Occupational Health Guideline for 2-Ethoxyethanol

INTRODUCTION

This guideline is intended as a source of information for employees, employers, physicians, industrial hygienists, and other occupational health professionals who may have a need for such information. It does not attempt to present all data; rather, it presents pertinent information and data in summary form.

SUBSTANCE IDENTIFICATION

- Formula: $C_2H_5OCH_2CH_2OH$
- Synonyms: Ethyleneglycol monoethyl ether; Cellosolve (R) solvent
- Appearance and odor: Colorless liquid with a sweetish odor.

PERMISSIBLE EXPOSURE LIMIT (PEL)

The current OSHA standard for 2-ethoxyethanol is 200 parts of 2-ethoxyethanol per million parts of air (ppm) averaged over an eight-hour work shift. This may also be expressed as 740 milligrams of 2-ethoxyethanol per cubic meter of air (mg/m^3). The American Conference of Governmental Industrial Hygienists has issued a Notice of Intended Changes of their recommended Threshold Limit Value for 2-ethoxyethanol from 100 ppm to 50 ppm with a skin notation.

HEALTH HAZARD INFORMATION

- **Routes of exposure**

2-Ethoxyethanol can affect the body if it is inhaled, if it comes in contact with the eyes or skin, or if it is swallowed. It may enter the body through the skin.

- **Effects of overexposure**

In animal experiments 2-ethoxyethanol has caused liver, kidney, and lung damage and anemia due to the destruction of red blood cells. It has also caused irritation of the eyes.

- **Reporting signs and symptoms:**

A physician should be contacted if anyone develops any signs or symptoms and suspects that they are caused by exposure to 2-ethoxyethanol.

- **Recommended medical surveillance**

The following medical procedures should be made available to each employee who is exposed to 2-ethoxyethanol at potentially hazardous levels:

1. Initial Medical Screening: Employees should be screened for history of certain medical conditions (listed below) which might place the employee at increased risk from 2-ethoxyethanol exposure.

—Chronic respiratory disease: 2-Ethoxyethanol causes respiratory irritation in animals. In persons with impaired pulmonary function, especially those with obstructive airway diseases, the breathing of 2-ethoxyethanol might cause exacerbation of symptoms due to its irritant properties.

—Blood disease: 2-Ethoxyethanol causes in animals an increase in red cell fragility, decreased levels of red cells and hemoglobin, and an increase in immature white cells. Persons with anemia may be at increased risk from exposure.

—Kidney disease: 2-Ethoxyethanol causes kidney damage in animals. The importance of this organ in the elimination of toxic substances justifies special consideration in those with impaired renal function.

—Skin disease: 2-Ethoxyethanol is absorbed through the skin. Persons with chronic skin disorders characterized by eczema or fissures may be at added risk of absorption of toxic amounts.

—Liver disease: Although 2-ethoxyethanol is not known as a liver toxin in humans, the importance of this organ in the biotransformation and detoxification of foreign substances should be considered before exposing persons with impaired liver function.

2. Periodic Medical Examination: Any employee developing the above-listed conditions should be referred for further medical examination.

U.S. DEPARTMENT OF HEALTH AND HUMAN SERVICES
Public Health Service Centers for Disease Control
National Institute for Occupational Safety and Health

U.S. DEPARTMENT OF LABOR
Occupational Safety and Health Administration

• **Summary of toxicology**

2-Ethoxyethanol vapor is toxic to the lungs, kidneys, and hematopoietic system in animals. In mice the LC50 for 7 hours was 1820 ppm; death was attributed to lung and kidney injury. In rabbits, repeated daily doses of 1 ml/kg given orally caused albuminuria and hematuria on the 7th day with death on the 8th day due to kidney injury. Dogs repeatedly exposed to 840 ppm for 12 weeks developed a slight decrease in red cells and hemoglobin and an increase in immature white cells. In female rats exposed to 125 ppm for 4 hours, there was an increase in erythrocyte fragility. Of two workers employed for 3 years in factories using 2-ethoxyethanol as a solvent, one had a slight yellowish discoloration of the sclera and the other had trace albuminuria and a slightly increased level of bilirubin in the blood. The liquid instilled in the eyes of animals caused immediate discomfort, some conjunctival irritation, and a slight transitory irritation of the cornea which was readily reversible. Repeated and prolonged contact of the liquid with the skin of rabbits caused only a mild irritation, but toxic amounts were readily absorbed through the skin.

