

Occupational Health Guideline for tert-Butyl Alcohol

INTRODUCTION

This guideline is intended as a source of information for employees, employers, physicians, industrial hygienists, and other occupational health professionals who may have a need for such information. It does not attempt to present all data; rather, it presents pertinent information and data in summary form.

SUBSTANCE IDENTIFICATION

- Formula: $(\text{CH}_3)_3\text{COH}$
- Synonyms: 2-Methyl-2-propanol; TBA; trimethylcarbinol
- Appearance and odor: Colorless liquid or solid with a camphor-like odor.

PERMISSIBLE EXPOSURE LIMIT (PEL)

The current OSHA standard for tert-butyl alcohol is 100 parts of tert-butyl alcohol per million parts of air (ppm) averaged over an eight-hour work shift. This may also be expressed as 300 milligrams of tert-butyl alcohol per cubic meter of air (mg/m^3).

HEALTH HAZARD INFORMATION

• Routes of exposure

tert-Butyl alcohol can affect the body if it is swallowed, is inhaled, or comes in contact with the skin or eyes.

• Effects of overexposure

1. *Short-term Exposure:* Overexposure to tert-butyl alcohol may cause irritation of the eyes, nose, and throat, headache, dizziness, and drowsiness.

2. *Long-term Exposure:* Drying and cracking of the skin may result from prolonged skin exposure.

3. *Reporting Signs and Symptoms:* A physician should be contacted if anyone develops any signs or symptoms and suspects that they are caused by exposure to tert-butyl alcohol.

• Recommended medical surveillance

The following medical procedures should be made available to each employee who is exposed to tert-butyl alcohol at potentially hazardous levels:

1. *Initial Medical Screening:* Employees should be screened for history of certain medical conditions (listed below) which might place the employee at increased risk from tert-butyl alcohol exposure.

—Skin disease: tert-Butyl alcohol is a defatting agent and can cause dermatitis on prolonged exposure. Persons with pre-existing skin disorders may be more susceptible to the effects of this agent.

—Liver disease: Although tert-butyl alcohol is not known as a liver toxin in humans, the importance of this organ in the biotransformation and detoxification of foreign substances should be considered before exposing persons with impaired liver function.

—Kidney disease: Although tert-butyl alcohol is not known as a kidney toxin in humans, the importance of this organ in the elimination of toxic substances justifies special consideration in those with impaired renal function.

—Chronic respiratory disease: In persons with impaired pulmonary function, especially those with obstructive airway diseases, the breathing of tert-butyl alcohol might cause exacerbation of symptoms due to its irritant properties.

2. *Periodic Medical Examination:* Any employee developing the above-listed conditions should be referred for further medical examination.

• Summary of toxicology

Experimental and clinical observations have been limited, but tert-butyl alcohol is regarded primarily as a narcotic, with the potential of causing drowsiness from exposure to high concentrations of the vapor. Repeated daily narcotic doses were not fatal to animals, and no injurious effects resulted from a long-continued dosage. It is also considered to be a mild skin irritant. No chronic systemic effects have been reported in humans.

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

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

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

CHEMICAL AND PHYSICAL PROPERTIES

• Physical data

1. Molecular weight: 74
2. Boiling point (760 mm Hg): 83 C (181 F)
3. Specific gravity (water = 1): 0.8
4. Vapor density (air = 1 at boiling point of tert-butyl alcohol): 2.6
5. Melting point: 25 C (77 F)
6. Vapor pressure at 20 C (68 F): 31 mm Hg
7. Solubility in water, g/100 g water at 20 C (68 F): Miscible in all proportions

8. Evaporation rate (butyl acetate = 1): 1.05

• Reactivity

1. Conditions contributing to instability: Heat
2. Incompatibilities: Strong mineral acids can cause decomposition to flammable isobutylene gas. Strong hydrochloric acid reacts with tert-butyl alcohol to form tert-butyl chloride, a volatile liquid.
3. Hazardous decomposition products: Toxic gases and vapors (such as carbon monoxide and isobutylene) may be released in a fire involving tert-butyl alcohol.
4. Special precautions: tert-Butyl alcohol will attack some forms of plastics, rubber, and coatings.

• Flammability

1. Flash point: 11 C (52 F) (closed cup)
2. Autoignition temperature: 480 C (896 F)
3. Flammable limits in air, % by volume: Lower: 2.4; Upper: 8

4. Extinguishant: Alcohol foam, dry chemical, carbon dioxide

• Warning properties

1. Odor Threshold: May reports an odor threshold of 73 ppm.
2. Eye Irritation Level: tert-Butyl alcohol is not specifically known to be an eye irritant, but by analogy to the other butyl alcohols, which produce eye irritation at 100 ppm, it is treated as an eye irritant.
3. Evaluation of Warning Properties: Since the odor threshold of tert-butyl alcohol is below the permissible exposure limit, it is treated as a material with adequate warning properties.

