

NIOSH/OSHA STANDARDS COMPLETION PROGRAM

DRAFT TECHNICAL STANDARD AND
SUPPORTING DOCUMENTATION FOR

*** N-BUTYL GLYCIDYL ETHER ***

NIOSH/OSHA Draft Technical Standard
and Supporting Documentation for N-BUTYL GLYCIDYL ETHER

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 N-BUTYL GLYCIDYL ETHER.

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 n-butyl glycidyl ether in concentrations not in excess of 50 parts per million (ppm) (270 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 n-butyl glycidyl ether.

(b) EMPLOYEE INFORMATION - Each employer who has a workplace in which n-butyl glycidyl ether 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 N-BUTYL GLYCIDYL ETHER - Inform affected employees of the quantity, location, and manner of use or storage of n-butyl glycidyl ether.

(c) EXPOSURE MEASUREMENT

- (1) INITIAL DETERMINATION - Each employer who has a place of employment in which n-butyl glycidyl ether is released into the workplace air shall determine if any employee may be exposed to airborne concentrations of n-butyl glycidyl ether 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 n-butyl glycidyl ether. 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 n-butyl glycidyl ether;
 - (ii) Any measurements of airborne concentrations of n-butyl glycidyl taken;
 - (iii) Any employee complaints of symptoms which may be attributable to exposure to n-butyl glycidyl ether; 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 n-butyl glycidyl ether 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 n-butyl glycidyl ether 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 n-butyl glycidyl ether at or above the action

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level, 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 n-butyl glycidyl ether 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 n-butyl glycidyl ether 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 n-butyl glycidyl ether 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 n-butyl glycidyl ether to at or below the permissible

- (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) Where a fan is located in duct work and where n-butyl glycidyl ether is present in concentrations greater than 5000 ppm, 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.

- (2) Respirators

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- (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 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 n-BUTYL GLYCIDYL ETHER

Condition	Permissible Respiratory Protection
Vapor Concentration	
Equal to or less than 500 ppm	organic vapor cartridge(s). A gas mask with a chin-style or front or back mounted organic vapor canister. Any supplied-air respirator with a full facepiece, helmet or hood.
Equal to or less than 1000 ppm	
Greater than 1000 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 air respirator with a full facepiece operated in pressure-demand or other positive pressure mode. auxiliary self-contained air supply operated in pressure-demand or other positive pressure mode.

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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 n-butyl glycidyl ether which is contained in Appendix B in order to ensure the safe handling and use of n-butyl glycidyl ether.

- (1) Electrical - For the purposes of compliance with section 1910.309, locations classified as hazardous locations due to the presence of n-butyl glycidyl ether shall be classified as Class I Group C.
- (2) Powered industrial trucks - For the purposes of compliance with section 1910.178, locations classified as hazardous locations due to the presence of n-butyl glycidyl ether shall be Class I Group C.
- (3) Portable fire extinguishers - For the purposes of compliance with section 1910.157, n-butyl glycidyl ether is classified as a Class B fire hazard.
- (4) Combustible liquids - For the purposes of compliance with section 1910.106, liquid n-butyl glycidyl ether is classified as a Class II combustible liquid.
- (5) Sources of ignition - Sources of ignition such as smoking or open flames are prohibited where n-butyl glycidyl ether is handled, used or stored in a manner so as to create a potential fire or explosion hazard.
- (6) Storage - n-butyl glycidyl ether shall be stored so as not to come in contact with strong oxidizers and strong caustics.

(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 any possibility of skin contact to liquid n-butyl glycidyl ether. Face shields shall comply with section 1910.133 (a)(6).
- (ii) Employers shall ensure that clothing contaminated with liquid n-butyl glycidyl ether is placed in closed containers for storage until it can be discarded or until the employer provides for the removal of n-butyl glycidyl ether from the clothing. If the clothing is to be laundered or otherwise cleaned to remove the n-butyl glycidyl ether, the employer shall inform the person performing the operation of the hazardous properties of n-butyl glycidyl ether.
- (iii) Employers shall ensure that non-impervious clothing contaminated with liquid n-butyl glycidyl ether be removed promptly and not reworn until the n-butyl glycidyl ether is removed from the clothing.

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(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 eye contact to liquid n-butyl glycidyl ether may occur.

