

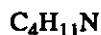
# OCCUPATIONAL SAFETY AND HEALTH GUIDELINE FOR BUTYLAMINE

## INTRODUCTION

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 Recommendations may be superseded by new developments; readers are therefore advised to regard these recommendations as general guidelines and to determine periodically whether new information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

1-Butylamine, n-butylamine, 1-aminobutane, 1-butanamine, Norvalamine, mono-n-butylamine

### • Identifiers

1. CAS No: 109-73-9
2. RTECS No.: EO2975000
3. DOT UN: 1125 68
4. DOT label: Flammable Liquid

### • Appearance and odor

Butylamine is a colorless, volatile, flammable liquid with an ammonialike odor; the liquid tends to yellow on standing. The odor threshold is reported to be 1.8 parts per million (ppm) parts of air.

## CHEMICAL AND PHYSICAL PROPERTIES

### • Physical data

1. Molecular weight: 73.1
2. Boiling point (760 mm Hg): 78°C (172°F)
3. Specific gravity (water = 1): 0.74 at 20°C (68°F)
4. Vapor density (air = 1 at boiling point of butylamine): 2.5
5. Melting point: -50°C (-58°F)
6. Vapor pressure at 20°C (68°F): 82 mm Hg
7. Solubility: Miscible with water, alcohol, and ether
8. Evaporation rate: Data not available

### • Reactivity

1. Conditions contributing to instability: Heat, sparks, and open flame
2. Incompatibilities: Fires and explosion may result from contact of butylamine with strong oxidizers or strong acids.
3. Hazardous decomposition products: Toxic gases (such as oxides of nitrogen and carbon monoxide) may be released in a fire involving butylamine.
4. Special precautions: In the presence of moisture, butylamine corrodes some metals on contact.

### • Flammability

The National Fire Protection Association has assigned a flammability rating of 3 (dangerous fire hazard) to butylamine.

1. Flash point: -12°C (10°F) (closed cup)
2. Autoignition temperature: 312°C (594°F)
3. Flammable limits in air (% by volume): Lower, 1.7; upper, 9.8
4. Extinguishant: Use dry chemical, alcohol foam, or carbon dioxide to fight fires involving butylamine. Water may be an ineffective extinguishant, but it may be used to cool

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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 butylamine should be fought upwind and from the maximum distance possible. Isolate the hazard area and deny access to unnecessary personnel. Emergency personnel should stay out of low areas and ventilate closed spaces before entering. Containers of butylamine 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 butylamine. Firefighters' protective clothing may not provide protection against permeation by butylamine.

## EXPOSURE LIMITS

### • OSHA PEL

The current Occupational Safety and Health Administration (OSHA) permissible exposure limit (PEL) for butylamine is 5 ppm (15 mg/m<sup>3</sup>) as a ceiling limit. A worker's exposure to butylamine shall at no time exceed this ceiling limit. The OSHA PEL also bears a "Skin" notation, which indicates that the cutaneous route of exposure (including mucous membranes and eyes) contributes to overall exposure [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 (15 mg/m<sup>3</sup>) as a ceiling limit with a "Skin" notation [NIOSH 1992].

### • ACGIH TLV®

The American Conference of Governmental Industrial Hygienists (ACGIH) has assigned butylamine a ceiling limit of 5 ppm (15 mg/m<sup>3</sup>), which should not be exceeded during any part of the working exposure. The ACGIH also assigns a "Skin" notation to butylamine [ACGIH 1991b].

### • Rationale for limits

The limits are based on the risk of eye, skin, and respiratory tract irritation associated with exposure to butylamine.

## HEALTH HAZARD INFORMATION

### • Routes of exposure

Exposure to butylamine can occur through inhalation, ingestion, eye or skin contact, and by skin absorption.

### • Summary of toxicology

1. *Effects on Animals:* Butylamine vapor is an irritant of the eyes, nose, respiratory tract, and skin; contact of liquid butylamine with the eyes or skin causes corrosive burns. The oral LD<sub>50</sub> in rats is 366 mg/kg, the LC<sub>50</sub> in rats is 4,000 ppm for 4 hr, and the dermal LD<sub>50</sub> in rabbits is 850 mg/kg [NIOSH 1991]. Rats exposed for an unspecified time to butylamine at concentrations of 3,000 to 5,000 ppm exhibited signs of severe irritation of the respiratory tract, developed pulmonary edema, and died within minutes or hours of the exposure [Clayton and Clayton 1981]. When applied to the skin of guinea pigs, butylamine caused necrosis [ACGIH 1991a]. Butylamine caused severe damage to the eyes of rabbits [ACGIH 1991a].

