadequate for EtO
 - ◆ Visual appearance
- Monitors
- Direct reading instrumentation
- Personal/area monitoring
 - ◆ Normally requires lab analysis



Exposure Monitoring

- Determination of concentrations present (parts per million) to determine whether exposures and levels of EtO are within acceptable limits
- Personal monitoring
- Area monitoring
 - ◆ Installed monitor to continuously measure concentrations
 - ◆ Alarm at elevated levels



Exposure Monitoring

- Direct reading



- Lab analysis



Personal Monitoring

- Monitor worn by worker in the breathing zone during normal or high risk procedures
 - ◆ Full shift (8hr TWA)→PEL
 - ◆ 15 minutes during brief/intense exposures→ Excursion Limit
 - ★ During unloading of sterilizer
 - ★ Older sterilizers using large tanks required cylinder changes



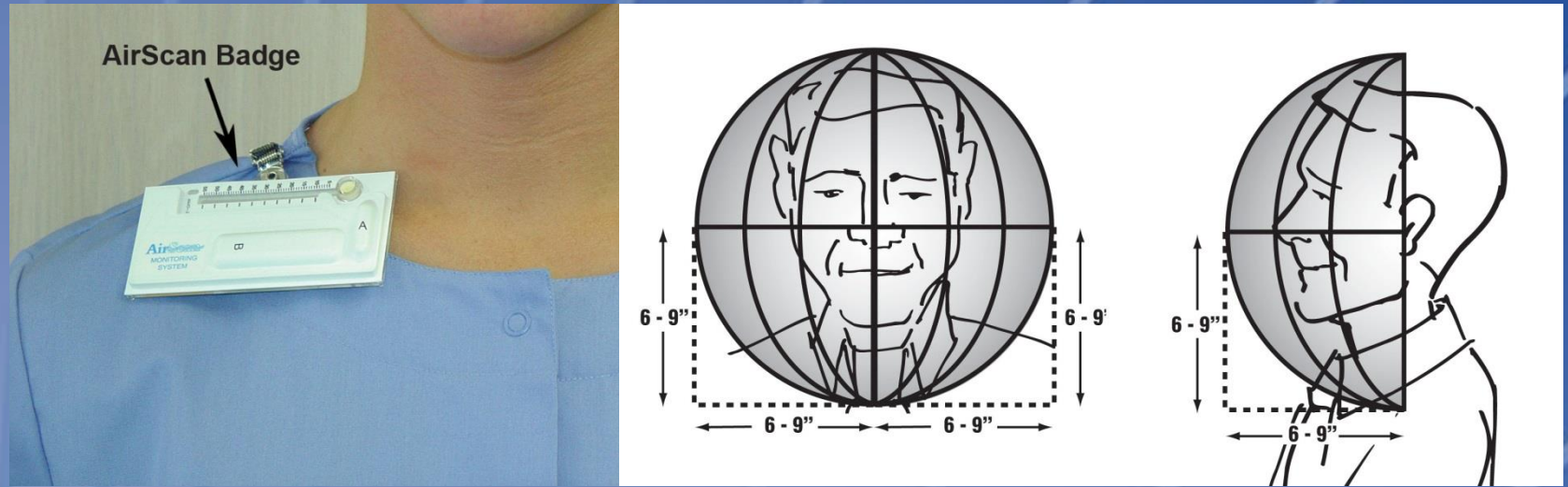
Monitoring specific tasks



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EtO Passive Monitor



Badge must be worn in the operator's breathing zone*



*OSHA Small Business Guide for Ethylene Oxide, p.41

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Area Monitoring

- Monitors placed in the area during normal or high risk procedures
- Installed monitors
 - ◆ Draeger PointGard II EtO monitor
 - ◆ Gives continuous digital readout of EtO concentration in the area of the sterilizer
 - ◆ Set to alarm at 1.0 ppm (loud audible alarm)



Area Continuous Monitor



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Control Measures

- Engineering controls
 - ◆ Ventilation (sterilizer is connected to exhaust duct to the outdoors)
 - ◆ Interlocks (door will not open until cycle is complete)
- Administrative controls
 - ◆ Small quantity of EtO in cartridge
 - ◆ Only trained individuals use system
- Work practices



Medical Surveillance

- Required if:
 - ◆ Exposure above the allowable limits
 - ◆ Following accidents, spills, releases, system failures resulting in single high exposure
 - ◆ Worker develops signs and symptoms believed due to EtO exposure



Medical Surveillance (cont.)

- Provided by the CDC Occupational Health Clinic
- Workers should report to their supervisor:
 - ◆ Illness, signs, symptoms related to EtO
 - ◆ Accidents, releases, equipment failure, etc



Response to Emergencies

- In event of alarm:
 - ◆ Exit area
 - ◆ Notify supervisor
 - ◆ Possibly notify Anderson if equipment problem
- In the event of exposure
 - ◆ Move to fresh air
 - ◆ Seek medical attention