(h) Spills

- (1) Spills of n-butyl glycidyl ether shall be cleaned up immediately after eliminating potential sources of ignition and utilizing available ventilation.
- (2) Liquid n-butyl glycidyl ether 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 contaminated with liquid n-butyl glycidyl ether promptly wash or shower using soap or mild detergent to remove any n-butyl glycidyl ether from the skin.
- (2) Employers shall ensure that employees who handle liquid n-butyl glycidyl ether wash their hands thoroughly with soap or mild detergent and water before eating, smoking or using toilet facilities.

(j) Training and Information - Each employer who has employees exposed to n-butyl glycidyl ether in excess of the action level, or employees who may have skin or eye contact with liquid n-butyl glycidyl ether, or employees who work where accidental release, spill, fire, or explosion of n-butyl glycidyl ether may occur, shall annually:

- (1) Substance Safety Data Sheet - Inform each employee of the information contained in the Substance Safety Data Sheet for n-butyl glycidyl ether, which is contained in Appendix A; and

(2) Medical -

- (I) Advise employees as to the signs and symptoms of exposure to n-butyl glycidyl ether.
- (II) Instruct the employees to advise the employer of the development of signs and symptoms of exposure to n-butyl glycidyl ether 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 correct use of protective equipment relative to n-butyl glycidyl ether.
- (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 n-butyl glycidyl ether, or

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airborne concentrations of n-butyl glycidyl ether 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) Kidney disease
 - (III) Chronic lung disease
 - (IV) Liver 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 n-butyl glycidyl ether.
- (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 n-butyl glycidyl ether 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 n-butyl glycidyl ether.
- (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;
 - (II) A description of the employee's duties as they relate to his exposure to n-butyl glycidyl ether;
 - (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 n-butyl glycidyl ether or which could significantly interfere with the ability of the employee to follow recommended or required procedures for protecting himself from unusual or emergency

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- exposure.
- (B) Any recommended limitations upon the employee's exposure to n-butyl glycidyl ether.
- (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 n-butyl glycidyl ether.
- (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.
- (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.
 - (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 n-butyl glycidyl ether.
 - (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 n-butyl glycidyl ether 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.

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- (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 n-b-butyl glycidyl ether;
 - (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.
 - (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 employer 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 n-butyl glycidyl ether which is conducted pursuant to this section.
 - (2) Exercise of opportunity to observe monitoring.
 - (i) When observation of the monitoring of employee exposure to n-butyl glycidyl ether 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 n-butyl glycidyl ether that are being performed at the place of exposure.
 - (c) Record the results obtained.

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(n) Employee notification.

- (1) The employer shall notify in writing, within five work days, every employee who is found to be exposed to n-butyl glycidyl ether 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: n-Butyl glycidyl ether (BGE)

PERMISSIBLE EXPOSURE: 50 parts of n-butyl glycidyl ether per million parts of air (ppm) or 270 milligrams of n-butyl glycidyl ether per cubic meter of air (mg/cu m)

APPEARANCE: Pale yellow liquid

II. HEALTH HAZARD DATA

A. Ways in Which the Chemical Affects Your Body: n-Butyl glycidyl ether can affect your body if you inhale it, swallow it, or if it comes into contact with your eyes or skin.

B. Effects of Overexposure:

1. Short-Term Overexposure: Overexposure to n-butyl glycidyl ether may cause irritation of the eyes, nose and skin.

2. Long-Term Overexposure: Prolonged or repeated exposure to n-butyl glycidyl ether may cause skin irritation or sensitization.

3. Reporting Signs and Symptoms: You should inform your employer if you develop any signs or symptoms associated with n-butyl glycidyl ether exposure.

III. EMERGENCY FIRST AID PROCEDURES

A. Eye Exposure: If n-butyl glycidyl ether 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 n-butyl glycidyl ether gets on your skin, immediately wash the contaminated skin using soap or mild detergent. If n-butyl glycidyl ether soaks through your clothing, remove the clothing immediately and wash the skin using soap or mild detergent. If skin irritation persists, get medical attention. Do not wear the clothing again until the n-butyl glycidyl ether has been removed. Replace or repair impervious clothing that has developed leaks.

