

Occupational Health Guideline for 2-Butoxy Ethanol

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: $C_4H_9OCH_2CH_2OH$
- Synonyms: Butyl "Cellosolve"; ethylene glycol monobutyl ether; Dowanol EB; butyl oxitol; Jeffersol EB; Ektasolve EB
- Appearance and odor: Colorless liquid with a mild odor.

PERMISSIBLE EXPOSURE LIMIT (PEL)

The current OSHA standard for 2-butoxy ethanol is 50 parts of 2-butoxy ethanol per million parts of air (ppm) averaged over an eight-hour work shift. This may also be expressed as 240 milligrams of 2-butoxy ethanol 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-butoxy ethanol from 50 ppm to 25 ppm with a skin notation.

HEALTH HAZARD INFORMATION

• Routes of exposure

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

• Effects of overexposure

Overexposure to high air levels of 2-butoxy ethanol may cause irritation of the eyes, nose, and throat. It may also cause a person to have dark red urine.

• 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-butoxy ethanol.

• Recommended medical surveillance

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

1. Initial Medical Examination:

—A complete history and physical examination: The purpose is to detect pre-existing conditions that might place the exposed employee at increased risk, and to establish a baseline for future health monitoring. Examination of the liver, kidneys, and lymphoid system should be stressed. The skin should be examined for evidence of chronic disorders.

—A complete blood count: This compound has been shown to increase erythrocyte fragility in animals exposed repeatedly to 2-butoxy ethanol vapors. A complete blood count should be performed before exposure including a red cell count, a white cell count, a differential count of a stained smear, as well as hemoglobin, hematocrit, clotting time determinations, and red blood cell fragility test.

2. Periodic Medical Examination: The aforementioned medical examinations should be repeated on an annual basis.

• Summary of toxicology

2-Butoxy ethanol irritates the eyes and upper respiratory tract and is a hemolytic agent. The LC50 for mice was 700 ppm, with death due to lung and kidney injury. Repeated exposures of 100 to 400 ppm were non-lethal but caused visceral effects in animals: at the higher concentrations rats exhibited greatly increased erythrocyte fragility, hemoglobinuria and hematuria, pulmonary hemorrhage, and liver injury; at lower concentrations, increased red-cell fragility was the most sensitive criterion of effect, however transitory. The substance is metabolized to butoxyacetic acid, which appears in the urine of animals and man promptly following exposure,

These recommendations reflect good industrial hygiene and medical surveillance practices and their implementation will assist in achieving an effective occupational health program. However, they may not be sufficient to achieve compliance with all requirements of OSHA regulations.

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

both are hemolytic agents. Human subjects inhaling 2-butoxy ethanol at 200 ppm for 8 hours had discomfort of the eyes, nose, and throat, although there were no objective signs of injury or increase in erythrocytic fragility; some individuals complained of discomfort at 100 ppm. This substance penetrates the skin readily, and this may account for more absorption than does inhalation in some cases. The liquid is damaging to the eye, producing pain, conjunctival irritation, and transitory injury to the cornea. Chronic systemic effects have not been reported in humans.

CHEMICAL AND PHYSICAL PROPERTIES

• Physical data

1. Molecular weight: 118.2
2. Boiling point (760 mm Hg): 171 C (340 F)
3. Specific gravity (water = 1): 0.9
4. Vapor density (air = 1 at boiling point of 2-butoxy ethanol): 4.1
5. Melting point: -70 C (-94 F)
6. Vapor pressure at 20 C (68 F): 0.6 mm Hg
7. Solubility in water, g/100 g water at 20 C (68 F): Miscible in all proportions below 48 C (118 F)
8. Evaporation rate (butyl acetate = 1): 0.1

• Reactivity

1. Conditions contributing to instability: Heat
2. Incompatibilities: Contact with strong oxidizing agents may cause fires and explosions. Contact with strong caustics may cause decomposition.
3. Hazardous decomposition products: Toxic gases and vapors (such as carbon monoxide) may be released in a fire involving 2-butoxy ethanol.
4. Special precautions: 2-Butoxy ethanol will attack some forms of plastics, rubber, and coatings.

• Flammability

1. Flash point: 61 C (141 F) (closed cup)
2. Autoignition temperature: 244 C (472 F)
3. Flammable limits in air, % by volume: Lower: 1.1; Upper: 10.6
4. Extinguishant: Carbon dioxide, dry chemical, alcohol foam

• Warning properties

1. Odor Threshold: According to Patty, 2-butoxy ethanol has a mild ethereal odor, but no quantitative information is available concerning the odor threshold of this material.

2. Eye Irritation Level: Browning reports that "in some investigations by Carpenter et al. on volunteer subjects, those inhaling 113 ppm for 4 hours reported nasal and ocular (irritation) with a slight increase in nasal discharge and occasional eructation."

3. Other Information: Browning also reports that "in a second experiment a year later three subjects inhaled 195 ppm for two 4-hour periods separated by an interval of 30 min . . . They all noted immediate irritation of the nose and throat and later of the eyes, and disturbed taste." Patty points out that in sensitive individuals 100 ppm can cause eye, nose, and throat irritation.