MONITORING AND MEASUREMENT PROCEDURES

• General

Measurements to determine employee exposure are best taken so that the average eight-hour exposure is based on a single eight-hour sample or on two four-hour samples. Several short-time interval samples (up to 30 minutes) may also be used to determine the average exposure level. Air samples should be taken in the employee's breathing zone (air that would most nearly represent that inhaled by the employee).

• Method

Sampling and analyses may be performed by collection of tert-butyl alcohol vapors using an adsorption tube with subsequent desorption with 2-butanone in carbon

disulfide and gas chromatographic analysis. Also, detector tubes certified by NIOSH under 42 CFR Part 84 or other direct-reading devices calibrated to measure tert-butyl alcohol may be used. An analytical method for tert-butyl alcohol is in the *NIOSH Manual of Analytical Methods*, 2nd Ed., Vol. 2, 1977, available from the Government Printing Office, Washington, D.C. 20402 (GPO No. 017-033-00260-6).

RESPIRATORS

• Good industrial hygiene practices recommend that engineering controls be used to reduce environmental concentrations to the permissible exposure level. However, there are some exceptions where respirators may be used to control exposure. Respirators may be used when engineering and work practice controls are not technically feasible, when such controls are in the process of being installed, or when they fail and need to be supplemented. Respirators may also be used for operations which require entry into tanks or closed vessels, and in emergency situations. If the use of respirators is necessary, the only respirators permitted are those that have been approved by the Mine Safety and Health Administration (formerly Mining Enforcement and Safety Administration) or by the National Institute for Occupational Safety and Health.

• In addition to respirator selection, a complete respiratory protection program should be instituted which includes regular training, maintenance, inspection, cleaning, and evaluation.

PERSONAL PROTECTIVE EQUIPMENT

• Employees should be provided with and required to use impervious clothing, gloves, face shields (eight-inch minimum), and other appropriate protective clothing necessary to prevent repeated or prolonged skin contact with liquid or solid tert-butyl alcohol.

• Clothing wet with liquid tert-butyl alcohol or heavily contaminated with solid tert-butyl alcohol should be placed in closed containers for storage until it can be discarded or until provision is made for the removal of tert-butyl alcohol from the clothing. If the clothing is to be laundered or otherwise cleaned to remove the tert-butyl alcohol, the person performing the operation should be informed of tert-butyl alcohol's hazardous properties.

• Any clothing which becomes wet with liquid tert-butyl alcohol or heavily contaminated with solid tert-butyl alcohol should be removed immediately and not reworn until the tert-butyl alcohol is removed from the clothing.

• Employees should be provided with and required to use dust- and splash-proof safety goggles where liquid or solid tert-butyl alcohol may contact the eyes.

SANITATION

• Skin that becomes wet with liquid tert-butyl alcohol or heavily contaminated with solid tert-butyl alcohol should be promptly washed or showered to remove any tert-butyl alcohol.

COMMON OPERATIONS AND CONTROLS

The following list includes some common operations in which exposure to tert-butyl alcohol may occur and control methods which may be effective in each case:

Operation	Controls
Liberation during vapor application of lacquer surface coatings; during use of industrial cleaning compounds	Local exhaust ventilation; general dilution ventilation; personal protective equipment
Use as a chemical intermediate in manufacture of tert-butyl chloride and tert-butyl phenol	Local exhaust ventilation; general dilution ventilation
Liberation during mixing of perfumes, lacquers, and denatured alcohol in open-surface tanks	Local exhaust ventilation; general dilution ventilation
Use as a solvent for drug extraction, water removal, wax solvent, extraction of hypochlorous acid lube oil, and laboratory procedures	Local exhaust ventilation; general dilution ventilation

EMERGENCY FIRST AID PROCEDURES

In the event of an emergency, institute first aid procedures and send for first aid or medical assistance.

• Eye Exposure

If tert-butyl alcohol gets into the eyes, wash eyes immediately with large amounts of water, lifting the lower and upper lids occasionally. Get medical attention as soon as possible. Contact lenses should not be worn when working with this chemical.

• Skin Exposure

If tert-butyl alcohol gets on the skin, promptly flush the contaminated skin with water. If tert-butyl alcohol soaks through the clothing, remove the clothing immediately and flush the skin with water. If there is skin irritation, get medical attention.

