

# OCCUPATIONAL SAFETY AND HEALTH GUIDELINE FOR *sec*-BUTYL ALCOHOL

## INTRODUCTION

This guideline summarizes pertinent information about *sec*-butyl alcohol for workers and employers as well as for physicians, industrial hygienists, and other occupational safety and health professionals who may need such information to conduct effective occupational safety and health programs. Recommendations may be superseded by new developments; readers are therefore advised to regard these recommendations as general guidelines and to determine periodically whether new information is available.

## SUBSTANCE IDENTIFICATION

### • Formula



### • Structure



### • Synonyms

2-Butanol, *sec*-butanol, 2-butyl alcohol, methyl ethyl carbinol, butylene hydrate, 2-hydroxybutane

### • Identifiers

1. CAS No.: 78-92-2
2. RTECS No.: EO1750000
3. DOT UN: 1120 26
4. DOT label: Flammable Liquid

### • Appearance and odor

*sec*-Butyl alcohol is a colorless, flammable, volatile liquid with a strong, winelike odor. The odor threshold is reported to be between 0.4 and 2.5 parts per million (ppm) parts of air.

## CHEMICAL AND PHYSICAL PROPERTIES

### • Physical data

1. Molecular weight: 74.1
2. Boiling point (760 mm Hg): 99.5°C (211.1°F)
3. Specific gravity (water = 1): 0.81 at 20°C (68°F)
4. Vapor density (air = 1 at boiling point of *sec*-butyl alcohol): 2.55
5. Melting point: -115°C (-175°F)
6. Vapor pressure at 20°C (68°F): 12 mm Hg
7. Solubility: Moderately soluble in water; miscible with alcohol, ether, and most organic solvents
8. Evaporation rate (butyl acetate = 1): 1.3

### • Reactivity

1. Conditions contributing to instability: Heat, sparks, and open flame. *sec*-Butyl alcohol auto-oxidizes to form an explosive peroxide.
2. Incompatibilities: Fires and explosions may result from contact of *sec*-butyl alcohol with strong oxidizers, organic peroxides, or perchloric or permonosulfuric acid. *sec*-Butyl alcohol ignites on contact with chromium trioxide.
3. Hazardous decomposition products: Toxic gases (such as carbon monoxide) may be released when *sec*-butyl alcohol decomposes.
4. Special precautions: None

### • Flammability

The National Fire Protection Association has assigned a flammability rating of 3 (dangerous fire hazard) to *sec*-butyl alcohol.

1. Flash point: 24°C (75°F)
2. Autoignition temperature: 405°C (761°F)

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Public Health Service Centers for Disease Control  
National Institute for Occupational Safety and Health  
Division of Standards Development and Technology Transfer

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

3. Flammable limits in air at 100°C (212°F) (% by volume): Lower, 1.7; upper, 9.8

4. Extinguishant: Use alcohol foam, carbon dioxide, or dry chemical to fight fires involving sec-butyl alcohol. Water may be ineffective, but it may be used to cool fire-exposed containers. If a leak or spill has not ignited, water spray may be used to disperse vapors and to protect persons attempting to stop the leak.

Fires involving sec-butyl alcohol should be fought upwind and from the maximum distance possible. Isolate the hazard area and deny access to unnecessary personnel. Vapors may travel to a source of ignition and flash back. Vapor explosion hazards may occur indoors, outdoors, or in sewers. Emergency personnel should stay out of low areas and ventilate closed spaces before entering. Containers of sec-butyl alcohol may explode in the heat of the fire and should be moved from the fire area if it is possible to do so safely. If this is not possible, cool containers from the sides with water until well after the fire is out. Stay away from the ends of containers. Personnel should withdraw immediately if they hear a rising sound from a venting safety device or if a container becomes discolored as a result of fire. Dikes should be used to contain fire-control water for later disposal. If a tank car or truck is involved in a fire, personnel should isolate an area of a half mile in all directions. Firefighters should wear a full set of protective clothing (including a self-contained breathing apparatus) when fighting fires involving sec-butyl alcohol. Firefighters' protective clothing may not provide protection against permeation by sec-butyl alcohol.

## EXPOSURE LIMITS

### • OSHA PEL

The current Occupational Safety and Health Administration (OSHA) permissible exposure limit (PEL) for sec-butyl alcohol is 100 ppm (305 mg/m<sup>3</sup>) as an 8-hr time-weighted average (TWA) concentration [29 CFR 1910.1000, Table Z-1-A].

