

NIOSH/OSHA STANDARDS COMPLETION PROGRAM

DRAFT TECHNICAL STANDARD AND
SUPPORTING DOCUMENTATION FOR

*** TERT-BUTYL ALCOHOL ***

NIOSH/OSHA Draft Technical Standard
and Supporting Documentation for TERT-BUTYL ALCOHOL

The basic text of this document contains the draft technical standard approved by the Joint Review Committee of the NIOSH/OSHA Standards Completion Program and the supporting documentation for the substance TERT-BUTYL ALCOHOL.

The SCP draft technical standards are recommendations to the Department of Labor for its consideration in rulemaking and have no legal status until final rules have been promulgated by that agency. This draft standard is provided for your information only.

The References and Sources, Respirator Table Documentation and Use/Exposure and Control Documentation are the working documents used by the various SCP working groups during the development of the draft technical standard and serve as the technical foundation for the standard. The classification for each substance and the regulatory statements were derived following a decision logic established for the various sections of the standard.

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(a) DEFINITIONS

- (1) PERMISSIBLE EXPOSURE - "Permissible Exposure" means inhalation of tert-butyl alcohol in concentrations not in excess of 100 parts per million (ppm) (300 milligrams per cubic meter, mg/cu.m.) averaged over an eight hour work shift, as stated in section 1910.93, Table G-1.
- (2) ACTION LEVEL - "Action Level" means one half (1/2) of the permissible exposure for tert-butyl alcohol.

(b) EMPLOYEE INFORMATION - Each employer who has a workplace in which tert-butyl alcohol is present shall:

- (1) STANDARD AVAILABILITY - Keep a copy of this section with its appendices A, B and C, at the workplace. This material shall be made readily available to affected employees; and
- (2) PRESENCE OF TERT-BUTYL ALCOHOL - Inform affected employees of the quantity, location, and manner of use or storage of tert-butyl alcohol.

(c) EXPOSURE MEASUREMENT

- (1) INITIAL DETERMINATION - Each employer who has a place of employment in which tert-butyl alcohol is released into the workplace air shall determine if any employee may be exposed to airborne concentrations of tert-butyl alcohol at or above the action level. The determination shall be made each time there is a change in production, process, or control measures which could result in an increase in airborne concentrations of tert-butyl alcohol. A written determination shall be made and it shall contain at least the following information:
 - (i) Any information, observations, or calculations which would indicate employee exposure to tert-butyl alcohol;
 - (ii) Any measurements of airborne concentrations of tert-butyl alcohol taken;
 - (iii) Any employee complaints of symptoms which may be attributable to exposure to tert-butyl alcohol; and
 - (iv) Date of determination, work being performed at the time, location within work site, name, and social security number of each employee considered.
- (2) INITIAL EXPOSURE MEASUREMENT - If the employer determines that any employee may be exposed to airborne concentrations of tert-butyl alcohol at or above the action level, the exposure of the employee believed to have the greatest exposure shall be measured. The exposure measurement shall be representative of the maximum exposure of the employee.
- (3) IDENTIFICATION OF EXPOSED EMPLOYEES - If the exposure measurement taken under paragraph (c)(2) of this section reveals employee exposure to airborne concentrations of tert-butyl alcohol at or above the action level, the employer shall:
 - (i) Identify all employees who may be exposed at or above the action level; and
 - (ii) Measure the exposure of the employees so identified.
- (4) EXPOSURE ABOVE THE ACTION LEVEL - If an employee exposure measurement reveals that an employee is exposed to airborne concentrations of tert-butyl alcohol at or above the action level,

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but not above the permissible exposure, the exposure of that employee shall be measured at least every two months.

- (5) EXPOSURE ABOVE THE PERMISSIBLE EXPOSURE - If an employee exposure measurement reveals that an employee is exposed to airborne concentrations of tert-butyl alcohol above the permissible exposure, the employer shall:

- (i) Inform the employee of the exposure as required by paragraph (N)(1) of this section; and
- (ii) Measure the exposure of the employee at least monthly; and
- (iii) Institute control measures as required by paragraph (E) of this section.

- (6) TERMINATION OF EXPOSURE MEASUREMENT - If two consecutive employee exposure measurements taken at least one week apart reveal that the employee is exposed to airborne concentrations of tert-butyl alcohol below the action level, the employer may terminate measurement for the employee. For purposes of this subparagraph, use of respirators shall not constitute reduction of employee exposure below the action level.

- (d) METHODS OF MEASUREMENT - An employee's exposure shall be obtained by any combination of long term or short term samples which represents the employee's actual exposure averaged over an eight hour work shift (Appendix B (iv)). The method of measurement shall have an accuracy, to a confidence level of 95%, of not less than that given in Table 1 below.

Table 1

Concentration	Required Accuracy
Above permissible exposure	Plus or Minus 25%
At or below permissible exposure and above the action level	Plus or Minus 35%
At or below the action level	Plus or Minus 50%

- (e) Methods of Compliance

- (1) Engineering controls - No employee shall be exposed to tert-butyl alcohol above the permissible limit as defined in paragraph (a)(1) of this section. Engineering and work practice controls shall be used to reduce exposure to tert-butyl alcohol to at or below the permissible exposure.

- (i) When mechanical ventilation is used to control exposure, measurements which demonstrate system efficiency (for example: air velocity, static pressure, or air volume) shall be made at least every three months. Measurements of system efficiency shall also be made within five work days of any change in production, process or control which might result in a reduction in control.

