

## 1. PUBLIC HEALTH STATEMENT

This public health statement tells you about 2-butoxyethanol and 2-butoxyethanol acetate and the effects of exposure.

The Environmental Protection Agency (EPA) identifies the most serious hazardous waste sites in the nation. These sites make up the National Priorities List (NPL) and are the sites targeted for long-term federal clean-up activities. 2-Butoxyethanol has been found in at least 20 of the 1,430 current or former NPL sites. 2-Butoxyethanol acetate has not been found at any of the 1,430 current or former NPL sites. However, the total number of NPL sites evaluated is not known. As more sites are evaluated, the sites at which 2-butoxyethanol or 2-butoxyethanol acetate are found may increase. This is important because exposure to these substances may harm you and because these sites may be sources of exposure.

When a substance is released from a large area, such as an industrial plant, or from a container, such as a drum or bottle, it enters the environment. This release does not always lead to exposure. You are exposed to a substance only when you come in contact with it. You may be exposed by breathing, eating, or drinking the substance or by skin contact.

If you are exposed to 2-butoxyethanol or 2-butoxyethanol acetate, many factors determine whether you'll be harmed. These factors include the dose (how much), the duration (how long), and how you come in contact with it. You must also consider the other chemicals you're exposed to and your age, sex, diet, family traits, lifestyle, and state of health.

### 1.1 WHAT ARE 2-BUTOXYETHANOL AND 2-BUTOXYETHANOL ACETATE?

2-Butoxyethanol (bu-tox-zi-eth-an-ol) has many names, including ethylene glycol monobutyl ether, ethylene glycol butyl ether, ethylene glycol *n*-butyl ether, Butyl Cellosolve, butyl glycol, butyl Oxitol, glycol butyl ether, Dowanol EB, Gafcol EB, Poly-solv EB, and Ektasolve EB. Common abbreviations for 2-butoxyethanol include BE and EGBE. It is a clear, colorless liquid

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that smells somewhat like ether. Most people can begin to smell 2-butoxyethanol in air at 0.10-0.40 parts of 2-butoxyethanol per million parts of air (ppm). These levels are about 500 times lower than the present standard for worker exposure. 2-Butoxyethanol has been found in air, water, and soil as a contaminant. It is completely soluble in water and in most organic solvents. This means that when 2-butoxyethanol and water or 2-butoxyethanol and organic solvents are mixed, the mixtures form one layer, unlike mixing oil and water which separate into two layers. 2-Butoxyethanol is a fire hazard when exposed to heat, sparks, or open flames.

2-Butoxyethanol in the environment comes from some industrial activities. It is usually produced by a reaction of ethylene oxide with butyl alcohol, but it may also be made by the reaction of ethylene glycol with dibutyl sulfate. 2-Butoxyethanol is widely used as a solvent in protective surface coatings such as spray lacquers, quick-dry lacquers, enamels, varnishes, and latex paints. It is also used as an ingredient in paint thinners and strippers, varnish removers, agricultural chemicals, herbicides, silicon caulks, cutting oils, and hydraulic fluids. It has other uses in metal cleaners, fabric dyes and inks, industrial and household cleaners (as a degreaser), and dry-cleaning compounds. It is also used in liquid soaps and in cosmetics.

The acetate (ass-e-tate) form of this chemical is 2-butoxyethanol acetate. It is also known as ethylene glycol monobutyl ether acetate, butoxyethyl acetate, butyl glycol acetate, ethylene glycol butyl ether acetate, acetic acid 2-butoxyethyl ester, glycol monobutyl ether acetate, Butyl Cellosolve acetate, or Ektasolve EB acetate. Common abbreviations for 2-butoxyethanol acetate include BEA and EGBEA. 2-Butoxyethanol acetate has been found in air, water, and soil as a contaminant. It is a colorless liquid with a fruity odor. Most people can begin to smell 2-butoxyethanol acetate in air at 0.10-0.48 ppm. It is only moderately soluble in water but is soluble in most organic solvents. This means that when 2-butoxyethanol acetate and water or 2-butoxyethanol and organic solvents are mixed, the mixtures form one layer, unlike mixing oil and water which separate into two layers. 2-Butoxyethanol acetate is a fire hazard when exposed to heat, sparks, flames, or oxidizers.

