

NIOSH/OSHA STANDARDS COMPLETION PROGRAM

DRAFT TECHNICAL STANDARD AND
SUPPORTING DOCUMENTATION FOR

*** 2-BUTOXY ETHANOL ***

NIOSH/OSHA Draft Technical Standard
and Supporting Documentation for 2-BUTOXY ETHANOL

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 2-BUTOXY ETHANOL.

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.

NIOSH/OSHA Draft Technical Standard
and Supporting Documentation for 2-BUTOXY ETHANOL

(a) DEFINITIONS

- (1) PERMISSIBLE EXPOSURE - "Permissible Exposure" means inhalation of 2-butoxy ethanol in concentrations not in excess of 50 parts per million (ppm) (240 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 2-butoxy ethanol.

(b) EMPLOYEE INFORMATION - Each employer who has a workplace in which 2-butoxy ethanol 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 2-BUTOXY ETHANOL - Inform affected employees of the quantity, location, and manner of use or storage of 2-butoxy ethanol.

(c) EXPOSURE MEASUREMENT

- (1) INITIAL DETERMINATION - Each employer who has a place of employment in which 2-butoxy ethanol is released into the workplace air shall determine if any employee may be exposed to airborne concentrations of 2-butoxy ethanol 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 2-butoxy ethanol. 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 2-butoxy ethanol;
 - (ii) Any measurements of airborne concentrations of 2-butoxy ethanol taken;
 - (iii) Any employee complaints of symptoms which may be attributable to exposure to 2-butoxy ethanol; 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 2-butoxy ethanol 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 2-butoxy ethanol 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 2-butoxy ethanol at or above the action level, but not above the permissible exposure, the exposure of that employee shall be measured at least every two months.

NIOSH/OSHA Draft Technical Standard
and Supporting Documentation for 2-BUTOXY ETHANOL

- (5) EXPOSURE ABOVE THE PERMISSIBLE EXPOSURE - If an employee exposure measurement reveals that an employee is exposed to airborne concentrations of 2-butoxy ethanol 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 2-butoxy ethanol 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 2-butoxy ethanol 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 2-butoxy ethanol 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) Where a fan is located in duct work and where 2-butoxy ethanol is present in concentrations greater than 2750 ppm, one fourth of the lower flammable limit, the fan rotating element 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.
 - (iii) In the design of open surface tank ventilation for the purposes of section 1910.94 (d), operations involving 2-butoxy ethanol shall be classified as B-4 at 70 F.

(2) Respirators

NIOSH/OSHA Draft Technical Standard
and Supporting Documentation for 2-BUTOXY ETHANOL

- (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 2-BUTOXY ETHANOL

Condition	
Vapor Concentration	
Equal to or less than 250 ppm	organic vapor cartridge(s). A gas mask with 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 500 ppm	piece.
Greater than 500 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 demand or other positive pressure or continuous flow mode a auxiliary self-contained air supply operated in pressure-demand or other positive pressure mode.

NIOSH/OSHA Draft Technical Standard
and Supporting Documentation for 2-BUTOXY ETHANOL

Fire Fighting	Self-contained breathing apparatus with a full facepiece operated in pressure-demand or other positive pressure mode

Escape	Any gas mask providing protection against organic vapors. Any escape self-contained breathing apparatus.

(f) Fire and Safety

Employers shall familiarize themselves with the information contained in the Substance Technical Guidelines for 2-butoxy ethanol which is contained in Appendix B in order to ensure the safe handling and use of 2-butoxy ethanol.

- (1) Electrical - For the purposes of compliance with section 1910.309, locations classified as hazardous locations due to the presence of 2-butoxy ethanol shall be Class I Group C.
- (2) Portable fire extinguishers - For the purposes of compliance with section 1910.157, 2-butoxy ethanol 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 2-butoxy ethanol shall be Class I Group C.
- (4) Combustible liquids - For the purposes of compliance with section 1910.106, liquid 2-butoxy ethanol is classified as a Class IIIA combustible 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 2-butoxy ethanol is handled, used or stored in a manner so as to create a potential fire or explosion hazard.
- (6) Storage - 2-Butoxy ethanol 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 2-butoxy ethanol. Face shields shall comply with section 1910.133 (a)(6).
- (ii) Employers shall ensure that clothing contaminated with liquid 2-butoxy ethanol is placed in closed containers for storage until it can be discarded or until the employer provides for the removal of 2-butoxy ethanol from the clothing. If the clothing is to be laundered or otherwise cleaned to remove the 2-butoxy ethanol, the employer shall inform the person performing the operation of the hazardous properties of 2-butoxy ethanol.