### • NIOSH REL

The National Institute for Occupational Safety and Health (NIOSH) has established a recommended exposure limit (REL) of 100 ppm (305 mg/m<sup>3</sup>) as an 8-hr TWA and 150 ppm (455 mg/m<sup>3</sup>) as a short-term exposure limit (STEL). A STEL is a 15-min TWA exposure that should not be exceeded at any time during a workday [NIOSH 1992].

### • ACGIH TLV®

The American Conference of Governmental Industrial Hygienists (ACGIH) has assigned sec-butyl alcohol a threshold limit value (TLV) of 100 ppm (303 mg/m<sup>3</sup>) as a

TWA for a normal 8-hr workday and a 40-hr workweek [ACGIH 1991b].

### • Rationale for limits

The limits are based on the risks of narcosis and irritation associated with exposure to sec-butyl alcohol.

## HEALTH HAZARD INFORMATION

### • Routes of exposure

Exposure to sec-butyl alcohol can occur through inhalation, ingestion, and eye or skin contact.

### • Summary of toxicology

1. *Effects on Animals:* In animals, sec-butyl alcohol is an eye irritant and, at high concentrations, a narcotic. Although it is not an irritant when in contact with rabbit skin, it can induce severe corneal injury when directly instilled into the eyes of rabbits [Grant 1986; NLM 1991]. Five of six rats died following an exposure of 16,000 ppm for 4 hr [Clayton and Clayton 1981]. Death also occurred in all five female rats that inhaled 10,000 ppm for 7 hr. Another group of female rats exposed to 7,000 ppm for 7 hr did not die and had not completely recovered from the induced narcosis on the day following exposure. Female rats exposed to 5,000 ppm also had impaired motor activity and developed narcosis [Nelson et al. 1989]. Inhalation of 10,670 ppm for 225 min or 16,000 ppm for 160 min was fatal to exposed mice [Clayton and Clayton 1981]. Mice that inhaled exposures ranging from 3,300 ppm for 5 hr to 19,800 ppm for 40 min developed restlessness, ataxia, prostration, and narcosis but did not die [NLM 1991]. Mice were unaffected by exposure to 1,650 ppm for 7 hr [ACGIH 1991a]. The oral LD<sub>50</sub> in the rat is 6.5 g/kg [NIOSH 1991]. Mice exposed repeatedly to a sec-butyl alcohol concentration of 5,330 ppm for a total of 117 hr developed narcosis but survived the exposure [Clayton and Clayton 1981]. Groups of female rats were exposed to 7,000, 5,000, 3,500, or 0 ppm sec-butyl alcohol for 7 hr/day on gestation days 1 through 19. Absorbed daily doses for each of these respective exposure concentrations were theorized to be 700, 500, 350, or 0 mg/kg. No deaths occurred, but weight gain and food consumption were depressed for dams at each sec-butyl alcohol exposure concentration. The number of live fetuses was significantly reduced, resorptions increased, and the fetal weights were slightly depressed at 7,000 and 5,000 ppm [Nelson et al. 1989]. In two mutagenicity assays, *Schizosaccharomyces pombe* (yeast) and V-79 Chinese hamster cells, sec-butyl alcohol was nonmutagenic [IPCS 1987].

2. *Effects on Humans:* sec-Butyl alcohol has a defatting effect on the skin [Proctor et al. 1988]. Workers repeatedly exposed to 100 ppm have not developed signs or symptoms

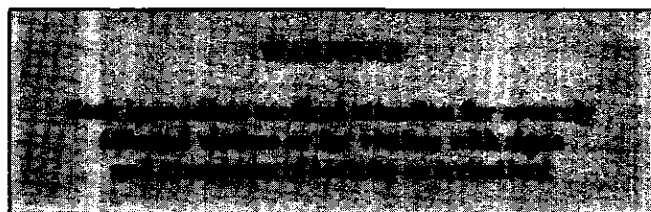
of toxicity or irritation [Proctor et al. 1988]. However, two patients who had become sensitized to primary alcohols tested positive when challenged with *sec*-butyl alcohol [NLM 1991]. Excessive exposure may result in headache, dizziness, drowsiness, and narcosis [IPCS 1987].

#### • Signs and symptoms of exposure

1. *Acute exposure*: Acute exposure to *sec*-butyl alcohol can cause eye, nose, and throat irritation, with redness and tearing of the eyes, runny nose, defatting of skin, and cough. Exposure to high concentrations of *sec*-butyl alcohol is likely to cause headache, fatigue, nausea, dizziness, and narcosis.

2. *Chronic exposure*: Chronic exposure to *sec*-butyl alcohol can cause dermatitis in chronically exposed workers and may cause intense dermal sensitization in some exposed individuals.