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2-Butoxyethanol acetate in the environment also comes from some industrial activities. It is prepared by reacting 2-butoxyethanol with acetic acid, acetic acid anhydride, or acetic acid chloride. 2-Butoxyethanol acetate is widely used as a slow-evaporating solvent for lacquers, varnishes, epoxy resins, and enamels. It is also used in polyvinyl acetate latex, and it may be used in some ink and spot remover formulations.

For more information on the nature and uses of 2-butoxyethanol and 2-butoxyethanol acetate, see Chapters 3 and 4.

### **1.2 WHAT HAPPENS TO 2-BUTOXYETHANOL OR 2-BUTOXYETHANOL ACETATE WHEN THEY ENTER THE ENVIRONMENT?**

2-Butoxyethanol may be released into the environment at places where it is produced or used as a solvent. Solvent-based household cleaners or building materials such as varnishes, lacquers, latex paints, and enamels may release 2-butoxyethanol into the air as they dry. Municipal landfills and hazardous waste sites can also release 2-butoxyethanol to water that is under the ground.

2-Butoxyethanol can pass into air from water and soil. In the atmosphere, 2-butoxyethanol probably exists almost entirely as a vapor. Once in the air, 2-butoxyethanol may be removed by precipitation (rain, snow, ice) or may break down to other compounds within a few days.

2-Butoxyethanol breaks down more slowly in water and soil than it does in air. It can move out of contaminated soil and move into groundwater. 2-Butoxyethanol does not build up in plants and animals. For more information on what happens to 2-butoxyethanol after it gets into the environment, see Chapter 5.

2-Butoxyethanol acetate can pass into air from water and soil. It is directly released to the atmosphere by evaporation while it is being used as a solvent in paints, lacquers, thinners, inks, ink and spot removers, and resins. 2-Butoxyethanol acetate probably exists almost entirely as a vapor in outdoor air. It can be removed from the air by precipitation because it is moderately soluble in water. In air, 2-butoxyethanol acetate may also break down to other compounds within a few days. 2-Butoxyethanol acetate breaks down more slowly in water and soil than it does in

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air. It can move out of contaminated soil and move into groundwater. 2-Butoxyethanol acetate does not build up in plants and animals. For more information on what happens to 2-butoxyethanol acetate after it gets into the environment, see Chapter 5.

**1.3 HOW MIGHT I BE EXPOSED TO 2-BUTOXYETHANOL OR 2-BUTOXYETHANOL ACETATE?**

Many people are exposed to small amounts of 2-butoxyethanol and 2-butoxyethanol acetate every day. You can be exposed to these chemicals in the environment, in the workplace, and at home. Higher exposures usually occur in the workplace rather than in the environment or at home. The general population is exposed to 2-butoxyethanol and 2-butoxyethanol acetate mainly by breathing air or having skin contact with liquids, particularly household cleaners, that contain these compounds.

You are less likely to be exposed by eating or drinking something that contains 2-butoxyethanol. The Food and Drug Administration has regulations to control its presence as a food contaminant. However, some drinking water supplies have been shown to contain 2-butoxyethanol.

Some people have been poisoned by accidentally or intentionally drinking consumer products such as all-purpose liquid cleaners containing 2-butoxyethanol. Some people who work in silkscreening, printing, furniture production and finishing, asbestos-mastic removal, and housekeeping occupations that use materials containing 2-butoxyethanol have been exposed to this chemical. People who work in spray-painting operations, chemical production facilities, automobile repair shops, automobile manufacturing facilities, construction sites, and areas that have recently been remodeled using products that contain 2-butoxyethanol may also be exposed to this compound.

You are most likely to be exposed to 2-butoxyethanol acetate by inhaling the vapors and by skin contact with liquid and vapors. Industrial exposures are most likely through inhalation of vapors, although excessive contact with eyes and skin may also occur. 2-Butoxyethanol acetate is used as a solvent in latex paints, lacquers, epoxy resins, thinners, inks, stains, and varnishes, and in ink and spot removers. People who use these products at work or at home can be exposed by inhaling the

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vapors or by skin or eye contact. Exposure only occurs while these products are being used or while they are drying.