NIOSH/OSHA Draft Technical Standard
and Supporting Documentation for 2-BUTOXY ETHANOL

- (iii) Employers shall ensure that non-impervious clothing contaminated with liquid 2-butoxy ethanol be removed promptly and not reworn until the 2-butoxy ethanol is removed from the clothing.
- (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 2-butoxy ethanol may occur.
- (h) Spills
 - (1) Spills of 2-butoxy ethanol shall be cleaned up immediately after utilizing available ventilation.
- (i) Sanitation
 - (1) Employers shall ensure that employees whose skin becomes contaminated with liquid 2-butoxy ethanol promptly wash or shower using soap or mild detergent to remove any 2-butoxy ethanol from the skin.
 - (2) Employers shall ensure that employees who handle 2-butoxy ethanol 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 2-butoxy ethanol in excess of the action level, or employees who may have skin or eye contact with liquid 2-butoxy ethanol, or employees who work where accidental release, spill, fire, or explosion of 2-butoxy ethanol may occur, shall annually:
 - (1) Substance Safety Data Sheet - Inform each employee of the information contained in the Substance Safety Data Sheet for 2-butoxy ethanol, which is contained in Appendix A; and
 - (2) Medical -
 - (I) Advise employees as to the signs and symptoms of exposure to 2-butoxy ethanol.
 - (II) Instruct the employees to advise the employer of the development of signs and symptoms of exposure to 2-butoxy ethanol which are listed in Appendix A.
 - (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 2-butoxy ethanol.
- (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 Examination - The employer shall make available to each employee who is to be exposed to airborne concentrations of 2-butoxy ethanol at or above the action level or is at risk to skin exposure to 2-butoxy ethanol, a medical examination which shall include as a minimum the following:
 - (I) A medical history and physical examination with

NIOSH/OSHA Draft Technical Standard
and Supporting Documentation for 2-BUTOXY ETHANOL

emphasis on the liver, kidneys, lymphoid system and the skin.

- (II) A blood count to include at least a hemoglobin, hematocrit, white and red cell count, a differential smear, and red blood cell fragility test.
- (3) The employer shall obtain from the physician, as a record of the examination, the following information:
 - (I) The physician's written opinion stating whether or not the employee has any detected medical conditions which would place him at increased risk from exposure to 2-butoxy ethanol.
 - (II) A recording of the complete blood count.
- (4) Periodic Examinations - The employer shall make available to each employee, exposed to 2-butoxy ethanol in excess of the action level at 12 months from the date of the employee's first exposure, and at every 12 months of exposure thereafter, a medical examination which must include the following:
 - (I) A medical history and physical examination (see (k)(2)(I) of this section).
 - (II) A complete blood count (see (k)(2)(II) of this section).
- (5) The employer shall obtain from the physician, as a record of the periodic examination, the following information:
 - (I) The physician's written opinion stating whether or not the employee has any detected medical conditions which would place him at increased risk to further exposure to 2-butoxy ethanol.
 - (II) A recording of the complete blood count.
- (6) Exclusion or Removal from Exposure - No employee shall be exposed to 2-butoxy ethanol if such exposure could place the employee at increased risk of material impairment of his health.
- (7) Emergency Procedures - The employer shall provide emergency and follow-up medical examinations and treatment for any employee injured through exposure to 2-butoxy ethanol.
- (8) 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 2-butoxy ethanol;
 - (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.
- (9) Physician's Written Opinion
 - (I) The physician's written opinion shall be a signed statement by the examining physician specifically stating:

