

OCCUPATIONAL SAFETY AND HEALTH GUIDELINE FOR n-BUTYL LACTATE

INTRODUCTION

This guideline summarizes pertinent information about n-butyl lactate 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 Recommendations may be superseded by new developments; readers are therefore advised to regard these recommendations as general guidelines and to determine periodically whether new information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

Butyl α -hydroxypropionate; butyl lactate; 2-hydroxypropanoic acid, butyl ester; lactic acid, butyl ester

• Identifiers

1. CAS No.: 138-22-7
2. RTECS No.: OD4025000
3. DOT UN: 1993 27 (combustible liquid not otherwise specified)
4. DOT label: None

• Appearance and odor

n-Butyl lactate is a clear, colorless to white, combustible liquid. It has a mild, transient odor. The odor threshold is reported to be 7 parts per million (ppm) parts of air.

CHEMICAL AND PHYSICAL PROPERTIES

• Physical data

1. Molecular weight: 146.2

2. Boiling point (760 mm Hg): 188°C (370.4°F)
3. Specific gravity (water = 1): 0.9 to 0.984 at 20°C (68°F)
4. Vapor density (air = 1 at boiling point of n-butyl lactate): 5.0
5. Melting point: -43°C (-45.4°F)
6. Vapor pressure at 20°C (68°F): 0.4 mm Hg
7. Solubility: Slightly soluble in water; miscible with alcohol and ether; hydrolyzed by acids and bases
8. Evaporation rate (butyl acetate = 1): 0.44

• Reactivity

1. Conditions contributing to instability: Heat, sparks, and open flame. Strong acids (such as hydrochloric, sulfuric, or nitric) and strong bases (such as sodium hydroxide) can cause butyl lactate to decompose.
2. Incompatibilities: A reaction may result from contact of n-butyl lactate with strong oxidizers.
3. Hazardous decomposition products: Toxic gases (such as carbon dioxide) may be released in a fire involving n-butyl lactate.
4. Special precautions: None reported

• Flammability

The National Fire Protection Association has assigned a flammability rating of 2 (moderate fire hazard) to n-butyl lactate.

1. Flash point: 71°C (160°F) (open cup)
2. Autoignition temperature: 382°C (720°F)
3. Flammable limits in air (% by volume): Lower, 1.15; upper, data not available
4. Extinguishant: Use water fog, dry chemical, alcohol foam, or carbon dioxide to fight fires involving n-butyl lactate. Do not use a solid stream of water because this will scatter and spread the fire. Water may be ineffective for fighting fires, but it may be used to cool fire-exposed containers.

Fires involving n-butyl lactate should be fought upwind and from the maximum distance possible. Isolate the hazard area

U.S. DEPARTMENT OF HEALTH AND HUMAN SERVICES
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

and deny access to unnecessary personnel. Emergency personnel should stay out of low areas and ventilate closed spaces before entering. Vapor explosion and poison hazards may occur indoors, outdoors, or in sewers. Vapors may travel to a source of ignition and flash back. Containers of n-butyl lactate 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 n-butyl lactate. Firefighters' protective clothing may not provide protection against permeation by n-butyl lactate.

EXPOSURE LIMITS

• OSHA PEL

The current Occupational Safety and Health Administration (OSHA) permissible exposure limit (PEL) for n-butyl lactate is 5 ppm (25 mg/m³) 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 5 ppm (25 mg/m³) as an 8-hr TWA [NIOSH 1992].

• ACGIH TLV[®]

The American Conference of Governmental Industrial Hygienists (ACGIH) has assigned n-butyl lactate a threshold limit value (TLV) of 5 ppm (30 mg/m³) 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 risk of headaches and irritation of pharyngeal and laryngeal mucosa associated with exposure to n-butyl lactate.

HEALTH HAZARD INFORMATION

• Routes of exposure

Exposure to n-butyl lactate can occur through inhalation, ingestion, or eye or skin contact.

2 n-Butyl Lactate

• Summary of toxicology

1. *Effects on Animals:* n-Butyl lactate is an eye and respiratory tract irritant and a central nervous system depressant; it also causes a moderate degree of irritation to the skin of rabbits [NIOSH 1991]. The oral LD₅₀ in rats is 5 g/kg [NIOSH 1991]. Acutely poisoned animals exhibit somnolence, flaccid paralysis, and dyspnea before death.

2. *Effects on Humans:* n-Butyl lactate is a central nervous system depressant and an irritant of the eyes, mucous membranes, and upper respiratory tract. Prolonged or repeated contact with the skin by n-butyl lactate causes defatting, redness, and cracking of the skin [Genium 1987]. Prolonged exposures to approximately 7 ppm with peak exposures to 11 ppm caused irritation of the pharyngeal and laryngeal mucosa, coughing, and complaints of sleepiness and headache in the evening after work [ACGIH 1991a]. Some workers also experienced nausea and vomiting [ACGIH 1991a]. Exposure to 4 ppm also caused some of these symptoms [ACGIH 1991a]. No symptoms were reported by workers exposed to n-butyl lactate at concentrations below 1.4 ppm [ACGIH 1991a].

• Signs and symptoms of exposure

1. *Acute exposure:* Acute exposure to n-butyl lactate may cause coughing, scratchy throat, nausea, headache, dyspnea, vomiting, CNS depression, and redness, pain, and tearing of the eyes.

2. *Chronic exposure:* Prolonged or repeated contact with n-butyl lactate may cause ocular or mucosal irritation, dryness, redness, cracking, and defatting of the skin.