#### • Emergency procedures



Keep unconscious victims warm and on their sides to avoid choking if vomiting occurs. Initiate the following emergency procedures:

1. *Eye exposure*: Tissue irritation may result from exposure to concentrated solutions, vapors, mists, or aerosols of *sec*-butyl alcohol. *Immediately and thoroughly* flush eyes with large amounts of water, occasionally lifting the upper and lower eyelids.

2. *Skin exposure*: Skin irritation may result. *Immediately remove contaminated clothing and thoroughly wash* contaminated skin with soap and water.

3. *Inhalation exposure*: If vapors, mists, or aerosols of *sec*-butyl alcohol are inhaled, move the victim to fresh air *immediately*.

If the victim is not breathing, clean any chemical contamination from the victim's lips and perform cardiopulmonary resuscitation (CPR); if breathing is difficult, give oxygen.

4. *Ingestion exposure*: Take the following steps if *sec*-butyl alcohol or a solution containing it is ingested:

—Have the victim rinse the contaminated mouth cavity several times with a fluid such as water.

—Have the victim drink a glass (8 oz) of fluid such as water.

—Induce vomiting by giving syrup of ipecac as directed on the package. If ipecac is unavailable, have the victim

touch the back of the throat with a finger until productive vomiting ceases.

—Do *not* force an unconscious or convulsing person to drink fluid or to vomit.

5. *Rescue*: Remove an incapacitated worker from further exposure and implement appropriate emergency procedures (e.g., those listed on the material safety data sheet required by OSHA's hazard communication standard [29 CFR 1910.1200]). All workers should be familiar with emergency procedures and the location and proper use of emergency equipment.

## EXPOSURE SOURCES AND CONTROL METHODS

The following operations may involve *sec*-butyl alcohol and may result in worker exposures to this substance:

—Use of *sec*-butyl alcohol as an adhesive in the manufacture of plywood and as a chemical intermediate in the production of methyl ethyl ketone, *sec*-butyl acetate, and xanthate

—Use of *sec*-butyl alcohol as a solvent for natural resins, linseed oil, castor oil, lacquer, paint removers, and adhesives

—Manufacture of flotation agents, hydraulic fluids, flavors, perfumes, dyestuffs, wetting agents, paint removers, industrial cleaners, and polishes

—Use of *sec*-butyl alcohol as a dehydrating agent, an anti-foaming agent, and an ingredient in dewaxing paraffin

The following methods are effective in controlling worker exposures to *sec*-butyl alcohol, depending on the feasibility of implementation:

—Process enclosure

—Local exhaust ventilation

—General dilution ventilation

—Personal protective equipment

Good sources of information about control methods are as follows:

1. ACGIH [1992]. *Industrial ventilation—a manual of recommended practice*. 21st ed. Cincinnati, OH: American Conference of Governmental Industrial Hygienists.

2. Burton DJ [1986]. *Industrial ventilation—a self study companion*. Cincinnati, OH: American Conference of Governmental Industrial Hygienists.

3. Alden JL, Kane JM [1982]. *Design of industrial ventilation systems*. New York, NY: Industrial Press, Inc.

4. Wadden RA, Scheff PA [1987]. Engineering design for control of workplace hazards. New York, NY: McGraw-Hill.

5. Plog BA [1988]. Fundamentals of industrial hygiene. Chicago, IL: National Safety Council.

## MEDICAL MONITORING

Workers who may be exposed to chemical hazards should be monitored in a systematic program of medical surveillance that is intended to prevent occupational injury and disease. The program should include education of employers and workers about work-related hazards, placement of workers in jobs that do not jeopardize their safety or health, early detection of adverse health effects, and referral of workers for diagnosis and treatment. The occurrence of disease or other work-related adverse health effects should prompt immediate evaluation of primary preventive measures (e.g., industrial hygiene monitoring, engineering controls, and personal protective equipment). A medical monitoring program is intended to supplement, not replace, such measures. To place workers effectively and to detect and control work-related health effects, medical evaluations should be performed (1) before job placement, (2) periodically during the term of employment, and (3) at the time of job transfer or termination.

### • Preplacement medical evaluation

Before a worker is placed in a job with a potential for exposure to sec-butyl alcohol, a licensed health care professional should evaluate and document the worker's baseline health status with thorough medical, environmental, and occupational histories, a physical examination, and physiologic and laboratory tests appropriate for the anticipated occupational risks. These should concentrate on the function and integrity of the eyes, skin, and respiratory tract. Medical monitoring for respiratory disease should be conducted using the principles and methods recommended by the American Thoracic Society [ATS 1987].