**1.4 HOW CAN 2-BUTOXYETHANOL AND 2-BUTOXYETHANOL ACETATE ENTER AND LEAVE MY BODY?**

2-Butoxyethanol and 2-butoxyethanol acetate can enter your body through your lungs when you breathe them. They can also enter your body through your stomach and intestines when you eat food or drink water that contains either one. They can enter your body through skin contact with liquid products such as paints, varnishes, ink and spot removers, and household cleaners. If your skin comes in contact with vapors of these compounds in the air, some can also enter your body through your skin. The amount of vapor that enters through your skin is much less than the amount that enters through your lungs, especially if most of your skin is covered by clothing.

When you are exposed to high levels of 2-butoxyethanol or 2-butoxyethanol acetate in air, some of the compound you breathe in leaves your body when you breathe out. The remainder passes through the lining of your lungs and enters your bloodstream. Both can also enter your bloodstream from your intestines if you swallow them. They can enter your bloodstream through your skin if your skin comes into contact with cleaning products containing them or with the vapors in the air. The amount of vapor that enters through your skin is much less than the amount that enters through your lungs, especially if most of your skin is covered by clothing. Once in your bloodstream, 2-butoxyethanol and 2-butoxyethanol acetate travel through your body to many organs and tissues, but they don't stay there very long. 2-Butoxyethanol and 2-butoxyethanol acetate are converted to products, called metabolites, in the liver. Scientists think that some of the effects of exposure to these chemicals are caused by metabolites. Most of the metabolites of 2-butoxyethanol and 2-butoxyethanol acetate leave the body in the urine within 24-48 hours after exposure. Smaller amounts of metabolites leave the body in exhaled air and in the feces. For more information on how 2-butoxyethanol and 2-butoxyethanol acetate can enter and leave your body, see Chapter 2.

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**1.5 HOW CAN 2-BUTOXYETHANOL OR 2-BUTOXYETHANOL ACETATE AFFECT MY HEALTH?**

After exposure to 2-butoxyethanol or 2-butoxyethanol acetate, several factors determine whether harmful health effects will occur and, if they do, what the type and severity of these health effects might be. These factors include the amount of 2-butoxyethanol or 2-butoxyethanol acetate to which you are exposed and the length of time of the exposure. Other factors that must be considered include the other chemicals you're exposed to and your age, sex, diet, family traits, lifestyle, and state of health.

Some information about potential effects on people comes from an experiment in which men and women were exposed continuously to about 100 ppm or more of 2-butoxyethanol vapors in air for 4 or 8 hours. This level is twice as high as the occupational standard for 2-butoxyethanol. Some of these people reported irritation of the nose and eyes, headache, a metallic taste, or vomiting. None of these people had effects on blood pressure or pulse. In another experiment, people were exposed to 20 ppm of 2-butoxyethanol vapors in air for 2 hours. Lung tests (pulmonary function) and heart tests (heart rate and electrocardiogram) showed no harmful effects for any of these people. Exposure to these solvents in the workplace involves both breathing in of vapors and skin contact with the liquids and vapors. Workers are usually exposed to much higher levels than the levels normally encountered by the general population.

Some information on harmful effects also comes from case reports of people who swallowed large amounts of cleaning agents containing 2-butoxyethanol. These harmful effects included breathing problems, low blood pressure, lowered levels of hemoglobin (the substance in the blood that carries oxygen to organs of the body), blood in the urine, and metabolic acidosis (high levels of acid in the body). The lowered levels of hemoglobin and blood in the urine indicate effects related to hemolysis, which involves destruction of red blood cells that results in the release of hemoglobin. Some of these people fell into a coma but recovered after successful treatment in hospitals. People should keep household products containing 2-butoxyethanol out of the reach of children.

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There are no data on whether 2-butoxyethanol or 2-butoxyethanol acetate cause reproductive effects, birth defects, or cancer in people.