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

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

- D. Swallowing: When n-butyl glycidyl ether 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 n-butyl glycidyl ether. 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.) For effective protection respirators must fit your face and head snugly. Respirators should not be loosened or removed in work situations where their use is required. If you can smell n-butyl glycidyl ether 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 shield or other appropriate protective clothing to prevent any possibility of skin contact with liquid n-butyl glycidyl ether.
- C. EYE PROTECTION: You must wear splash-proof safety goggles (cup-cover type dust and splash safety goggles) where eye contact to liquid n-butyl glycidyl ether may occur.

V. PRECAUTIONS FOR SAFE USE, HANDLING AND STORAGE

n-Butyl glycidyl ether is a combustible liquid and its vapors can form explosive mixtures with air at elevated temperatures. It must be stored in tightly closed containers in a cool, well-ventilated area away from heat, sparks, flames, strong oxidizers and strong caustics. Sources of ignition such as smoking and open flames are prohibited wherever n-butyl glycidyl ether 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 n-butyl glycidyl ether and the containers must be bonded and grounded when transferring or pouring liquid n-butyl glycidyl ether. If your skin becomes contaminated with liquid n-butyl glycidyl ether, you must immediately wash or shower using soap or mild detergent to remove any n-butyl glycidyl ether from the skin. You must promptly remove any non-impervious clothing that becomes

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contaminated with liquid n-butyl glycidyl ether and this clothing must not be reworn until the n-butyl glycidyl ether is removed from the clothing. If you handle liquid n-butyl glycidyl ether, you must wash your hands thoroughly with soap or mild detergent and water before eating, smoking or using toilet facilities. Fire extinguishers, where provided, must be readily available and you should know where they are and how to operate them. Ask your supervisor where n-butyl glycidyl ether is used in your work area and for any additional plant safety and health rules.

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APPENDIX B

SUBSTANCE TECHNICAL GUIDELINES
N-BUTYL GLYCIDYL ETHER

I. PHYSICAL AND CHEMICAL DATA

A. Substance Identification

1. Synonyms: BGE; 1,2-epoxy-3-butoxypropane
2. Formula: $C_4H_9OCH_2CHOCH_2$
3. Molecular weight: 130

B. Physical Data

1. Boiling point (760 mm Hg): 164 C (327 F)
2. Specific gravity (water=1): 0.9
3. Vapor density (air=1 at boiling point of n-butyl glycidyl ether): 4.5
4. Melting point: Data not available
5. Vapor pressure at 20 C (68 F): 3 mm Hg
6. Solubility in water, % by weight at 20 C (68 F): 2
7. Evaporation rate (butyl acetate=1): Data not available
8. Appearance: Pale yellow liquid

II. FIRE, EXPLOSION AND REACTIVITY HAZARD DATA

A. Fire

1. Flash point: 54 C (130 F) (closed cup)
2. Autoignition temperature: Data not available
3. Flammable limits in air, % by volume: Data not available
4. Extinguishing media: Foam, carbon dioxide, dry chemical
5. Special fire-fighting procedures: Do not use a solid stream of water since a stream will scatter and spread the fire. Use water spray to cool containers exposed to a fire.
6. Unusual fire and explosion hazards: N-Butyl glycidyl ether is a combustible liquid. At elevated temperatures its vapors can form explosive mixtures with air. All ignition sources must be controlled where n-butyl glycidyl ether is used, handled or stored. n-Butyl glycidyl ether 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 n-butyl glycidyl ether is handled.
7. For purposes of complying with the requirements of 29 CFR 1910.106, n-butyl glycidyl ether is classified as a Class II combustible liquid.
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 n-butyl glycidyl ether shall be Class I, Group C.

B. Reactivity

1. Conditions contributing to instability: Heat
2. Incompatibilities: Contact with strong oxidizing agents may cause fire and explosions. Contact with strong caustics may

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cause polymerization with the liberation of heat and the bursting of containers.