CHEMICAL AND PHYSICAL PROPERTIES

• **Physical data**

1. Molecular weight: 90.1
2. Boiling point (760 mm Hg): 135 C (275 F)
3. Specific gravity (water = 1): 0.93
4. Vapor density (air = 1 at boiling point of 2-ethoxyethanol): 3.0
5. Melting point: −70 C (−94 F) (pour point)
6. Vapor pressure at 20 C (68 F): 4 mm Hg
7. Solubility in water, g/100 g water at 20 C (68 F): Miscible in all proportions
8. Evaporation rate (butyl acetate = 1): Less than 1

• **Reactivity**

1. Conditions contributing to instability: Elevated temperatures may cause containers to burst.
2. Incompatibilities: Contact with strong oxidizers may cause fires and explosions.
3. Hazardous decomposition products: Toxic gases and vapors (such as carbon monoxide) may be released in a fire involving 2-ethoxyethanol.
4. Special precautions: 2-Ethoxyethanol will attack some forms of plastics, rubber, and coatings.

• **Flammability**

1. Flash point: 49 C (120 F) (closed cup)
2. Autoignition temperature: 235 C (455 F)
3. Flammable limits in air, % by volume: Lower: 1.8; Upper: 14
4. Extinguishant: "Alcohol" foam, carbon dioxide

• **Warning properties**

1. Odor Threshold: The AIHA *Hygienic Guide* states that 2-ethoxyethanol has "a slight odor at low concentrations and a disagreeable odor at high concentrations." Grant states that this substance "is a practically odorless liquid."
2. Eye Irritation Level: Grant states that "exposure of rabbits to high vapor concentrations causes symptoms of ocular and respiratory irritation, but even at concentrations which are probably lethal, causes no significant ocular injury."
3. Other Information: The *Hygienic Guide* states that "high vapor concentrations can cause irritation of the nose and throat." No quantitative information is available, however, concerning the thresholds of irritation.
4. Evaluation of Warning Properties: Since eye, nose and throat irritation occur only at high levels, and since Grant points out that this substance is almost odorless, 2-ethoxyethanol is treated as a material with poor warning properties.

MONITORING AND MEASUREMENT PROCEDURES

• **General**

Measurements to determine employee exposure are best taken so that the average eight-hour exposure is based on a single eight-hour sample or on two four-hour samples. Several short-time interval samples (up to 30 minutes) may also be used to determine the average exposure level. Air samples should be taken in the employee's breathing zone (air that would most nearly represent that inhaled by the employee).

• **Method**

An analytical method for 2-ethoxyethanol is in the *NIOSH Manual of Analytical Methods*, 2nd Ed., Vol. 5, 1979, available from the Government Printing Office, Washington, D.C. 20402 (GPO No. 017-033-00349-1).

RESPIRATORS

• Good industrial hygiene practices recommend that engineering controls be used to reduce environmental concentrations to the permissible exposure level. However, there are some exceptions where respirators may be used to control exposure. Respirators may be used when engineering and work practice controls are not technically feasible, when such controls are in the process of being installed, or when they fail and need to be supplemented. Respirators may also be used for operations which require entry into tanks or closed vessels, and in emergency situations. If the use of respirators is necessary, the only respirators permitted are those that have been approved by the Mine Safety and Health Administration (formerly Mining Enforcement and Safety Administration) or by the National Institute for Occupational Safety and Health.

• In addition to respirator selection, a complete respiratory protection program should be instituted which includes regular training, maintenance, inspection, cleaning, and evaluation.

PERSONAL PROTECTIVE EQUIPMENT

• Employees should be provided with and required to use impervious clothing, gloves, face shields (eight-inch

minimum), and other appropriate protective clothing necessary to prevent repeated or prolonged skin contact with liquid 2-ethoxyethanol.

• Clothing wet with 2-ethoxyethanol should be placed in closed containers for storage until it can be discarded or until provision is made for the removal of 2-ethoxyethanol from the clothing. If the clothing is to be laundered or otherwise cleaned to remove the 2-ethoxyethanol, the person performing the operation should be informed of 2-ethoxyethanol's hazardous properties.

• Non-impervious clothing which becomes contaminated with 2-ethoxyethanol should be removed promptly and not reworn until the 2-ethoxyethanol is removed from the clothing.

• Employees should be provided with and required to use splash-proof safety goggles where liquid 2-ethoxyethanol may contact the eyes.

SANITATION

• Skin that becomes contaminated with 2-ethoxyethanol should be promptly washed or showered to remove any 2-ethoxyethanol.

• Employees who handle liquid 2-ethoxyethanol should wash their hands thoroughly before eating or smoking.