- (ii) In the design of open surface tank ventilation for the purposes of section 1910.94 (d), operations involving tert-butyl alcohol shall be classified as B-1 at 70 F.

- (iii) Where a fan is located in duct work and where tert-butyl alcohol is present in concentrations greater than 6000 ppm, one fourth of the lower flammable limit, the fan rotating element shall be of non-sparking material or the casing shall consist of, or be lined with, non-sparking material. There shall be sufficient clearance between the fan rotating element and the fan casing so as to prevent contact.

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(2) Respirators

- (i) Compliance with the permissible exposure may not be achieved by the use of respirators except:
 - (a) During the time period necessary to install engineering controls; or
 - (b) In work situations in which engineering controls are technically not feasible; or
 - (c) In work situations in which feasible engineering and work practice controls are insufficient to reduce employees exposure to at or below the permissible exposure. Where technically feasible engineering and work practice controls are not sufficient to reduce exposure to at or below permissible exposure, they shall be used to reduce exposure to the lowest level feasible; or
 - (d) For operations not exceeding 40 hours per year; or
 - (e) In emergencies.
- (ii) Respirators shall be jointly approved by the Mining Enforcement and Safety Administration (formerly Bureau of Mines) and by the National Institute for Occupational Safety and Health under the provisions of 30 CFR Part 11.
- (iii) Employers shall select and provide the appropriate respirator from Table 2 and shall ensure that the employee uses the respirator provided.
- (iv) Employers shall institute a respiratory protection program in accordance with sections 1910.134(b),(d),(e) and (f).

TABLE 2. RESPIRATORY PROTECTION FOR tert-BUTYL ALCOHOL

Condition

Vapor Concentration

Equal to or Less
Than 1000 ppm and organic vapor cartridge(s).

Equal to or Less
Than 5000 ppm organic vapor canister.
Any supplied-air respirator with a full facepiece, helmet
or hood.
Any self-contained breathing apparatus with a full face-
piece.

Equal to or Less
Than 10000 ppm with a full facepiece, helmet, or hood operated in con-
tinuous-flow mode.

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Greater than 10000 ppm or, Entry and Escape from Unknown Concentrations	Self contained breathing apparatus with a full facepiece operated in pressure-demand (positive pressure) mode. air respirator with a full facepiece operated in pressure- auxiliary self-contained air supply operated in pressure- demand mode.
Fire Fighting	Self-contained breathing apparatus with a full facepiece operated in pressure-demand (positive pressure) mode.
Escape	Any gas mask providing protection against organic vapors. Any escape self-contained breathing apparatus.

(f) Fire and Safety

Employers shall familiarize themselves with the information contained in the Substance Technical Guidelines for tert-butyl alcohol which is contained in Appendix B in order to ensure the safe handling and use of tert-butyl alcohol.

- (1) Electrical - For the purposes of compliance with section 1910.309, locations classified as hazardous locations due to the presence of tert-butyl alcohol shall be Class I Group D.
- (2) Portable fire extinguishers - For the purposes of compliance with section 1910.157, tert-butyl alcohol is classified as a Class B fire hazard.
- (3) Powered industrial trucks - For the purposes of compliance with section 1910.178, locations classified as hazardous locations due to the presence of tert-butyl alcohol shall be Class I Group D.
- (4) Flammable liquids - For the purposes of compliance with section 1910.106, liquid tert-butyl alcohol is classified as a Class IB flammable liquid. Spray finishing operations shall be performed in accordance with sections 1910.107 and 1910.94(c). Dip tank operations shall be performed in accordance with sections 1910.108 and 1910.94(d).
- (5) Sources of ignition - Sources of ignition such as smoking or open flames are prohibited where tert-butyl alcohol is handled, used or stored in a manner so as to create a potential fire or explosion hazard.
- (6) Storage - tert-butyl alcohol shall be stored so as not to come in contact with strong mineral acids.

(g) Personal Protective Equipment

(1) Skin Contact

- (i) Employers shall provide, and require employees to use, impervious clothing, gloves, face shields (8 inch minimum) and other appropriate protective clothing necessary to prevent repeated or prolonged skin contact to liquid or solid tert-butyl alcohol. Face shields shall comply with section 1910.133(a)(6).

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- (ii) Employers shall ensure that clothing which becomes wet with tert-butyl alcohol be removed immediately and not reworn until the tert-butyl alcohol is removed from the clothing.
 - (iii) Employers shall ensure that clothing wet with tert-butyl alcohol is placed in closed containers for storage until it can be discarded or until the employer provides 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, the employer shall inform the person performing the operation of the hazardous properties of tert-butyl alcohol.
- (2) Eye Contact
- (i) Employers shall provide, and require employees to use, splash-proof safety goggles (cup-cover type dust and splash safety goggles), which comply with section 1910.133(a)(6), where there is any possibility of liquid or solid tert-butyl alcohol contacting the eye.
 - (ii) Where there is any possibility that an employee's eyes may be exposed to liquid or solid tert-butyl alcohol, employers shall provide an eye wash fountain within the immediate work area for emergency use.
- (h) Spills
- (1) Spills of tert-butyl alcohol shall be cleaned up immediately after eliminating potential sources of ignition and utilizing available ventilation.
 - (2) Tert-butyl alcohol may not be allowed to enter a confined space, such as a sewer, because of the possibility of an explosion.
- (i) Sanitation
- (1) Employers shall ensure that employees whose skin becomes wet with tert-butyl alcohol promptly wash or shower as necessary to remove any tert-butyl alcohol from the skin.
- (j) Training and Information - Each employer who has employees exposed to tert-butyl alcohol in excess of the action level, or employees who may have skin or eye contact with tert-butyl alcohol, or employees who work where accidental release, spill, fire, or explosion of tert-butyl alcohol may occur, shall annually:
- (1) Substance Safety Data Sheet - Inform each employee of the information contained in the Substance Safety Data Sheet for tert-butyl alcohol, which is contained in Appendix A; and
 - (2) Medical -
 - (I) Advise employees as to the signs and symptoms of exposure to tert-butyl alcohol.
 - (II) Instruct the employees to advise the employer of the development of signs and symptoms of exposure to tert-butyl alcohol which are listed in Appendix A.
 - (III) Instruct the employees to inform the employer if they develop any of the medical conditions listed in (k)(2) of this section; and
- (3) Procedures -
- (I) Provide training to ensure that employees understand the precautions of safe use, emergency procedures, and the