3. Hazardous decomposition products: Toxic gases and vapors (such as carbon monoxide) may be released in a fire involving n-butyl glycidyl ether.
4. Special precautions: N-Butyl glycidyl ether will attack some forms of plastics, rubber and coatings

III. SPILL, LEAK AND DISPOSAL PROCEDURES

- A. If n-butyl glycidyl ether 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. Remove to safe place (such as a fume hood) and burn the paper. Large quantities may be collected and atomized in a suitable combustion chamber. n-Butyl glycidyl ether 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:
n-Butyl glycidyl ether may be disposed of 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 8-hour 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 n-butyl glycidyl ether 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 n-butyl glycidyl ether to plus or minus 25%. Methods meeting these accuracy requirements are available from NIOSH.
- V. MISCELLANEOUS PRECAUTIONS

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- A. Store n-butyl glycidyl ether in tightly closed containers in a cool, well-ventilated area.
- B. High exposures to n-butyl glycidyl ether can occur when transferring the liquid from one container to another.
- C. Non-sparking tools must be used to open and close metal n-butyl glycidyl ether 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 n-butyl glycidyl ether could occur.

VI. COMMON OPERATIONS

Common operations in which exposure to n-butyl glycidyl ether is likely to occur are: during its production; in the formulation and use of epoxy resins; during its use as a chemical intermediate; and during its use as a stabilizing agent for organic chemicals.

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APPENDIX C - MEDICAL SURVEILLANCE GUIDELINES

I. ROUTE OF ENTRY

Inhalation.

II. TOXICOLOGY

n-Butyl glycidyl ether is primarily a skin irritant and sensitizer. It also causes slight irritation of the upper respiratory tract. The LC50 for an 8 hour exposure in rats was 1,030 ppm, causing depression of the central nervous system and acute pulmonary edema. The liquid instilled in the eye of rabbits caused mild irritation. No chronic systemic effects have been reported in humans.

III. SIGNS AND SYMPTOMS

Irritation of the eyes and nose; skin irritation and sensitization; narcosis may occur at high levels of exposure.

IV. SPECIAL TESTS

None in common usage.

V. TREATMENT

Remove from exposure. Flush eyes and skin with water. If swallowed and the person is conscious, induce vomiting. Recovery is usually rapid and complete.

VI. SURVEILLANCE AND PREVENTIVE CONSIDERATIONS

A. GENERAL

The most likely effects of n-butyl glycidyl ether are skin irritation and sensitization. It is important that the physician becomes familiar with plant operating conditions in which exposure to n-butyl glycidyl ether 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 n-butyl glycidyl ether exposure. Only those giving a positive history of these conditions must be referred for further medical examinations.

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1. Skin disease -- n-Butyl glycidyl ether can cause dermatitis. Persons with pre-existing skin disorders may be more susceptible to the effects of this agent.
2. Liver disease -- Although n-butyl glycidyl ether 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 n-butyl glycidyl ether 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.
4. Chronic respiratory disease -- In persons with impaired pulmonary function, especially those with obstructive airway diseases, the breathing of nbutyl glycidyl ether 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. American Conference of Governmental Industrial Hygienists: "n-Butyl Glycidyl Ether (BGE)," (3d ed., 2d printing), Documentation of the Threshold Limit Values for Substances in Workroom Air, Cincinnati, 1974, p. 33.
2. Patty, Frank A.: Industrial Hygiene and Toxicology, Vol. II - Toxicology (2d ed. revised), Interscience Publishing Company, New York, 1963, pp. 1604-1606.
3. Hine, C.H. et al.: "Toxicology of Glycidol and Some Glycidyl Esters," A.M.A. Archives of Industrial Health, 14:250-264, 1956.

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REFERENCES AND SOURCES
N-BUTYL GLYCIDYL ETHER
1910.93

(d) Methods of Compliance

- (1) Engineering Controls - In the absence of definitive data on the lower flammable limit of n-butyl glycidyl ether, 5000 ppm was estimated to be the level above which non-sparking materials are required to minimize fire or explosion hazards from fan construction.

(f) Fire and Safety

- (1) Electrical - Classification based on "Fire Hazard Classification of Chemical Vapors Relative to Explosion-proof Electrical Equipment," H. Carhart et al., National Academy of Sciences, 1973, report to U. S. Coast Guard, report no. CG-D-92-74, p. 31.