NIOSH/OSHA Draft Technical Standard
and Supporting Documentation for 2-BUTOXY ETHANOL

- (A) Whether the employee has any detected medical conditions which could be directly or indirectly aggravated by exposure to 2-butoxy ethanol 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 on the employee's exposure to 2-butoxy ethanol.
- (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 2-butoxy ethanol.
- (10) Alternative Medical Examinations - If the examining physician chooses to use alternative medical examinations to those specified in sections (2) and (4), the employer may accept such alternative medical surveillance examinations as meeting the requirements of this part provided that the employer:
 - (I) Obtains a statement from the examining physician setting forth the alternative medical examinations and the rationale for substitution and evidence that they will be equally effective.
 - (II) Informs each exposed employee of the fact that alternative medical examinations to those required in section (2) or (4) above are to be made available.
- (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 2-butoxy ethanol.
 - (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;

NIOSH/OSHA Draft Technical Standard
and Supporting Documentation for 2-BUTOXY ETHANOL

- (c) Operations involving exposure to 2-butoxy ethanol which is 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) Annual training.
- (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 employee 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) Results of tests required in Section (k)(3) and (k)(5) of t
 - (b) Physician's written opinion;
 - (c) Any employee medical complaints relative to exposure to 2-b
 - (d) A signed statement of any refusal to be examined;
 - (e) A copy of information provided to the physician pursuant to paragraph (k)(8) (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 employee or former employee.

NIOSH/OSHA Draft Technical Standard
and Supporting Documentation for 2-BUTOXY ETHANOL

- (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 2-butoxy ethanol which is conducted pursuant to this section.
 - (2) Exercise of opportunity to observe monitoring.
 - (i) When observation of the monitoring of employee exposure to 2-butoxy ethanol 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 2-butoxy ethanol 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 2-butoxy ethanol above the permissible exposure. The employee shall also be notified of the level of his exposure and 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.

NIOSH/OSHA Draft Technical Standard
and Supporting Documentation for 2-BUTOXY ETHANOL

APPENDIX A

SUBSTANCE SAFETY DATA SHEET

I. SUBSTANCE IDENTIFICATION

SUBSTANCE: 2-Butoxy ethanol (butyl cellosolve)

PERMISSIBLE EXPOSURE: 50 parts of 2-butoxy ethanol per million parts of air (ppm) or 240 milligrams of 2-butoxy ethanol per cubic meter of air (mg/cu m)

APPEARANCE AND ODOR: Colorless liquid with a mild odor.

II. HEALTH HAZARD DATA

A. Ways in Which the Chemical Affects Your Body: 2-Butoxy ethanol can affect your body if you inhale it, swallow it or if it comes in contact with your skin or eyes. It may enter your body through your skin.

B. Effects of Overexposure:

1. Short-Term Overexposure: Overexposure to high air levels of 2-butoxy ethanol may cause irritation of the eyes, nose and throat. It may also cause you to have dark red urine.
2. Reporting Signs and Symptoms: You should inform your employer if you develop any signs or symptoms associated with 2-butoxy ethanol exposure.

III. EMERGENCY FIRST AID PROCEDURES

A. Eye Exposure: If 2-butoxy ethanol gets into your eyes, wash the eyes immediately with large amounts of water, lifting the lower and upper lids occasionally. Get medical attention if discomfort persists. Contact lenses should not be worn when working with this chemical.

B. Skin Exposure: If 2-butoxy ethanol gets on your skin, promptly wash the contaminated skin using soap or mild detergent. If 2-butoxy ethanol soaks through your clothing, remove the clothing promptly and wash the skin using soap or mild detergent. Do not wear the clothing again until the 2-butoxy ethanol 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 2-butoxy ethanol remove the exposed person to fresh air at once. If breathing has stopped, perform artificial respiration. Keep the affected person warm and at rest. Get medical attention as soon as possible.

NIOSH/OSHA Draft Technical Standard
and Supporting Documentation for 2-BUTOXY ETHANOL

- D. Swallowing: When 2-butoxy ethanol 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 2-butoxy ethanol. 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 2-butoxy ethanol 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 2-butoxy ethanol.
- 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 2-butoxy ethanol contacting your eyes.