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correct use of protective equipment relative to tert-butyl alcohol.

- (II) The procedures required by (j)(1), (2), and (3)(I) shall be provided to employees at the expense of the employer during the employee's normal working hours.

(k) Medical Surveillance

- (1) The employer shall provide medical procedures as required by paragraph (k). These procedures shall be provided at no cost to the employee.

- (2) Preplacement Questionnaire - The employer shall obtain from each employee who will be exposed to liquid tert-butyl alcohol, or airborne concentrations of tert-butyl alcohol at or above the action level, a written statement as to whether such employee has a history of any of the following:

- (I) Skin disease
- (II) Liver disease
- (III) Kidney disease
- (IV) Chronic lung disease

- (3) Preplacement Medical Examination - The employer shall provide a medical examination for an employee if the employee provides a history of any of the conditions named in paragraph (k)(2).

- (4) Results of Preplacement Examination - The employer shall obtain a physician's written opinion based on the medical examination pursuant to paragraph (k)(3).

- (5) Periodic Medical Examinations - The employer shall provide a medical examination for an employee if the employee advises the employer of the development of:

- (I) Any of the medical conditions listed in (k)(2)
- (II) Signs and symptoms listed in Appendix A which the employee suspects may be caused by exposure to tert-butyl alcohol.

- (6) Results of Periodic Examinations - The employer shall obtain a physician's written opinion based on the medical examination pursuant to paragraph (k)(5).

- (7) Exclusion or Removal from Exposure - No employee shall continue to be exposed to tert-butyl alcohol if such exposure could place the employee at increased risk of material impairment of his health.

- (8) Emergency Procedures - The employer shall provide emergency and follow-up medical examinations and treatment for any employee injured through exposure to tert-butyl alcohol.

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(9) Informing the Physician - The employer shall provide to the examining physician the following information:

- (I) A copy of this section with its Appendices A, B and C for tert-butyl alcohol;
- (II) A description of the employee's duties as they relate to his exposure to tert-butyl alcohol;
- (III) A description of any personal protective equipment, including respirators, required to be used;
- (IV) The results of any employee's exposure measurement, if available;
- (V) The employee's anticipated exposure level; and
- (VI) Upon request of the physician, information from previous medical examination of the employee.

(10) Physician's Written Opinion

- (I) The physician's written opinion shall be a signed statement by the examining physician specifically stating:
 - (A) Whether the employee has any detected medical conditions which could be directly or indirectly aggravated by exposure to tert-butyl alcohol or which could significantly interfere with the ability of the employee to follow recommended or required procedures for protecting himself from unusual or emergency exposure.
 - (B) Any recommended limitations upon the employee's exposure to tert-butyl alcohol.
 - (C) The employee has been informed by the physician of any detected medical conditions which require further medical examination or treatment.
- (II) The written opinion shall not reveal medical information unrelated to exposure to tert-butyl alcohol.

(11) Refusal to be Medically Examined - If an employee refuses any required medical examination, the employer shall inform the employee of the possible health consequences of such refusal and obtain a signed statement from the employee indicating that the employee understands the risks involved by refusing to be examined. n

(12) No medical procedure which would be performed pursuant to this section need be performed if records of a previous such procedure performed within the past six months are acceptable to the examining physician.

-(1) Recordkeeping.

(1) Initial determination.

- (i) The employer shall keep an accurate record of all initial determinations required to be made pursuant to paragraph (c)(1) of this section.

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- (ii) The record shall include the written determination and any supporting documentation as required in paragraph (c)(1) of this section.
 - (iii) This record shall be maintained until replaced by a more recent record.
- (2) Exposure measurements.
- (i) The employer shall keep an accurate record of all measurements taken to determine employee exposure to tert-butyl alcohol.
 - (ii) This record shall include:
 - (a) The date of measurement;
 - (b) A reference to the subparagraph of this regulation which required the measurement, if any;
 - (c) Operations involving exposure to tert-butyl alcohol which are being monitored;
 - (d) Sampling and analytical methods used and evidence of their accuracy;
 - (e) Number, duration, and results of samples taken;
 - (f) Name, Social Security number, and exposure of the employee monitored.
 - (iii) This record shall be maintained until replaced by a more recent record but in no event for less than one year.
- (3) Mechanical ventilation.
- (i) When mechanical ventilation is used as an engineering control, the employer shall maintain a record of measurements demonstrating the effectiveness of such ventilation as required by paragraph (e)(1)(i) of this section.
 - (ii) This record shall include:
 - (a) Date of measurement;
 - (b) Type of measurement taken;
 - (c) Result of measurement.
 - (iii) This record shall be maintained for at least one year.
- (4) Training and information.
- (i) The employer shall keep an accurate record of all employee training and advice required by paragraph (j) of this section.
 - (ii) The record shall include:
 - (a) Date of training;
 - (b) Name and Social Security number of employees trained;
 - (c) Substance of training provided.
 - (iii) This record shall be maintained until replaced by a more recent record.
- (5) Medical records.
- (i) The employer shall keep an accurate medical record for each employee.
 - (ii) The record shall include:
 - (a) Physician's written opinion;
 - (b) Preplacement questionnaire;
 - (c) Any employee medical complaints relative to exposure to ter-
 - (d) A signed statement of any refusal to be examined;
 - (e) A copy of information provided to the physician pursuant to paragraph (k)(9)(ii) through (vi) of this section.