(i) Personal Protective Equipment, and (h) Sanitation

Eye: Documentation in Support of TLV; Patty, Ind. Hyg. and Tox.;
Dow Chemical Co. MSDS; Grant, "Toxicology of the Eye"

Skin: Documentation in Support of TLV; Dow Chemical Co. MSDS; Shell MSDS
Patty, "Ind. Hyg. and Tox.;" Weil, C. S., Condra, N., Haun, C. and
Striegel, J. A., "Experimental Carcinogenicity and Acute Toxicity of
Representative Epoxides"

Ingestion: Patty, "Ind. Hyg. and Tox.;" NIOSH Toxic Substances List, 197
COMMENTS

Eye - Classification: 2

Output statement numbers: 10

Exceptions: None

Documentation of TLV's states that it is a mild eye irritant. Patty agrees. Dow MSDS states it may cause transient and minor corneal injury which heals rapidly. Grant reports "it causes slight reversible damage to the rabbit eye when applied as a drop."

A classification of 2 is concluded to be appropriate.

Skin - Classification: 1

Output statement numbers: 1, 7a, 17g, 17i, 20a

Exceptions: See below

Documentation of TLV's states it is a mild skin irritant which has a percutaneous LD50 for rabbits of 4.93 g/kg. Dow MSDS notes that it is considered a skin sensitizer and may be absorbed in toxic amounts. First aid instructions say to immediately wipe off and wash skin. Shell MSDS notes that it is a strong sensitizer that it should not be allowed to contact skin, and that contamination

SUBSTANCE TECHNICAL GUIDELINES

N-BUTYL GLYCIDYL ETHER

I. PHYSICAL AND CHEMICAL DATA

A. Substance Identification

1. Synonyms: BGE; 1,2-epoxy-3-butoxypropane
2. Formula: $C_4H_9OCH_2CHOCH_2$
3. Molecular weight: 130

B. Physical Data

1. Boiling point (760 mm Hg): 164 C (327 F)
2. Specific gravity (water=1): 0.9
3. Vapor density (air=1 at boiling point of n-butyl glycidyl ether): 4.5

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4. Melting point: Data not available
5. Vapor pressure at 20 C (68 F): 3 mm Hg
6. Solubility in water, % by weight at 20 C (68 F): 2
7. Evaporation rate (butyl acetate=1): Data not available
8. Appearance: Pale yellow liquid

II. FIRE, EXPLOSION AND REACTIVITY HAZARD DATA

A. Fire

1. Flash point: 54 C (130 F) (closed cup)
2. Autoignition temperature: Data not available
3. Flammable limits in air, % by volume: Data not available
4. Extinguishing media: Foam, carbon dioxide, dry chemical
5. Special fire-fighting procedures: Do not use a solid stream of water since a stream will scatter and spread the fire. Use water spray to cool containers exposed to a fire.
6. Unusual fire and explosion hazards: N-Butyl glycidyl ether is a combustible liquid. At elevated temperatures its vapors can form explosive mixtures with air. All ignition sources must be controlled where n-butyl glycidyl ether is used, handled or stored in a manner that could create a potential fire or explosion hazard. n-Butyl glycidyl ether 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 n-butyl glycidyl ether is handled.
7. For purposes of complying with the requirements of 29 CFR 1910.106, n-butyl glycidyl ether is classified as a Class II combustible liquid.
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 n-butyl glycidyl ether shall be Class I, Group C.

B. Reactivity

1. Conditions contributing to instability: Heat.
2. Incompatibilities: Contact with strong oxidizing agents may cause fire and explosions. Contact with strong caustics may cause polymerization with the liberation of heat, and the bursting of containers.
3. Hazardous decomposition products: Toxic gases and vapors (such as carbon monoxide) may be released in a fire involving n-butyl glycidyl ether.
4. Special precautions: N-Butyl glycidyl ether will attack some forms of plastics, rubber and coatings

III. SPILL, LEAK AND DISPOSAL PROCEDURES

- A. If n-butyl glycidyl ether 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. Remove to safe place (such as a fume hood) and burn the paper. Large quantities may be collected and atomized in a suitable combustion chamber.

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

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- C. Waste disposal methods: n-Butyl glycidyl ether 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.
- 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 8-hour 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 n-butyl glycidyl ether 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 n-butyl glycidyl ether to plus or minus 25%. Methods meeting these accuracy requirements are available from NIOSH.
- V. MISCELLANEOUS PRECAUTIONS
- A. Store n-butyl glycidyl ether in tightly closed containers in a cool, well-ventilated area.
- B. High exposures to n-butyl glycidyl ether can occur when transferring the liquid from one container to another.
- C. Non-sparking tools must be used to open and close metal n-butyl glycidyl ether 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 n-butyl glycidyl ether could occur.
- VI. COMMON OPERATIONS

Common operations in which exposure to n-butyl glycidyl ether is likely to occur are: during its production; in the formulation and use of epoxy resins; during its use as a chemical intermediate; and during its use as a stabilizing agent for organic chemicals.