V. PRECAUTIONS FOR SAFE USE, HANDLING AND STORAGE

2-Butoxy ethanol 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 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 2-butoxy ethanol is handled, used or stored in a manner that could create a potential fire or explosion hazard. If your skin becomes contaminated with liquid 2-butoxy ethanol, you must promptly wash or shower using soap or mild detergent to remove any 2-butoxy ethanol from the skin. You must promptly remove any non-impervious clothing that becomes contaminated with liquid 2-butoxy ethanol and this clothing must not be reworn until the 2-butoxy ethanol is removed from the clothing. If you handle liquid 2-butoxy ethanol, 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

NIOSH/OSHA Draft Technical Standard
and Supporting Documentation for 2-BUTOXY ETHANOL

where 2-butoxy ethanol is used in your work area and for any additional plant safety and health rules.

NIOSH/OSHA Draft Technical Standard
and Supporting Documentation for 2-BUTOXY ETHANOL

APPENDIX B

SUBSTANCE TECHNICAL GUIDELINES
2-BUTOXY ETHANOL

- I. PHYSICAL AND CHEMICAL DATA
 - A. Substance Identification
 - 1. Synonyms: Butyl "Cellosolve"; ethylene glycol monobutyl ether; Dowanol EB; butyl OXITOL; Jeffersol EB; Ektasolve EB
 - 2. Formula: $C_4H_9OCH_2CH_2OH$
 - 3. Molecular weight: 118.2
 - B. Physical Data
 - 1. Boiling point (760 mm Hg): 171 C (340 F)
 - 2. Specific gravity (water=1): 0.9
 - 3. Vapor density (air=1 at boiling point of 2-butoxy ethanol): 4.1
 - 4. Melting point: -70 C (-94 F)
 - 5. Vapor pressure at 20 C (68 F): 0.6 mm Hg
 - 6. Solubility in water, % by weight at 20 C (68 F): Miscible in all proportions below 48 C (118 F)
 - 7. Evaporation rate (butyl acetate=1): 0.1
 - 8. Appearance and odor: Colorless liquid with a mild odor
- II. FIRE, EXPLOSION AND REACTIVITY HAZARD DATA
 - A. Fire
 - 1. Flash point: 61 C (141 F) (closed cup)
 - 2. Autoignition temperature: 244 C (472 F)
 - 3. Flammable limits in air, % by volume: Lower: 1.1; Upper: 10.6
 - 4. Extinguishing media: Carbon dioxide, dry chemical, alcohol foam
 - 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: 2-Butoxy ethanol is a combustible liquid. At elevated temperatures its vapors can form explosive mixtures with air. All ignition sources must be controlled where 2-butoxy ethanol is used, handled or stored in a manner so as to create a potential fire or explosion hazard.
 - 7. For purposes of complying with the requirements of 29 CFR 1910.106, 2-butoxy ethanol is classified as a Class IIIA combustible liquid. At 2750 ppm, one-fourth of the lower flammable limit, 2-butoxy ethanol 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 2-butoxy ethanol shall be Class I Group C.

NIOSH/OSHA Draft Technical Standard
and Supporting Documentation for 2-BUTOXY ETHANOL

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 decomposition.
3. Hazardous decomposition products: Toxic gases and vapors (such as carbon monoxide) may be released in a fire involving 2-butoxy ethanol.
4. Special precautions: 2-Butoxy ethanol will attack some forms of plastics, rubber and coatings.

III. SPILL, LEAK AND DISPOSAL PROCEDURES

- A. If 2-butoxy ethanol is spilled or leaked, the following steps should be taken:
 1. Ventilate area of spill or leak
 2. For small quantities, absorb on paper towels. Remove to a safe place (such as a fume hood) and burn the paper. Large quantities can 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.
- C. Waste disposal methods:

2-Butoxy ethanol 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 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 2-butoxy ethanol 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 2-butoxy ethanol to plus or minus 25%. Methods meeting these accuracy requirements are available from NIOSH.