• Breathing

If a person breathes in large amounts of tert-butyl alcohol, move the exposed person to fresh air at once. If breathing has stopped, perform artificial respiration. Keep the affected person warm and at rest. Get medical attention as soon as possible.

• Swallowing

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

• Rescue

Move the affected person from the hazardous exposure. If the exposed person has been overcome, notify someone else and put into effect the established emergency rescue procedures. Do not become a casualty. Understand the facility's emergency rescue procedures and know the locations of rescue equipment before the need arises.

SPILL, LEAK, AND DISPOSAL PROCEDURES

• Persons not wearing protective equipment and clothing should be restricted from areas of spills or leaks until cleanup has been completed.

• If tert-butyl alcohol is spilled or leaked, the following steps should be taken:

1. Remove all ignition sources.
2. Ventilate area of spill or leak.
3. For small quantities, absorb on paper towels. Evaporate in a safe place (such as a fume hood). Allow sufficient time for evaporating vapors to completely clear the hood ductwork. Burn the paper in a suitable location away from combustible materials. Large quantities can be collected and atomized in a suitable combustion chamber. tert-Butyl alcohol should not be allowed to enter a confined space, such as a sewer, because of the possibility of an explosion.

• Waste disposal methods:

tert-Butyl alcohol may be disposed of:

1. By absorbing it in vermiculite, dry sand, earth or a similar material and disposing in a secured sanitary landfill.
2. By atomizing in a suitable combustion chamber.

REFERENCES

- American Conference of Governmental Industrial Hygienists: "tert-Butyl Alcohol," *Documentation of the Threshold Limit Values for Substances in Workroom Air* (3rd ed., 2nd printing), Cincinnati, 1974.
- Browning, E.: *Toxicity and Metabolism of Industrial Solvents*, Elsevier, New York, 1965.
- Grant, W. M.: *Toxicology of the Eye* (2nd ed.), C. C. Thomas, Springfield, Illinois, 1974.
- Kirk, R., and Othmer, D.: *Encyclopedia of Chemical Technology* (2nd ed.), Interscience, New York, 1968.
- May, J.: "Solvent Odor Thresholds for the Evaluation of Solvent Odors in the Atmosphere," *Staub-Reinhalt*, 26:9, 385-389, 1966.
- Patty, F. A. (ed.): *Toxicology*, Vol. II of *Industrial Hygiene and Toxicology* (2nd ed. rev.), Interscience, New York, 1963.
- Sax, N. I.: *Dangerous Properties of Industrial Materials* (3rd ed.), Van Nostrand Reinhold, New York, 1968.
- Spector, W. S. (Vols. I, II), Negherbon, W. O. (Vol. III), Grebe, R. M. (Vol. IV), and Dittmer, D. S. (Vol. V) (eds.): *Handbook of Toxicology*, Saunders, Philadelphia, 1956-1959.
- *Survey of Compounds Which Have Been Tested for Carcinogenic Activity*, U.S. Public Health Service Publication No. 149, Original, Supplements 1 and 2, 1961-1967, 1968-1969, and 1970-1971.

RESPIRATORY PROTECTION FOR TERT-BUTYL ALCOHOL

Condition	Minimum Respiratory Protection* Required Above 100 ppm
Vapor Concentration	
1000 ppm or less	A chemical cartridge respirator with a full facepiece and an organic vapor cartridge(s).
5000 ppm or less	A gas mask with a chin-style or a front- or back-mounted organic vapor canister. Any supplied-air respirator with a full facepiece, helmet, or hood. Any self-contained breathing apparatus with a full facepiece.
8000 ppm or less	A Type C supplied-air respirator with a full facepiece operated in pressure-demand or other positive pressure mode or with a full facepiece, helmet, or hood operated in continuous-flow mode.
Greater than 8000 ppm or entry and escape from unknown concentrations	Self-contained breathing apparatus with a full facepiece operated in pressure-demand or other positive pressure mode. A combination respirator which includes a Type C supplied-air respirator with a full facepiece operated in pressure-demand or other positive pressure or continuous-flow mode and an auxiliary self-contained breathing apparatus operated in pressure-demand or other positive pressure mode.
Fire Fighting	Self-contained breathing apparatus with a full facepiece operated in pressure-demand or other positive pressure mode.
Escape	Any gas mask providing protection against organic vapors. Any escape self-contained breathing apparatus.

*Only NIOSH-approved or MSHA-approved equipment should be used.