To protect the public from the harmful effects of toxic chemicals and to find ways to treat people who have been harmed, scientists use many tests.

One way to see if a chemical will hurt people is to learn how the chemical is absorbed, used, and released by the body; for some chemicals, animal testing may be necessary. Animal testing may also be used to identify health effects such as cancer or birth defects. Without laboratory animals, scientists would lose a basic method to get information needed to make wise decisions to protect public health. Scientists have the responsibility to treat research animals with care and compassion. Laws today protect the welfare of research animals, and scientists must comply with strict animal care guidelines.

Other information on the harmful effects of 2-butoxyethanol and 2-butoxyethanol acetate comes from animal testing. The harmful effect most often reported in animals exposed to 2-butoxyethanol is destruction of red blood cells that results in the release of hemoglobin, which is known as hemolysis. Effects related to hemolysis include increased hemoglobin levels in the urine, blood in the urine, and the build-up of hemoglobin and destroyed red blood cells in organs such as the kidney, spleen, and liver. These effects have been found in monkeys, rats, mice, rabbits, and dogs after exposure to high levels of 2-butoxyethanol in air for short and intermediate periods. These effects have also been found in rats and mice that swallowed high doses of 2-butoxyethanol for short and intermediate periods, and in rats and rabbits with skin contact for short periods. 2-Butoxyethanol acetate also caused these effects in rats or rabbits that breathed, swallowed, or had skin contact with 2-butoxyethanol acetate. Some studies showed that the red blood cells of animals (rats, rabbits, and baboons) are much more likely to be destroyed than the red blood cells of people after exposure to 2-butoxyethanol.

Other harmful effects of 2-butoxyethanol have been seen in animals. Breathing problems occurred in rats and mice that breathed or swallowed large amounts of 2-butoxyethanol for short periods.

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Bloody or reddened stomach or intestines, probably related to hemolysis, were seen in rats that swallowed very high doses of 2-butoxyethanol and in rabbits that had skin contact with very large amounts. Harmful effects on the liver and kidney were seen in some animals and may be related to hemolysis. 2-Butoxyethanol is also irritating to the skin and eyes of animals, as it is in people.

2-Butoxyethanol and 2-butoxyethanol acetate do not seem to have effects on the immune system of animals. Like many solvents, 2-butoxyethanol causes nervous system effects in animals. Some rats, dogs, and rabbits developed physical weakness and unsteadiness after exposure to very high levels of 2-butoxyethanol in air for short periods. Some rats and mice also became sluggish, drowsy, or prostrate after swallowing very large doses of 2-butoxyethanol for short periods. Some rabbits also became inactive or prostrate, had abnormal eye movement, or had convulsions after skin contact with very large amounts of 2-butoxyethanol.

2-Butoxyethanol can cause reproductive effects and birth defects in animals. Some female rats and rabbits that breathed in large amounts of 2-butoxyethanol while they were pregnant delivered fewer offspring than pregnant rats or rabbits that were not exposed. Some of the offspring had underdeveloped bones. Other reproductive effects and birth defects in animals have only been observed at doses that were toxic to the adult animals. Some female rats had changes in their estrous cycles after drinking water containing 2-butoxyethanol for moderate periods of time. Some female rats and mice had vaginal bleeding and fewer offspring after swallowing large doses of 2-butoxyethanol while they were pregnant. Some of the offspring of pregnant mice that swallowed very large doses had cleft palates. Some offspring of pregnant mice that swallowed large doses of 2-butoxyethanol also weighed less.

2-Butoxyethanol does not seem to cause mutations. No studies were found that tested either 2-butoxyethanol or 2-butoxyethanol acetate for causing cancer in animals.