A preplacement medical evaluation is recommended to assess an individual's suitability for employment at a specific job and to detect and assess medical conditions that may be aggravated or may result in increased risk when a worker is exposed to sec-butyl alcohol at or below the prescribed exposure limit. The licensed health care professional should consider the probable frequency, intensity, and duration of exposure as well as the nature and degree of any applicable medical condition. Such conditions (which should not be regarded as absolute contraindications to job placement) include a history and other findings consistent with eye, skin, and respiratory tract diseases.

### • Periodic medical examinations and biological monitoring

Occupational health interviews and physical examinations should be performed at regular intervals during the employment period, as mandated by any applicable Federal, State, or local standard. Where no standard exists and the hazard is minimal, evaluations should be conducted every 3 to 5 years or as frequently as recommended by an experienced occupational health physician. Additional examinations may be necessary if a worker develops symptoms attributable to sec-butyl alcohol exposure. The interviews, examinations, and medical screening tests should focus on identifying the adverse effects of sec-butyl alcohol on the eyes, skin, and respiratory tract. Current health status should be compared with the baseline health status of the individual worker or with expected values for a suitable reference population.

Biological monitoring involves sampling and analyzing body tissues or fluids to provide an index of exposure to a toxic substance or metabolite. No biological monitoring test acceptable for routine use has yet been developed for sec-butyl alcohol.

### • Medical examinations recommended at the time of job transfer or termination

The medical, environmental, and occupational history interviews, the physical examination, and selected physiologic or laboratory tests that were conducted at the time of job placement should be repeated at the time of job transfer or termination. Any changes in the worker's health status should be compared with those expected for a suitable reference population.

## WORKPLACE MONITORING AND MEASUREMENT

A worker's exposure to airborne sec-butyl alcohol is determined by using coconut shell charcoal tubes (100/50-mg sections, 20/40 mesh). Samples are collected at a maximum flow rate of 0.2 liter/min until a maximum air volume of 10 liters is collected. The samples are desorbed either with carbon disulfide/isopropanol (99:1) or carbon disulfide/dimethylformamide (99:1). Analysis is conducted by gas chromatography using a flame ionization detector. The limit of detection for this procedure is 0.01 mg/sample. This method is described in Method No. 1401 of the *NIOSH Manual of Analytical Methods* [NIOSH 1984].

## PERSONAL HYGIENE

If sec-butyl alcohol contacts the skin, workers should flush the affected areas immediately with plenty of water for 15 min and then wash with soap and water.

Clothing and shoes contaminated with sec-butyl alcohol should be removed immediately, and provisions should be made for safely removing this chemical from these articles. Persons laundering contaminated clothing should be informed of the hazardous properties of sec-butyl alcohol, particularly its potential to be irritating to the eyes and skin.

A worker who handles sec-butyl alcohol should thoroughly wash hands, forearms, and face with soap and water before eating, using tobacco products, or using toilet facilities.

Workers should not eat, drink, or use tobacco products in areas where sec-butyl alcohol is handled, processed, or stored.

## STORAGE

sec-Butyl alcohol should be stored in a cool, dry, well-ventilated area in tightly sealed containers that are labeled in accordance with OSHA's hazard communication standard [29 CFR 1910.1200]. The storage area must meet OSHA requirements for Class IC flammable liquids. Drums must be equipped with self-closing valves, pressure-vacuum bungs, and flame arrestors. Containers of sec-butyl alcohol should be protected from physical damage and should be kept separate from oxidizing agents, explosives, heat, sparks, and open flame. Small amounts of this substance may be stored in metal safety cans in OSHA-approved safety cabinets or storage rooms. Only nonsparking tools may be used to handle sec-butyl alcohol. To prevent static sparks, containers should be grounded and bonded during transfers. Because containers that formerly contained sec-butyl alcohol may still hold product residues, they should be handled appropriately.

## SPILLS AND LEAKS

In the event of a spill or leak involving sec-butyl alcohol, persons not wearing protective equipment and clothing should be restricted from contaminated areas until cleanup is complete. The following steps should be undertaken following a spill or leak:

1. Do not touch the spilled material; stop the leak if it is possible to do so without risk.
2. Notify safety personnel.
3. Remove all sources of heat and ignition.
4. Ventilate potentially explosive atmospheres.
5. Absorb small liquid spills with sand or other noncombustible absorbent material and place the material in a covered container for later disposal.
6. For large liquid spills, build dikes far ahead of the spill to contain the sec-butyl alcohol for later reclamation or disposal.