COMMON OPERATIONS AND CONTROLS

The following list includes some common operations in which exposure to 2-ethoxyethanol may occur and control methods which may be effective in each case:

Operation	Controls
Use as solvent in manufacture of lacquers, lacquer thinners, nitrocellulose lacquers, alkyd resins, printing ink solvents, varnish removers, cleaning compounds, soaps, cosmetics, pesticides, pharmaceuticals, adhesives, and detergents; during use in textile dyeing and printing and manufacture of leather finishes	Local exhaust ventilation; general dilution ventilation; personal protective equipment
Use as anti-icing additive in manufacture of brake fluids, aviation fuels, and automotive anti-stall additives	Local exhaust ventilation; general dilution ventilation; personal protective equipment

EMERGENCY FIRST AID PROCEDURES

In the event of an emergency, institute first aid procedures and send for first aid or medical assistance.

• **Eye Exposure**

If liquid 2-ethoxyethanol gets into the eyes, wash eyes immediately with large amounts of water, lifting the lower and upper lids occasionally. If irritation is present after washing, get medical attention. Contact lenses should not be worn when working with this chemical.

• **Skin Exposure**

If liquid 2-ethoxyethanol gets on the skin, promptly flush the contaminated skin with water. If liquid 2-ethoxyethanol soaks through the clothing, promptly flush the skin with water. If irritation is present after washing, get medical attention.

• **Breathing**

If a person breathes in large amounts of 2-ethoxyethanol, move the exposed person to fresh air at once. If breathing has stopped, perform artificial respiration. Keep the affected person warm and at rest. Get medical attention as soon as possible.

• **Swallowing**

When 2-ethoxyethanol has been swallowed and the person is conscious, give the person large quantities of water immediately. After the water has been swallowed, try to get the person to vomit by having him touch the back of his throat with his finger. Do not make an unconscious person vomit. Get medical attention immediately.

• **Rescue**

Move the affected person from the hazardous exposure. If the exposed person has been overcome, notify someone else and put into effect the established emergency rescue procedures. Do not become a casualty. Understand the facility's emergency rescue procedures and know the locations of rescue equipment before the need arises.

SPILL, LEAK, AND DISPOSAL PROCEDURES

• Persons not wearing protective equipment and clothing should be restricted from areas of spills or leaks until cleanup has been completed.

• If 2-ethoxyethanol is spilled or leaked, the following steps should be taken:

1. Remove all ignition sources.
2. Ventilate area of spill or leak.
3. For small quantities, absorb on paper towels. Evaporate in a safe place (such as a fume hood). Allow sufficient time for evaporating vapors to completely clear the hood ductwork. Burn the paper in a suitable location away from combustible materials. Large quantities can be reclaimed or collected and atomized in a suitable combustion chamber. 2-Ethoxyethanol should not be allowed to enter a confined space, such as a sewer, because of the possibility of an explosion. Sewers

designed to preclude the formation of explosive concentrations of 2-ethoxyethanol vapors are permitted.

• Waste disposal methods:

2-Ethoxyethanol may be disposed of:

1. By absorbing it in vermiculite, dry sand, earth or a similar material and disposing in a secured sanitary landfill.
2. By atomizing in a suitable combustion chamber.

REFERENCES

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RESPIRATORY PROTECTION FOR 2-ETHOXYETHANOL

Condition	Minimum Respiratory Protection* Required Above 200 ppm
Vapor Concentration	
2000 ppm or less	Any supplied-air respirator. Any self-contained breathing apparatus.
6000 ppm or less	Any supplied-air respirator with a full facepiece, helmet, or hood. Any self-contained breathing apparatus with a full facepiece. A Type C supplied-air respirator operated in pressure-demand or other positive pressure mode or continuous-flow mode.
Greater than 6000 ppm** or entry and escape from unknown concentrations	Self-contained breathing apparatus with a full facepiece operated in pressure-demand or other positive pressure mode. A combination respirator which includes a Type C supplied-air respirator with a full facepiece operated in pressure-demand or other positive pressure or continuous-flow mode and an auxiliary self-contained breathing apparatus operated in pressure-demand or other positive pressure mode.
Fire Fighting	Self-contained breathing apparatus with a full facepiece operated in pressure-demand or other positive pressure mode.
Escape	Any gas mask providing protection against organic vapors. Any escape self-contained breathing apparatus.

*Only NIOSH-approved or MSHA-approved equipment should be used.

**Use of supplied-air suits may be necessary to prevent skin contact while providing respiratory protection from airborne concentrations of 2-ethoxyethanol; however, this equipment should be selected, used, and maintained under the immediate supervision of trained personnel. Where supplied-air suits are used above a concentration of 6000 ppm, an auxiliary self-contained breathing apparatus operated in positive pressure mode should also be worn.