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- (iii) This record shall be maintained for the duration of the employment of the affected employee.
- (6) Access to records.
 - (i) All records required to be maintained by this section shall be made available upon request to authorized representatives of the Assistant Secretary and the Director.
 - (ii) Employee exposure measurement records required to be maintained by this section shall be made available to employees and former employees and their designated representatives.
 - (iii) Employee medical records required to be maintained by this section shall be made available upon written request to a physician designated by the employee or former employee.
- (m) Observation of monitoring.
 - (1) Duty.

The employer shall give affected employees or their representatives an opportunity to observe any monitoring of employee exposure to tert-butyl alcohol which is conducted pursuant to this section.
 - (2) Exercise of opportunity to observe monitoring.
 - (i) When observation of the monitoring of employee exposure to tert-butyl alcohol requires entry into an area where the use of personal protective devices is required, the observer shall use such equipment and comply with all other applicable safety procedures.
 - (ii) Without interfering with the measurement, observers shall be entitled to:
 - (a) Receive an explanation of the measurement procedures;
 - (b) Visually observe all steps related to the measurement of exposure to tert-butyl alcohol that are being performed at the place of exposure.
 - (c) Record the results obtained.
- (n) Employee notification.
 - (1) The employer shall notify in writing, within five work days, every employee who is found to be exposed to tert-butyl alcohol above the permissible exposure. The employee shall also be notified of the level of his exposure and the corrective action being taken to reduce the exposure to at or below the permissible exposure.
 - (2) Pursuant to paragraph (k) of this Section, when an employee is medically examined the employer shall provide the employee with a copy of the physician's written opinion.

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APPENDIX A

SUBSTANCE SAFETY DATA SHEET

I. SUBSTANCE IDENTIFICATION

SUBSTANCE: tert-Butyl alcohol

PERMISSIBLE EXPOSURE: 100 parts of tert-butyl alcohol vapor per million parts of air (ppm) or 300 milligrams of tert-butyl alcohol vapor per cubic meter of air (mg/cu m).

APPEARANCE AND ODOR: Colorless liquid or solid with a camphor-like odor.

II. HEALTH HAZARD DATA

A. Ways in Which the Chemical Affects Your Body: tert-Butyl alcohol may affect your body if it is swallowed or inhaled or if it comes in contact with your skin or eyes.

B. Effects of Overexposure:

1. Short-Term Overexposure: Overexposure to tert-butyl alcohol may cause irritation of the eyes, nose, and throat, headache, dizziness and drowsiness.
2. Long-Term Overexposure: Drying and cracking of the skin may result from prolonged skin exposure.
3. Reporting Signs and Symptoms: You should inform your employer if you develop any signs or symptoms associated with tert-butyl alcohol exposure.

III. EMERGENCY FIRST AID PROCEDURES

A. Eye Exposure: If tert-butyl alcohol gets into your eyes, wash the 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.

B. Skin Exposure: If tert-butyl alcohol gets on your skin flush the contaminated skin with water promptly. If tert-butyl alcohol soaks through your clothing, remove the clothing immediately and flush the skin with water. Do not rewear the clothing until the tert-butyl alcohol has been removed. Replace or repair impervious clothing that has developed leaks. If there is skin irritation get medical attention.

C. Breathing: If you or any other person breathes in large amounts of tert-butyl alcohol remove the exposed person to fresh air at once. If breathing has stopped, perform artificial respiration. Keep the

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affected person warm and at rest. Get medical attention as soon as possible.

- D. Swallowing: When tert-butyl alcohol has been swallowed get medical attention immediately. If medical attention is not immediately available get the affected person to vomit by having him touch the back of the throat with his finger or by giving him large amounts (one pint or more) of warm salt water (two tablespoons of salt per pint of water). Do not make an unconscious person vomit.
- E. Rescue: Move 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 yourself. Understand your emergency rescue procedures and know the locations of the equipment before the need arises.

IV. RESPIRATORS AND PROTECTIVE CLOTHING

- A. RESPIRATORS: Respirators are not the best way to control exposure to tert-butyl alcohol. You can only be required to wear them for routine use if your employer is in the process of installing controls or other control measures prove inadequate. You may be required to wear respirators for non-routine activities or in emergencies. If respirators are worn, they must have a Mining Enforcement and Safety Administration (MESA)/National Institute for Occupational Safety and Health (NIOSH) approval label. (Older respirators may have a Bureau of Mines approval label.) If you can smell tert-butyl alcohol while wearing a respirator, the respirator is not working correctly; go immediately to fresh air. If you experience difficulty breathing while wearing a respirator, tell your employer.
- B. PROTECTIVE CLOTHING: You must wear impervious clothing, gloves, face shields, and other impervious protective clothing to prevent repeated or prolonged skin contact with liquid or solid tert-butyl alcohol.
- C. EYE PROTECTION: You must wear splash-proof safety goggles (cup-cover type dust and splash safety goggles) if there is any possibility of liquid or solid tert-butyl alcohol contacting your eyes.