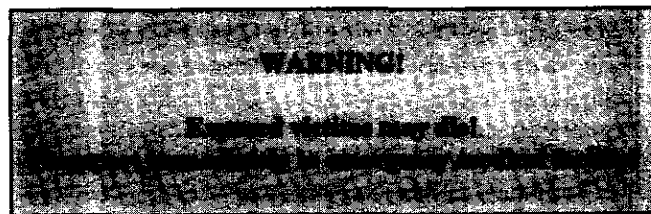
2. *Effects on Humans:* Exposure to butylamine vapor causes eye, nose, and upper respiratory tract irritation, and contact of the skin or eyes with liquid butylamine causes severe irritation, corrosive burns, and possibly blindness [Clayton and Clayton 1981]. Workers exposed to butylamine concentrations at 5 to 10 ppm or higher experience eye and upper respiratory tract irritation, and exposure to butylamine concentrations at 10 to 25 ppm for more than a few minutes is considered intolerable by some workers [Clayton and Clayton 1981; Proctor et al. 1988].

### • Signs and symptoms of exposure

1. *Acute exposure:* The signs and symptoms of acute exposure to butylamine include redness and tearing of the eyes, runny nose, scratchy throat, headache, facial flushing, increased pulse and respiratory rates, shortness of breath, and (if the exposure is severe) hyperactive reflexes, cyanosis, pulmonary edema, convulsions, and coma. If absorbed through the skin in toxic amounts, butylamine can cause nausea, vomiting, and shock. Direct eye or skin contact with the liquid can result in deep second-degree burns, blistering, corrosion, and possible blindness. Oral administration of near-lethal doses of butylamine to rats and rabbits resulted in hyperactivity of the reflexes, an increase in pulse and respiratory rates, shortness of breath, convulsions, cyanosis, and coma [ACGIH 1991a]. Some workers exposed to this substance at 5 to 10 ppm also experienced headache and facial flushing [Proctor et al. 1988].

2. *Chronic exposure:* No signs or symptoms of chronic exposure to butylamine have been reported.

## • Emergency procedures



Keep unconscious victims warm and on their sides to avoid choking if vomiting occurs. **Immediately** initiate the following emergency procedures, continuing them as appropriate en route to the emergency medical facility:

1. **Eye exposure:** Tissue destruction and blindness may result from exposure to concentrated solutions, vapors, mists or aerosols of butylamine! **Immediately but gently** flush the eyes with large amounts of water for at least 15 min, occasionally lifting the upper and lower eyelids.

2. **Skin exposure:** Severe burns, skin corrosion, and absorption of toxic amounts may result! **Immediately** remove all contaminated clothing! **Immediately and gently** wash skin for at least 15 min. Use soap and water if skin is intact; use only water if skin is not intact.

3. **Inhalation exposure:** If vapors, mists, or aerosols of butylamine 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 butylamine or a solution containing it is ingested:

—Do **not** induce vomiting.

—Have the victim rinse the contaminated mouth cavity several times with a fluid such as water. Immediately after rinsing, have the victim drink one cup (8 oz) of fluid and **no more**.

—Do **not** permit the victim to drink milk or carbonated beverages!

—Do **not** permit the victim to drink any fluid if more than 60 min have passed since initial ingestion.

**NOTE:** These instructions must be followed exactly. Drinking a carbonated beverage or more than one cup of fluid could create enough pressure to perforate already damaged stomach tissue. The tissue-coating action of milk may impede medical assessment of tissue damage. Ingestion of any fluid more than 60 min after initial exposure could further weaken damaged tissue and result in perforation.