## SPECIAL REQUIREMENTS

U.S. Environmental Protection Agency (EPA) requirements for emergency planning, reportable quantities of hazardous releases, community right-to-know, and hazardous waste management may change over time. Users are therefore advised to determine periodically whether new information is available.

### • Emergency planning requirements

sec-Butyl alcohol is not subject to EPA emergency planning requirements under the Superfund Amendments and Reauthorization Act (SARA) [42 USC 11022].

### • Reportable quantity requirements for hazardous releases

Employers are not required by the emergency release notification provisions of the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) [40 CFR 355.40] to notify the National Response Center of an accidental release of sec-butyl alcohol; there is no reportable quantity for this substance.

### • Community right-to-know requirements

Employers who own or operate facilities in SIC codes 20 to 39, who employ 10 or more workers, and who manufacture 25,000 lb or more or otherwise use 10,000 lb or more of sec-butyl alcohol per calendar year are required by EPA [40 CFR 372.30] to submit a Toxic Chemical Release Inventory Form (Form R) to EPA reporting the amount of sec-butyl alcohol emitted or released from their facility annually.

### • Hazardous waste management requirements

EPA considers a waste to be hazardous if it exhibits any of the following characteristics: ignitability, corrosivity, reactivity, or toxicity as defined in 40 CFR 261.21-261.24. Although sec-butyl alcohol is not specifically listed as a hazardous waste under the Resource Conservation and Recovery Act (RCRA) [40 USC 6901 et seq.], EPA requires employers to treat waste as hazardous if it exhibits any of the characteristics discussed above.

Providing detailed information about the removal and disposal of specific chemicals is beyond the scope of this guideline. The U.S. Department of Transportation, EPA, and State and local regulations should be followed to ensure that removal, transport, and disposal of this substance are conducted in accordance with existing regulations. To be certain that chemical waste disposal meets EPA regulatory requirements, employers should address any questions to the RCRA hotline at (800) 424-9346 or at (202) 382-3000 in Washington, D.C. In addition, relevant State and local

authorities should be contacted for information about their requirements for waste removal and disposal.

## RESPIRATORY PROTECTION

### • Conditions for respirator use

Good industrial hygiene practice requires that engineering controls be used where feasible to reduce workplace concentrations of hazardous materials to the prescribed exposure limit. However, some situations may require the use of respirators to control exposure. Respirators must be worn if the ambient concentration of sec-butyl alcohol exceeds prescribed exposure limits. Respirators may be used (1) before engineering controls have been installed, (2) during work operations such as maintenance or repair activities that involve unknown exposures, (3) during operations that require entry into tanks or closed vessels, and (4) during emergencies. Workers should use only respirators that have been approved by NIOSH and the Mine Safety and Health Administration (MSHA).

### • Respiratory protection program

Employers should institute a complete respiratory protection program that, at a minimum, complies with the requirements of OSHA's respiratory protection standard [29 CFR 1910.134]. Such a program must include respirator selection, an evaluation of the worker's ability to perform the work while wearing a respirator, the regular training of personnel, fit testing, periodic workplace monitoring, and regular respirator maintenance, inspection, and cleaning. The implementation of an adequate respiratory protection program (including selection of the correct respirator) requires that a knowledgeable person be in charge of the program and that the program be evaluated regularly. For additional information on the selection and use of respirators and on the medical screening of respirator users, consult the *NIOSH Respirator Decision Logic* [NIOSH 1987b] and the *NIOSH Guide to Industrial Respiratory Protection* [NIOSH 1987a].

## PERSONAL PROTECTIVE EQUIPMENT

Protective clothing should be worn to prevent skin contact with sec-butyl alcohol. Chemical protective clothing should be selected on the basis of available performance data, manufacturers' recommendations, and evaluation of the clothing under actual conditions of use. The following materials have been recommended for use against permeation by sec-butyl alcohol and may withstand permeation for more than 4 but fewer than 8 hr: butyl rubber and polyethylene/ethylene vinyl alcohol.

If sec-butyl alcohol is dissolved in water or an organic solvent, the permeation properties of both the solvent and

the mixture must be considered when selecting personal protective equipment and clothing.

Safety glasses, goggles, or face shields should be worn during operations in which sec-butyl alcohol might contact the eyes (e.g., through splashes of solution). Eyewash fountains and emergency showers should be available within the immediate work area whenever the potential exists for eye or skin contact with sec-butyl alcohol. Contact lenses should not be worn if the potential exists for sec-butyl alcohol exposure.

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