NIOSH/OSHA Draft Technical Standard
and Supporting Documentation for 2-BUTOXY ETHANOL

V. MISCELLANEOUS PRECAUTIONS

- A. Store 2-butoxy ethanol in tightly closed containers in a well-ventilated area away from heat.
- B. Employers must advise employees of all plant areas and operations where exposure to 2-butoxy ethanol could occur.

VI. COMMON OPERATIONS

Common operations in which exposure to 2-butoxy ethanol is likely to occur are: during its production; its use as a solvent for resins and gums; in the formulation and use of lacquers, varnishes, enamels, latex paints, lubricants, cutting oils, hydraulic fluids, and dry cleaning soaps; and as a chemical intermediate.

NIOSH/OSHA Draft Technical Standard
and Supporting Documentation for 2-BUTOXY ETHANOL

APPENDIX C - MEDICAL SURVEILLANCE GUIDELINES

I. ROUTE OF ENTRY

Inhalation; skin absorption.

II. TOXICOLOGY

2-Butoxy ethanol is an irritant to the eyes and upper respiratory tract, and a hemolytic agent. The LC50 for mice was 700 ppm with death due to lung and kidney injury. Repeated exposures of 100 to 400 ppm were non-lethal but caused visceral effects in animals: at the higher concentrations rats exhibited greatly increased erythrocyte fragility, hemoglobinuria and hematuria, pulmonary hemorrhage and liver injury; at lower concentrations, increased red cell fragility was the most sensitive criterion of effect, however transitory. The substance is metabolized to butoxyacetic acid which appears in the urine of animals and man promptly following exposure; both are hemolytic agents. Human subjects inhaling 2-butoxy ethanol at 200 ppm for 8 hours had discomfort of the eyes, nose and throat, although there were no objective signs of injury or increase in erythrocytic fragility; some individuals complained of discomfort at 100 ppm. This substance penetrates the skin readily, and this may account for more absorption than does inhalation in some employees. The liquid is damaging to the eye, producing pain, conjunctival irritation and transitory injury to the cornea. Chronic systemic effects have not been reported in humans.

III. SIGNS AND SYMPTOMS

Irritation of the eyes, nose and throat; may cause hemolysis with hemoglobin

IV. SPECIAL TESTS

Determination of butoxyacetic acid in the urine; test of erythrocyte fragility.

V. TREATMENT

Remove from exposure. Flush eyes immediately with copious amounts of water. Wash the skin with soap and water. If swallowed and the person is conscious, induce vomiting. Recovery is usually rapid and complete.

VI. SURVEILLANCE AND PREVENTIVE CONSIDERATIONS

A. GENERAL

Most reported effects of 2-butoxy ethanol are caused by its irritant properties. Hemolysis has been reported to occur in animals, and humans should be observed for such effects. It is important that the physician becomes familiar with plant operating conditions in which exposure to 2-butoxy ethanol occurs. Those with skin disease

NIOSH/OSHA Draft Technical Standard
and Supporting Documentation for 2-BUTOXY ETHANOL

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

The following medical procedures must be made available to each employee who is exposed to 2-butoxy ethanol.

1. A complete history and physical examination -- The purpose is to detect preexisting conditions that might place the exposed employee at increased risk, and to establish a baseline for future health monitoring. Examination of liver, kidneys, lymphoid system should be stressed. The skin should be examined for evidence of chronic disorders.
2. Complete blood count -- This compound has been shown to increase erythrocyte fragility in animals exposed repeatedly to 2-butoxy ethanol vapors. A complete blood count must be performed before exposure including a differential count of a stained blood smear, as well as hemoglobin, hematocrit, clotting time determinations, and red blood cell fragility test.

C. PERIODIC EXAMINATIONS

The above medical examinations are to be repeated on an annual basis.