V. PRECAUTIONS FOR SAFE USE, HANDLING AND STORAGE

Tert-butyl alcohol is a flammable liquid and its vapors easily form explosive mixtures with air. It must be stored in tightly closed containers in a cool, well-ventilated area away from heat, sparks, flames and mineral acids. Sources of ignition such as smoking and open flames are prohibited wherever tert-butyl alcohol is handled, used or stored in a manner that could create a potential fire or explosion hazard. You must use non-sparking tools when opening or closing metal containers of tert-butyl alcohol, and containers must be bonded and grounded when pouring or transferring liquid tert-butyl alcohol. If your skin becomes wet with tert-butyl alcohol, you must promptly wash or shower as necessary to remove the tert-butyl alcohol from your skin. You must immediately remove any clothing that becomes wet with liquid tert-butyl alcohol or contaminated with solid tert-butyl alcohol and this clothing must not be reworn until the tert-butyl alcohol is removed from the

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clothing. You must not eat or smoke in areas where solid tert-butyl alcohol is handled, processed or stored. If you handle liquid or solid tert-butyl alcohol, you must wash your hands thoroughly with soap or mild detergent and water before eating, smoking or using toilet facilities. Fire extinguishers and eye flushing facilities, where provided, must be readily available and you should know where they are and how to operate them. Ask your supervisor where tert-butyl alcohol is used in your work area and for any additional plant safety and health rules.

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APPENDIX B

SUBSTANCE TECHNICAL GUIDELINES
TERT-BUTYL ALCOHOL

I. PHYSICAL AND CHEMICAL DATA

A. Substance Identification

1. Synonyms: 2-methyl-2-propanol; TBA; trimethylcarbinol
2. Formula: $(CH_3)_3COH$
3. Molecular weight: 74

B. Physical Data

1. Boiling point (760 mm Hg): 83 C (181 F)
2. Specific gravity (water = 1): 0.8
3. Vapor density (air = 1 at boiling point of tert-butyl alcohol): 2.6
4. Melting point: 25 C (77 F)
5. Vapor pressure at 20 C (68 F): 31 mm Hg
6. Solubility in water, % by weight at 20 C (68 F): miscible in all proportions
7. Evaporation rate (butyl acetate = 1): 1.05
8. Appearance and odor: Colorless solid in cold weather; usually a colorless liquid. Camphor-like odor.

II. FIRE, EXPLOSION AND REACTIVITY HAZARD DATA

A. Fire

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. Extinguishing media: Alcohol foam, dry chemical, carbon dioxide.
5. Special fire-fighting procedures: Do not use a solid stream of water since the stream will scatter and spread the fire. Use water spray to cool containers exposed to a fire.
6. Unusual fire and explosion hazards: tert-Butyl alcohol is a flammable liquid. Its vapors can easily form explosive mixtures with air. All ignition sources must be controlled where tert-butyl alcohol is handled, used or stored. tert-Butyl alcohol vapors are heavier than air and may travel along the ground and be ignited by open flames or sparks at locations remote from the site at which tert-butyl alcohol is handled.
7. For purposes of conforming with the requirements of 29 CFR 1910.106, tert-butyl alcohol is classified as a Class IB flammable liquid. At 6000 ppm, one-fourth of the lower

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flammable limit, tert-butyl alcohol is considered to be a potential fire and explosion hazard.

8. For purposes of complying with 29 CFR 1910.309, the classification of hazardous locations as described in Article 500 of the National Electrical Code for tert-butyl alcohol shall be Class I Group D.

B. 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

III. SPILL, LEAK, AND DISPOSAL PROCEDURES

- A. 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) and burn the paper. Large quantities can be collected and atomized in a suitable combustion chamber. Tert-Butyl alcohol may not be allowed to enter a confined space, such as a sewer, because of the possibility of an explosion.

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

- C. 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 sanitary landfill.
2. By atomizing in a suitable combustion chamber.

IV. MONITORING AND MEASUREMENT PROCEDURES

- a. EXPOSURE ABOVE THE ACTION LEVEL: Measurements taken for the purpose of determining employee exposure under this section are best taken such that the average 8-hour exposure may be determined from a single sample or two (2) 4-hour samples. Short term interval samples (up to 30 minutes) may also be used to determine average exposure level if a minimum of five (5) measurements are taken in a random manner over the 8-hour work shift. Random sampling means that any portion of the work shift has the same chance of being sampled as any other. The arithmetic average of all such random equal duration samples taken on one (1) work shift is an estimate of an employee's average level of exposure for that work shift. Air samples should be taken in the employee's breathing zone (air that would most nearly represent that inhaled by the employee). Sampling and analyses may be performed by instruments such as detector tubes certified by NIOSH under 42 CFR Part 84, portable direct-reading instruments, gas and vapor adsorption tubes with subsequent chemical

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analyses or dosimeters. The method of measurement must determine the concentration of tert-butyl alcohol to plus or minus 35%.