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 butylamine and may result in worker exposures to this substance:

—Use of butylamine as a vulcanizing accelerator and reaction initiator in the rubber and polymer industries

—Use of butylamine as a chemical intermediate in the production of emulsifying agents, rubber chemicals, synthetic tanning agents, and special soaps

—Manufacture of photographic developers, pharmaceuticals, dyes, gasoline antioxidants, insecticides, and textile desizing agents

—Use of butylamine as a flavoring ingredient in alcoholic beverages, ice cream, ices, candy, baked goods, gelatins, and puddings

The following methods are effective in controlling worker exposures to butylamine, 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 butylamine, 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 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 butylamine 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, or respiratory system diseases.

### • Periodic medical examinations and biological monitoring

Occupational health interviews and physical examinations should be performed at regular intervals during the employ-

ment 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 butylamine exposure. The interviews, examinations, and medical screening tests should focus on identifying the adverse effects of butylamine on the eyes, 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. However, no biological monitoring test acceptable for routine use has yet been developed for butylamine.

### • 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 butylamine is determined by using sulfuric-acid-coated silica gel tubes (150/75-mg sections, 20/40 mesh). Samples are collected at a maximum flow rate of 1 liter/min until a maximum air volume of 15 liters is collected. The samples are desorbed with methanol/water (50:50). Analysis is conducted by gas chromatography using a flame ionization detector. The limit of detection for this procedure is not known. This method is described in Method No. S138 of the *NIOSH Manual of Analytical Methods* [NIOSH 1984].

## PERSONAL HYGIENE

Butylamine causes severe burns on contact with the skin; this substance can also be absorbed through the skin in toxic amounts. Therefore, if butylamine contacts the skin, workers should flush the affected areas immediately with plenty of water for at least 15 min and then wash with soap and water. Get medical attention immediately.

Clothing and shoes contaminated with butylamine 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 butylamine, particularly its potential to be absorbed through the skin and to cause eye and skin burns.

A worker who handles butylamine 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 butylamine or a solution containing butylamine is handled, processed, or stored.

## STORAGE

Butylamine 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]. Outside or detached storage is preferred; inside storage should be in a standard storage area or room for flammable liquids. All ventilation systems and electrical equipment in storage areas should be of explosionproof design. Containers of butylamine should be protected from physical damage and should be stored separately from strong oxidizers and strong acids, heat, sparks, and open flame. To prevent static sparks, all containers and equipment used in shipping, transferring, or receiving operations should be bonded and grounded. Because containers that formerly contained butylamine may still hold product residues, they should be handled appropriately.

## SPILLS AND LEAKS

In the event of a spill or leak involving butylamine, 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. Use water spray to cool fire-exposed containers and to reduce vapors; such spraying may not prevent ignition in closed spaces.
6. Absorb small spills with sand or other noncombustible absorbent material and place the material in a covered container for later disposal.
7. For large spills, build dikes far ahead of the spill to contain the butylamine 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

Butylamine 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

A hazardous substance release is defined by EPA as any spilling, pumping, pouring, emitting, emptying, discharging, injecting, escaping, leaching, dumping, or disposing of hazardous substances into the environment (including the abandonment or discarding of contaminated containers). In the event of a release that is equal to or greater than the reportable quantity for that chemical, employers are required by the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) [40 CFR 355.40] to notify the proper Federal authorities.

The reportable quantity for butylamine is 1,000 lb. If an amount equal to or greater than this quantity is released within a 24-hr period in a manner that will expose persons outside the facility, employers are required to do the following:

- Notify the National Response Center *immediately* at (800) 424-8802 or at (202) 426-2675 in Washington, D.C. [40 CFR 302.6].
- Notify the emergency response commission of the State likely to be affected by the release [40 CFR 355.40].
- Notify the community emergency coordinator of the local emergency planning committee (or relevant local emergency response personnel) of any area likely to be affected by the release [40 CFR 355.40].

### • 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 butylamine 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, reac-

tivity, or toxicity as defined in 40 CFR 261.21-261.24. Although butylamine 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 butylamine 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 any possibility of skin contact with butylamine. 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. Teflon<sup>®</sup> has been recommended for use against permeation by butylamine and may withstand permeation for more than 4 but fewer than 8 hr. Butyl rubber, natural rubber, neoprene, nitrile rubber, polyvinyl alcohol, polyvinyl chloride, and Viton<sup>®</sup> have demonstrated poor resistance to permeation by butylamine.

If butylamine 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 butylamine 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 butylamine. Contact lenses should not be worn if the potential exists for butylamine exposure.

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