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**1.6 IS THERE A MEDICAL TEST TO DETERMINE WHETHER I HAVE BEEN EXPOSED TO 2-BUTOXYETHANOL OR 2-BUTOXYETHANOL ACETATE?**

Some tests can show whether you have been exposed to 2-butoxyethanol or 2-butoxyethanol acetate. 2-Butoxyethanol (from 2-butoxyethanol or 2-butoxyethanol acetate exposure) can be measured in blood and urine. In the body, both are converted to products called metabolites, such as 2-butoxyacetic acid. Certain metabolites of 2-butoxyethanol (2-butoxyacetic acid and others) can be measured in the urine. These tests will not necessarily be able to tell how much you have been exposed to. These tests need to be done within a day after exposure because 2-butoxyethanol and its metabolites leave your body within 24-48 hours. Certain blood tests can determine if your red blood cells are damaged, but this effect is not specific for 2-butoxyethanol. Some of these tests may be available at your doctor's office, or your doctor can send blood or urine samples to laboratories that specialize in performing these tests. If workers are exposed to concentrations of 5 ppm or above, the National Institute for Occupational Safety and Health recommends that the level of 2-butoxyacetic acid in the urine be measured. For more information on tests for 2-butoxyethanol exposure, see Chapters 2 and 6.

**1.7 WHAT RECOMMENDATIONS HAS THE FEDERAL GOVERNMENT MADE TO PROTECT HUMAN HEALTH?**

The federal government develops regulations and recommendations to protect public health. Regulations can be enforced by law. Federal agencies that develop regulations for toxic substances include the Environmental Protection Agency (EPA), the Occupational Safety and Health Administration (OSHA), and the Food and Drug Administration (FDA). Recommendations provide valuable guidelines to protect public health but cannot be enforced by law. Federal organizations that develop recommendations for toxic substances include the Agency for Toxic Substances and Disease Registry (ATSDR) and the National Institute for Occupational Safety and Health (NIOSH).

Regulations and recommendations can be expressed in not-to-exceed levels in air, water, soil, or food that are usually based on levels that affect animals; then they are adjusted to help protect

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people. Sometimes these not-to-exceed levels differ among federal organizations because of different exposure times (an 8-hour workday or a 24-hour day), the use of different animal studies, or other factors.

Recommendations and regulations are also periodically updated as more information becomes available. For the most current information, check with the federal agency or organization that provides it. Some regulations and recommendations for 2-butoxyethanol include the following:

OSHA requires employers of workers who are occupationally exposed to 2-butoxyethanol to institute engineering controls and work practices to reduce and maintain employee exposure at or below the permissible exposure limit (PEL). The PEL for 2-butoxyethanol is 50 ppm. This regulation means that the workroom air should not contain no more than an average of 50 ppm of 2-butoxyethanol over an 8-hour working shift of a 40-hour work week. The American Conference of Governmental Industrial Hygienists (ACGIH) has recommended an average concentration limit value of 25 ppm for occupational exposure (8-hour workday and a 40-hour workweek) to 2-butoxyethanol. The recommended exposure limit (REL) for occupational exposure by NIOSH is 5 ppm for both 2-butoxyethanol and 2-butoxyethanol acetate. This recommendation means that the workroom air should contain no more than an average of 5 ppm of 2-butoxyethanol or 2-butoxyethanol acetate for up to a 10-hour working shift of a 40-hour workweek. OSHA recommends that workers who may be exposed to 2-butoxyethanol should wear personal protective equipment such as gloves, coveralls, and goggles to protect against exposure to the skin and eyes.

Both 2-butoxyethanol and 2-butoxyethanol acetate are regulated under the Clean Air Act, including the National Emission Standards for Hazardous Air Pollutants.

### **1.8 WHERE CAN I GET MORE INFORMATION?**

If you have any more questions or concerns, please contact your community or state health or environmental quality department or:

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Agency for Toxic Substances and Disease Registry  
Division of Toxicology  
1600 Clifton Road NE, Mailstop E-29  
Atlanta, GA 30333

\* Information line and technical assistance

Phone: 1-800-447- 1544  
Fax: (404) 639-6315

ATSDR can also tell you the location of occupational and environmental health clinics. These clinics specialize in recognizing, evaluating, and treating illnesses resulting from exposure to hazardous substances.

\* To order toxicological profiles, contact:

National Technical Information Service  
5285 Port Royal Road  
Springfield, VA 22161  
Phone: (800) 553-6847 or (703) 487-4650