- b. EXPOSURE ABOVE THE PERMISSIBLE EXPOSURE: The monitoring under this section should be essentially the same as described under paragraph IV. a. Laboratories performing chemical analyses should be accredited in Industrial Hygiene Chemistry by the American Industrial Hygiene Association (AIHA). The method of measurement must determine the concentration of tert-butyl alcohol to plus or minus 25%. Methods meeting these accuracy requirements are available in the "NIOSH Monitoring Methods Manual".

V. MISCELLANEOUS PRECAUTIONS

- A. Store tert-butyl alcohol in tightly closed containers in a cool, well-ventilated area.
- B. High exposures to tert-butyl alcohol can occur when transferring the liquid from one container to another.
- C. Non-sparking tools must be used to open and close metal tert-butyl alcohol containers. These containers must be effectively grounded and bonded prior to pouring.
- D. Employers must advise employees of all plant areas and operations where exposure to tert-butyl alcohol could occur.

VI. COMMON OPERATIONS

Common operations in which exposure to tert-butyl alcohol is likely to occur are: in the use of lacquer surface coatings and industrial cleaning compounds containing tert-butyl alcohol; in the handling and subdivision of quantities of tert-butyl alcohol; in its manufacture and use as a chemical intermediate in the manufacture of tert-butyl chloride, tert-butyl phenol, etc.; its use as a denaturant; its use in the preparation of perfumes, lacquers, etc.; its use as an extractant for drugs, water, hypochlorous acid, wax, lube oil, etc.; and its use in laboratory procedures.

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APPENDIX C - MEDICAL SURVEILLANCE GUIDELINES

I. ROUTE OF ENTRY

Inhalation

II. 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.

III. SIGNS AND SYMPTOMS

Drowsiness from heavy exposures; irritation of the skin from repeated contact. May be an eye irritant.

IV. SPECIAL TESTS

None in common usage.

V. TREATMENT

Remove from exposure. Give artificial resuscitation if indicated. Wash eyes and contaminated skin with water. If swallowed and the person is conscious, induce vomiting. Recovery is usually complete.

VI. SURVEILLANCE AND PREVENTIVE CONSIDERATIONS

A. GENERAL

Most reported effects of tert-butyl alcohol are caused by its irritant properties. It is important that the physician becomes familiar with plant operating conditions in which exposure to tert-butyl alcohol occurs. Those with skin disease may not tolerate the wearing of protective clothing and those with chronic respiratory disease may not tolerate the wearing of negative pressure respirators.

B. PREPLACEMENT

Routine medical histories and physical examination are not required. However, the employer must screen employees for history of certain medical conditions (listed below) which might place the employee at increased risk from exposure. Only those giving a positive history of these conditions must be referred for further medical examinations.

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1. Skin disease -- tert-Butyl alcohol is a defatting agent and can cause dermatitis on prolonged exposure. Persons with preexisting skin disorders may be more susceptible to the effects of this agent.
2. 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.
3. 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 possible impairment of renal function.
4. 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.

C. PERIODIC EXAMINATIONS

Routine periodic examinations are not required. However, if the employer becomes aware of an employee with the above-listed conditions, he must refer such employee for further medical examination.

References

1. Patty, Frank A.: Industrial Hygiene and Toxicology, Vol II - Toxicology (2d ed. revised), Interscience Publishers, New York, 1963, pp. 1449-1450.
2. Browning, Ethel: Toxicity and Metabolism of Industrial Solvents, Elsevier Publishing Company, Amsterdam, 1965, pp. 353-355.
3. American Conference of Governmental Industrial Hygienists, "tert-Butyl Alcohol," (3d ed., 2d printing), Documentation of the Threshold Limit Values for Substances in Workroom Air, Cincinnati, 1974, p. 32.

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REFERENCES AND SOURCES
TERT-BUTYL ALCOHOL
1910.93

- (f) Personal Protective Equipment, and, (h) Sanitation
Eye: Grant, "Toxicology of the Eye"
Skin: Browning, "Toxicity and Metabolism of Industrial Solvents"
Patty, "Industrial Hygiene and Toxicology", "Survey of Compounds
Which Have Been Tested for Carcinogenic Activity," PHS-149
Sax, "Dangerous Properties of Industrial Materials"
Ingestion: Browning, "Toxicity and Metabolism of Industrial Solvents"
Spector, "Handbook of Toxicology"
Kirk-Othmer Encyclopedia of Chemical Technology

COMMENTS

Eye - Classification: 2 and 6

Output statement numbers: 10 and 12 combined

Exceptions: None

No specific information could be found regarding the effects of tert-butyl alcohol upon the eye. For n-butyl alcohol Grant reports that "a drop to rabbit eyes caused moderate temporary injury graded 7 on a scale of 1 to 10 after 24 hours." For sec-butyl alcohol he reports that the substance was graded 4 on the scale of 10 noted above.

By analogy to these other isomers of butyl alcohol, it is concluded that classifications of 2 and 6 are appropriate.

Skin - Classification: 2 and 6

Output statement numbers: 2, 7b, 21, 16g

Exceptions: 5b and 20a deleted

Browning reports that "Oettel (1936) found only slight erythema and hyperaemia following its application to the skin," PHS-149 reports the formation of "1 sz cell carc from repeated application to the top back of mice. Sax considers it to be an acute local irritant of slight toxic hazard, and lists the acute systemic effects by skin absorption to be of moderate toxic hazard. For n-butyl alcohol Browning gives an acute skin penetration LD for rabbits of 9.4 ml/kg. (Patty gives this figure as a LD67).

tert-Butyl alcohol has a melting point of 77 degrees F. Its vapor pressure is 31 mm Hg at 20 degrees C; it is miscible in all proportions in water, and has a flash point of 52 degrees F.