• 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 n-butyl lactate. **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 n-butyl lactate 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 n-butyl lactate 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 uses of n-butyl lactate may result in worker exposures to this substance:

—Use as a solvent for cellulose, varnishes, lacquers, stencil pastes, natural gums, oils, dyes, and many synthetic polymers

—Use in making paint, inks, perfumes, and dry cleaning fluids

—Use in making antiskinning agents and adhesives and as a chemical intermediate

The following methods are effective in controlling worker exposures to n-butyl lactate, 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 n-butyl lactate, 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 skin and respiratory system. 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 n-butyl lactate 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 skin or respiratory system 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 n-butyl lactate exposure. The interviews, examinations, and medical screening tests should focus on identifying the adverse effects of n-butyl lactate on the skin and respiratory system. 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 n-butyl lactate.

- **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 n-butyl lactate is determined by using a charcoal tube (100/50-mg front and back-up sections). Samples are collected at a maximum flow rate

of 0.2 liter/min until a maximum air volume of 10 liters is collected. The sample is then treated with a 95:5 mixture of methylene chloride and methanol to extract the n-butyl lactate. Analysis is conducted by gas chromatography using a flame ionization detector. This method is described in the OSHA Computerized Information System [OSHA 1989] and in the OSHA Laboratory In-House Methods File [OSHA 1990].

PERSONAL HYGIENE

If n-butyl lactate contacts the skin, workers should immediately wash the affected areas with soap and water.

Clothing and shoes contaminated with n-butyl lactate should be removed, and provisions should be made for safely removing this chemical from these articles.

A worker who handles n-butyl lactate 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 n-butyl lactate or a solution containing n-butyl lactate is handled, processed, or stored.

STORAGE

n-Butyl lactate 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 the requirements for OSHA Class IIIA [29 CFR 1910.106] combustible liquids. Containers of n-butyl lactate should be protected from physical damage and should be stored separately from strong oxidizers, heat, sparks, and open flame. Only nonsparking tools may be used to handle n-butyl lactate. To prevent static sparks, containers and equipment must be grounded and bonded when transferring this material. Because containers that formerly contained n-butyl lactate may still hold product residues, they should be handled appropriately.

SPILLS AND LEAKS

In the event of a spill or leak involving n-butyl lactate, 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 using ventilation of explosionproof design.
5. Water spray may be used to reduce vapors, but the spray may not prevent ignition in closed spaces.
6. Absorb small liquid spills with sand or other noncombustible absorbent material and place the material in a covered container for later disposal.
7. For large liquid spills, build dikes far ahead of the spill to contain the n-butyl lactate 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**

n-Butyl lactate 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 n-butyl lactate; there is no reportable quantity for this substance.

- **Community right-to-know requirements**

Employers are not required by Section 313 of SARA to submit a Toxic Chemical Release Inventory Form (Form R) to EPA reporting the amount of n-butyl lactate 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 n-butyl lactate 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 n-butyl lactate 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 repeated or prolonged skin contact with n-butyl lactate. Impervious

gloves, aprons, boots, gauntlets, plastic coveralls, and other protective clothing should be worn as necessary when handling this material. 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.

No reports have been published on the resistance of various protective clothing materials to n-butyl lactate permeation. If permeability data are not readily available, protective clothing manufacturers should be requested to provide information on the best chemical protective clothing for workers to wear when they are exposed to n-butyl lactate.

If n-butyl lactate 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 n-butyl lactate 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 n-butyl lactate. Contact lenses should not be worn if the potential exists for n-butyl lactate exposure.

REFERENCES CITED

- ACGIH [1991a]. Documentation of the threshold limit values and biological exposure indices. 6th ed. Cincinnati, OH: American Conference of Governmental Industrial Hygienists.
- ACGIH [1991b]. 1991-1992 Threshold limit values for chemical substances and physical agents and biological exposure indices. Cincinnati, OH: American Conference of Governmental Industrial Hygienists.
- ATS [1987]. Standardization of spirometry—1987 update. American Thoracic Society. *Am Rev Respir Dis* 136:1285-1296.
- CFR. Code of Federal regulations. Washington, DC: U.S. Government Printing Office, Office of the Federal Register.
- Genium [1987]. Material safety data sheet no. 612. Schenectady, NY: Genium Publishing Corporation.
- NIOSH [1987a]. NIOSH guide to industrial respiratory protection. Cincinnati, OH: U.S. Department of Health and Human Services, Public Health Service, Centers for Disease Control, National Institute for Occupational Safety and Health, DHHS (NIOSH) Publication No. 87-116.
- NIOSH [1987b]. Respirator decision logic. Cincinnati, OH: U.S. Department of Health and Human Services, Public Health Service, Centers for Disease Control, National Institute for Occupational Safety and Health, DHHS (NIOSH) Publication No. 87-108.
- NIOSH [1991]. Registry of toxic effects of chemical substances database: lactate acid, butyl ester. Cincinnati, OH: U.S. Department of Health and Human Services, Public Health Service, Centers for Disease Control, National Institute for Occupational Safety and Health, Division of Standards Development and Technology Transfer, Technical Information Branch.
- NIOSH [1992]. NIOSH recommendations for occupational safety and health: compendium of policy documents and statements. Cincinnati, OH: U.S. Department of Health and Human Services, Public Health Service, Centers for Disease Control, National Institute for Occupational Safety and Health, DHHS (NIOSH) Publication No. 92-100.
- OSHA [1989]. Computerized information system. Washington, DC: U.S. Department of Labor, Occupational Safety and Health Administration.
- OSHA [1990]. OSHA laboratory in-house methods file. U.S. Department of Labor, Occupational Safety and Health Administration, OSHA Analytical Laboratory.