RESPIRATOR TABLE DOCUMENTATION

SUBSTANCE: n-Butyl Glycidyl Ether (BGE)

D. O. L. STANDARD: 50 ppm

WARNING PROPERTIES:

Odor Threshold: Patty states that "n-butyl glycidyl ether possesses satisfactory warning properties. The odor of vapors is not unpleasant but leads to

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irritation." There is no quantitative information available, however, concerning the odor threshold of BGE.

Eye Irritation Level: The Documentation of TLV's reports that BGE, on the basis of animal experiments, "is classified as . . . a mild eye irritant." Grant also notes that BGE causes eye irritation, "but not so severe as (that produced by) certain other glycidyl ethers." According to the Documentation of TLV's, a TLV of 50 ppm "should provide an environment relatively free from irritation but may cause some response in sensitized persons." Only full facepiece respirators are permitted.

Other Information: Grant states that BGE causes respiratory tract irritation but does not give any quantitative information.

Evaluation of Warning Properties: Through its irritant effects, n-butyl glycidyl ether can be detected near the permissible exposure limit. In addition, since Patty states that "n-butyl glycidyl ether possesses satisfactory warning properties," gas sorbent respiratory equipment is permitted.

IDLH: 3500 ppm

Basis for IDLH Value: This IDLH is based upon the statement in the Documentation of TLV's that "the LC50 for mice (4 hours) was greater than 3500 ppm."

Other Toxicological Information: Patty states that "n-butyl glycidyl ether is a central nervous system depressant, also causing slight irritation of the respiratory tract. It is classified as slightly toxic after oral administration and practically nontoxic after single percutaneous application and vapor exposure . . . Repeated exposures lead to cumulative toxicity of a moderate degree. . . Air saturated with the vapors of the compound did not kill mice exposed for 4 hours. The LC50 for an 8-hour exposure in rats was 1020 ppm." According to Patty, the cause of death from exposure to BGE is "paralysis of the respiratory center and acute pulmonary edema."

The Documentation of TLV's, which has obtained its quantitative information from the same source which Patty used, gives a 4-hour mouse LC50 greater than 3500 ppm, and an 8-hour rat LC50 of 670 ppm. The source which the Documentation of TLV's and Patty cite actually gives a 8-hour rat LC50 of 1030 ppm BGE.

IFL: Data not available

VAPOR PRESSURE AT 20 C: 3 mm Hg

SATURATED CONCENTRATION AT 20 C: Approximately 3950 ppm

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USE/EXPOSURE AND CONTROL DOCUMENT
N-BUTYL GLYCIDYL ETHER

Use/Exposure	Principal Route of Entry	Currently Used Control Methods
1. Inhalation of vapor and skin contact with liquid during use as a reactive of epoxy resins (adhesives and laminating formulations, thin films, metal bonding resins, epoxy flooring compounds)	A,B	Local exhaust ventilation general dilution ventila- tion; personal protective equipment (gloves, goggles)
2. Inhalation of vapor and skin contact with liquid during use as a chemical intermediate (dihydroxyamine ethers, surfactants, polymers and resins)	A,B	Local exhaust ventilation general dilution ventila- tion; personal protective equipment (gloves, goggles) enclosed process as necessary
3. Inhalation of vapor during the production of n-butyl glycidyl ether	A	Local exhaust ventilation general dilution ventila- tion; enclosed process
4. Inhalation of vapor and skin contact with liquid during use as a stabilizing agent for organic chemicals (chlorinated hydrocarbons against deterioration)	A,B	Local exhaust ventilation general dilution ventila- tion; personal protective equipment (gloves, goggles)
5. Inhalation of vapor and skin contact with liquid during cleaning and maintenance of storage tanks and during clean-up of accidental spills	A,B	Local exhaust ventilation general dilution ventila- tion; personal protective equipment (rubber gloves, goggles, respirator, protective clothing)

A -- Inhalation

B -- Skin contact resulting in
localized irritation

C -- Ingestion

D -- Skin contact resulting in
absorption and subsequent
systemic poisoning