Classifications of 2 and 6 are concluded to be appropriate to prevent the cited effects. Statements 5b and 20a are not used because of the significant vapor pressure of the substance and the innocuous effects of small amounts. Since the melting point of the substance is above its flash point, the flammability hazards of the substance are treated by the application of statements 7b and 21 to not only clothing wet with the liquid but also "heavily contaminated with" the solid. Statement 16i is modified similarly.

Ingestion - Classification: 0

Output statement numbers: None

Exceptions: None

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Browning reports an oral lethal dose for rabbits of 6.0 ml/kg. In general she states that the substance is "a narcotic, stronger in animals than butanol-1 or isobutyl al. Its toxic action, however, appears to be less; the mice investigated by Weese (1928) appeared to tolerate narcosis well with little evidence of organic injury." Spector lists an acute oral rat LD50 of 3500 mg/kg. Kirk-Othmer states in general referring to butyl alcohols that "the histologic effects of these alcohols are similar; they cause fatty accumulations in the liver, heart, and kidneys of experimental animals."

Since the substance is only moderately toxic by acute ingestion and there are no data in the literature indicating chronic systemic effects, it is concluded that ingestion, in the context of this standards, would not present a hazard in the industrial environment.

SUBSTANCE TECHNICAL GUIDELINES
TERT-BUTYL ALCOHOL

I. PHYSICAL AND CHEMICAL DATA

A. Substance Identification

1. Synonyms: 2-methyl-2-propanol; TBA; trimethylcarbinol
2. Formula: $(CH_3)_3COH$
3. Molecular weight: 74

B. Physical Data

1. Boiling point (760 mm Hg): 83 C (181 F)
2. Specific gravity (water = 1): 0.8
3. Vapor density (air = 1 at boiling point of tert-butyl alcohol): 2.6
4. Melting point: 25 C (77 F)
5. Vapor pressure at 20 C (68 F): 31 mm Hg
6. Solubility in water, % by weight at 20 C (68 F): miscible in all proportions
7. Evaporation rate (butyl acetate = 1): 1.05
8. Appearance and odor: Colorless solid in cold weather; usually a colorless liquid. Camphor-like odor.

II. FIRE, EXPLOSION AND REACTIVITY HAZARD DATA

A. Fire

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. Extinguishing media: Alcohol foam, dry chemical, carbon dioxide.
5. Special fire-fighting procedures: Do not use a solid stream of water since the stream will scatter and spread the fire. Use water spray to cool containers exposed to a fire.
6. Unusual fire and explosion hazards: tert-Butyl alcohol is a flammable liquid. Its vapors can easily form explosive mixtures with air. All ignition sources must be controlled where tert-butyl alcohol is handled, used or stored in a manner that could create a potential fire or explosion

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hazard. tert-Butyl alcohol vapors are heavier than air and may travel along the ground and be ignited by open flames or sparks at locations remote from the site at which tert-butyl alcohol is handled.

7. For purposes of conforming with the requirements of 29 CFR 1910.106, tert-butyl alcohol is classified as a Class IB flammable liquid. For example, 6000 ppm, approximately one-fourth of the lower flammable limit, is one situation in which tert-butyl alcohol is considered to be a potential fire and explosion hazard.
8. For purposes of complying with 29 CFR 1910.309, the classification of hazardous locations as described in Article 500 of the National Electrical Code for tert-butyl alcohol shall be Class I Group D.

B. 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

III. SPILL, LEAK, AND DISPOSAL PROCEDURES

- A. 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, sweep onto paper or other suitable material, place in an appropriate container and burn in a safe place (such as a fume hood). Large quantities may be reclaimed; however, if this is not practical, dissolve in a flammable solvent (such as alcohol) and atomize in a suitable combustion chamber equipped with an appropriate effluent gas cleaning device. tert-Butyl alcohol may not be allowed to enter a confined space, such as a sewer, because of the possibility of an explosion.
- B. Persons not wearing protective equipment should be restricted from areas of spills or leaks until cleanup has been completed.
- C. Waste disposal methods: tert-Butyl alcohol may be disposed of:
 1. By making packages of tert-butyl alcohol in paper or other flammable material and burning in a suitable combustion chamber equipped with an appropriate effluent gas cleaning device.
 2. By dissolving tert-butyl alcohol in a flammable solvent (such as alcohol) and atomizing in a suitable combustion chamber equipped with an appropriate effluent gas cleaning device.

IV. MONITORING AND MEASUREMENT PROCEDURES

- a. EXPOSURE ABOVE THE ACTION LEVEL: Measurements taken for the purpose of determining employee exposure under this section are best taken

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such that the average 8-hour exposure may be determined from a single sample or two (2) 4-hour samples. Short term interval samples (up to 30 minutes) may also be used to determine average exposure level if a minimum of five (5) measurements are taken in a random manner over the 8-hour work shift. Random sampling means that any portion of the work shift has the same chance of being sampled as any other. The arithmetic average of all such random equal duration samples taken on one (1) work shift is an estimate of an employee's average level of exposure for that work shift. Air samples should be taken in the employee's breathing zone (air that would most nearly represent that inhaled by the employee). Sampling and analyses may be performed by instruments such as detector tubes certified by NIOSH under 42 CFR Part 84, portable direct-reading instruments, gas and vapor adsorption tubes with subsequent chemical analyses or dosimeters. The method of measurement must determine the concentration of tert-butyl alcohol to plus or minus 35%.