4. Evaluation of Warning Properties: Through its irritant effects, 2-butoxy ethanol can be detected at concentrations only a few times the permissible exposure limit. For the purposes of this guideline, therefore, 2-butoxy ethanol is treated as a material with good 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

Sampling and analyses may be performed by collection of 2-butoxy ethanol vapors using an adsorption tube with subsequent desorption with methylene chloride and gas chromatographic analysis. Also, detector tubes certified by NIOSH under 42 CFR Part 84 or other direct-reading devices calibrated to measure 2-butoxy ethanol may be used. An analytical method for 2-butoxy ethanol is in the *NIOSH Manual of Analytical Methods*, 2nd Ed., Vol. 2, 1977, available from the Government Printing Office, Washington, D.C. 20402 (GPO No. 017-033-00260-6).

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-butoxy ethanol.

- Clothing contaminated with liquid 2-butoxy ethanol should be placed in closed containers for storage until it can be discarded or until provision is made for the removal of 2-butoxy ethanol from the clothing. If the clothing is to be laundered or otherwise cleaned to remove the 2-butoxy ethanol, the person performing the operation should be informed of 2-butoxy ethanol's hazardous properties.
- Where exposure of an employee's body to liquid 2-butoxy ethanol may occur, facilities for quick drenching of the body should be provided within the immediate work area for emergency use.
- Non-impervious clothing which becomes contaminated with liquid 2-butoxy ethanol should be removed immediately and not reworn until the 2-butoxy ethanol is removed from the clothing.
- Employees should be provided with and required to use splash-proof safety goggles where liquid 2-butoxy ethanol may contact the eyes.

SANITATION

- Skin that becomes contaminated with liquid 2-butoxy ethanol should be immediately washed or showered to remove any 2-butoxy ethanol.
- Employees who handle liquid 2-butoxy ethanol should wash their hands thoroughly before eating, smoking, or using toilet facilities.

COMMON OPERATIONS AND CONTROLS

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

Operation	Controls
Liberation from spray and brush application of lacquers, varnishes, and enamels	Process enclosure; local exhaust ventilation; personal protective equipment
Use in preparation of esters for textile treatment to produce "scroop"	Process enclosure; general dilution ventilation; personal protective equipment
Application as an industrial solvent	General dilution ventilation; personal protective equipment
Use in production of plasticizers for polyvinyl chloride and acetate	Process enclosure; general dilution ventilation; personal protective equipment
Use as a stabilizing	General dilution

Operation

agent in metal cleaners and liquid household cleaners
Use in hydraulic fluids, insecticides, herbicides, and rust removers

Controls

ventilation; personal protective equipment
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 2-butoxy ethanol gets into the eyes, wash eyes immediately with large amounts of water, lifting the lower and upper lids occasionally. Get medical attention if discomfort persists. Contact lenses should not be worn when working with this chemical.

• Skin Exposure

If 2-butoxy ethanol gets on the skin, promptly wash the contaminated skin using soap or mild detergent and water. If 2-butoxy ethanol soaks through the clothing, remove the clothing promptly and wash the skin using soap or mild detergent and water.

• Breathing

If a person breathes in large amounts of 2-butoxy ethanol, 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-butoxy ethanol has been swallowed, get medical attention immediately. If medical attention is not immediately available, get the afflicted person to vomit by having him touch the back of his throat with his finger or by giving him syrup of ipecac as directed on the package. This non-prescription drug is available at most drug stores and drug counters and should be kept with emergency medical supplies in the workplace. Do not make an unconscious person vomit.

• 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-butoxy ethanol is spilled or leaked, the following steps should be taken:
 1. Ventilate area of spill or leak.
 2. For small quantities, absorb on paper towels. Evapo-

rate 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 collected and atomized in a suitable combustion chamber.

• Waste disposal methods:

2-Butoxy ethanol 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

• American Conference of Governmental Industrial Hygienists: "2-Butoxy Ethanol," *Documentation of the Threshold Limit Values for Substances in Workroom Air* (3rd ed., 2nd printing), Cincinnati, 1974.

- Browning, E.: *Toxicity and Metabolism of Industrial Solvents*, Elsevier, New York, 1965.
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- Christensen, H. E., and Luginbyhl, T. L. (eds.): *NIOSH Toxic Substances List*, 1974 Edition, HEW Publication No. 74-134, 1974.
- Grant, W. M.: *Toxicology of the Eye* (2nd ed.), C. C. Thomas, Springfield, Illinois, 1974.
- Patty, F. A. (ed.): *Toxicology*, Vol. II of *Industrial Hygiene and Toxicology* (2nd ed. rev.), Interscience, New York, 1963.
- Shell Chemical Company: *Material Safety Data Sheet - 2-Butoxy Ethanol*.

RESPIRATORY PROTECTION FOR 2-BUTOXY ETHANOL

Condition	Minimum Respiratory Protection* Required Above 50 ppm
Vapor Concentration 700 ppm or less	<p>A chemical cartridge respirator with a full facepiece and an organic vapor cartridge(s).</p> <p>A gas mask with a chin-style or a front- or back-mounted organic vapor canister.</p> <p>Any supplied-air respirator with a full facepiece, helmet, or hood.</p> <p>Any self-contained breathing apparatus with a full facepiece.</p>
Greater than 700 ppm** or entry and escape from unknown concentrations	<p>Self-contained breathing apparatus with a full facepiece operated in pressure-demand or other positive pressure mode.</p> <p>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.</p>
Fire Fighting	<p>Self-contained breathing apparatus with a full facepiece operated in pressure-demand or other positive pressure mode.</p>
Escape	<p>Any gas mask providing protection against organic vapors.</p> <p>Any escape self-contained breathing apparatus.</p>

*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-butoxy ethanol; 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 700 ppm, an auxiliary self-contained breathing apparatus operated in positive pressure mode should also be worn.