- b. EXPOSURE ABOVE THE PERMISSIBLE EXPOSURE: The monitoring under this section should be essentially the same as described under paragraph IV. a. Laboratories performing chemical analyses should be accredited in Industrial Hygiene Chemistry by the American Industrial Hygiene Association (AIHA). The method of measurement must determine the concentration of tert-butyl alcohol to plus or minus 25%. Methods meeting these accuracy requirements are available in the "NIOSH Monitoring Methods Manual".

V. MISCELLANEOUS PRECAUTIONS

- A. Store tert-butyl alcohol in tightly closed containers in a cool, well-ventilated area.
- B. High exposures to tert-butyl alcohol can occur when transferring the liquid from one container to another.
- C. Non-sparking tools must be used to open and close metal tert-butyl alcohol containers. These containers must be effectively grounded and bonded prior to pouring.
- D. Employers should advise employees of all plant areas and operations where exposure to tert-butyl alcohol could occur.

VI. COMMON OPERATIONS

Common operations in which exposure to tert-butyl alcohol is likely to occur are: in the use of lacquer surface coatings and industrial cleaning compounds containing tert-butyl alcohol; in the handling and subdivision of quantities of tert-butyl alcohol; in its manufacture and use as a chemical intermediate in the manufacture of tert-butyl chloride, tert-butyl phenol, etc.; its use as a denaturant; its use in the preparation of perfumes, lacquers, etc.; its use as an extractant for drugs, water, hypochlorous acid, wax, lube oil, etc.; and its use in laboratory procedures.

RESPIRATOR TABLE DOCUMENTATION

SUBSTANCE: tert-Butyl alcohol

—D.O.L. STANDARD: 100 ppm

WARNING PROPERTIES:

Odor Threshold: Staub reports an odor threshold of 73 ppm for tert-butyl al

Eye Irritation Level: tert-Butyl alcohol is not specifically known to be an irritant but by analogy to the other butyl alcohols which produce eye irritation at 100 ppm, it is treated as an eye irritant.

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Evaluation of Warning Properties: Since the odor threshold of tert-butyl alcohol is below the permissible exposure limit, tert-butyl alcohol is treated as a material with warning properties. Gas sorbent respiratory equipment is permitted.

IDLH: 8000 ppm

Basis for IDLH Value: There are no acute inhalation toxicity data available upon which to base the IDLH concentration for tert-butyl alcohol, but it is noted that "the signs of intoxication on the part of animals exposed to vapors of tert-butyl alcohol are similar to those induced by the other butyl alcohols. For the purposes of this standard, therefore, the IDLH is based upon an analogy with isobutyl alcohol and butyl alcohol, both for which an IDLH concentration of 8000 ppm has been chosen. Two out of six rats died from a 4-hour exposure to 8000 ppm isobutyl alcohol.

Other Toxicological Information: Browning reports that "Like the other butyl alcohols, tertiary butyl alcohol is a narcotic, stronger in animals than n-butanol-1 (n-butyl alcohol) or isobutyl alcohol. Its toxic action, however, appears to be less; the mice investigated by Weese appeared to tolerate narcosis well with little evidence of organic injury. No toxic effects from its industrial use have been recorded."

The Documentation of TLV's states that the TLV (100 ppm tert-butyl alcohol) has been recommended to prevent narcosis.

LFL: 24,000 ppm

VAPOR PRESSURE AT 20 C: 31 mm Hg

SATURATED CONCENTRATION AT 20 C: Approximately 40,800 ppm

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USE/EXPOSURE AND CONTROL DOCUMENT
TERTIARY BUTYL ALCOHOL

	Use/Exposure	Principal Route of Entry	Currently Used Control Methods
1.	Inhalation of vapors and mists and skin contact with vapor application of lacquer surface coatings	A,B	Local exhaust ventilation; general dilution ventilation; personal protective equipment (gloves, respiratory protective devices)
2.	Inhalation of vapors and mists and skin contact with liquid during the use of industrial cleaning compounds containing tert-butyl alcohol	A,B	Local exhaust ventilation; general dilution ventilation; personal protective equipment (gloves, respiratory protective devices)
3.	Inhalation of vapors and skin contact with liquid during the handling and subdivision of quantities of tert-butyl alcohol	A,B	Local exhaust ventilation; general dilution ventilation; personal protective equipment (gloves, respiratory protective devices)
4.	Inhalation of vapors during the manufacture of tert-butyl alcohol and its use as a chemical intermediate (mfr. tert-butyl chloride, tert-butyl phenol)	A	Local exhaust ventilation; general dilution ventilation
5.	Inhalation of vapors and skin contact with liquid during the mixing of compounds in open tanks (perfumes, lacquers, denatured alcohol)	A,B	Local exhaust ventilation; general dilution ventilation
6.	Inhalation of vapors during the use of tert-butyl alcohol as a solvent (drug extraction water removal, wax solvent, extraction of hypochlorous acid lube oil, laboratory procedures)	A	Local exhaust ventilation; general dilution ventilation
	A -- Inhalation		
	B -- Skin contact resulting in localized irritation		
	C -- Ingestion		
	D -- Skin contact resulting in absorption and subsequent systemic poisoning		