References

1. American Conference of Governmental Industrial Hygienists: "2-Butoxy Ethanol," (3d ed., 2d printing), Documentation of the Threshold Limit Values for Substances in Workroom Air, Cincinnati, 1974, pp. 29-30.
2. Patty, Frank A.: Industrial Hygiene and Toxicology, Vol. II - Toxicology (2d ed. revised), Interscience Publishing Company, New York, 1963, pp. 1552-1558.
3. Carpenter, C.P. et al.: "Toxicity of Butyl Cellosolve Solvent, A.M.A. Archives of Industrial Health, 14:114-131, 1956.

NIOSH/OSHA Draft Technical Standard
and Supporting Documentation for 2-BUTOXY ETHANOL

REFERENCES AND SOURCES

2-BUTOXY ETHANOL

1910.93

- (d) Methods of Compliance - Open surface tank classification based on a relative evaporation rate of 125 hours.
- (e) 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. 14.
- (f) Personal Protective Equipment, and (h) Sanitation
 - Eye: Patty, "Ind. Hyg. and Tox.;" Grant, "Toxicology of the Eye"
 - Skin: Documentation in Support of TLV; Patty, "Ind. Hyg. and Tox.;" Shell MSDS
 - Ingestion: Patty, "Ind. Hyg. and Tox."

COMMENTS

Eye - Classification: 2

Output statement numbers: 10

Exceptions: None

Patty states it is appreciably irritating and injurious to eyes, causing marked appreciable pain, conjunctival irritation, and slight transitory injury of the cornea. In summarizing the views of others, Grant states that, "It has been noted to cause mild eye and nose irritation in workmen exposed to its vapors. Tests of the liquid by dropping on rabbit eyes induces reddening and swelling of the conjunctiva with slight clouding of the corneal epithelium. The degree of injury judged 24 hours after the application of a drop has been graded 4 on a scale of 1 to 10. Rabbit eyes in contact with the liquid for 8 minutes before irrigation with water have recovered completely in 4 days."

There is no indication that the substance produces irreversible injury. It is therefore assigned a classification of 2.

Skin - Classification: 2

Output statement numbers: 2, 7a, 8b, 14g, 14i, 20a

Exceptions: See below

Documentation of TLV's states that it penetrates the skin readily, and toxic action from excessive skin exposure may be more likely than from vapor inhalation. Patty notes that it is appreciably irritating to the skin under ordinary conditions of exposure but if confined for prolonged periods may cause appreciable irritation, even burns. The rabbit skin penetration LD50 is 0.4. It has been shown that erythrocyte fragility is increased after a single 3-minute contact with 0.56 ml/kg on 4.5 per cent of the skin surface area. Shell MSDS states that damage to liver, kidney and blood can be caused by skin absorption.

2-Butoxy ethanol has a vapor pressure of 0.6 mm Hg at 20 degrees. It is miscible in all proportions with water and has a flash point of 160 degrees F.

A classification of 2 is concluded to be appropriate to prevent excessive skin absorption if statements 14g and 14i are used instead of 17g and 17i and statement 8b is specified.

Ingestion - Classification: 0

NIOSH/OSHA Draft Technical Standard
and Supporting Documentation for 2-BUTOXY ETHANOL

Output statement numbers: None

Exceptions: None

Patty considers it to be moderately toxic orally. The oral LD50 for young adult female rats is 0.47 g/kg. Chronic feeding studies with rats showed no effects of significance when the material made up 0.125 per cent of their diets. Growth depression and increased liver weight were observed at the 0.5 per cent level. The material tastes sour at first but later causes a burning sensation followed by numbness of the tongue. This makes it unlikely to be ingested repeatedly. It is therefore concluded that, in the context of this standard, ingestion would not present a hazard in the environment, especially since statement 20a is specified under the "skin" section above.

SUBSTANCE TECHNICAL GUIDELINES

2-BUTOXY ETHANOL

I. PHYSICAL AND CHEMICAL DATA

A. Substance Identification

1. Synonyms: Butyl "Cellosolve"; ethylene glycol monobutyl ether; Dowanol EB; butyl OXITOL; Jeffersol EB; Ektasolve EB
2. Formula: $C_4H_9OCH_2CH_2OH$
3. Molecular weight: 118.2

B. Physical Data

1. Boiling point (760 mm Hg): 171 C (340 F)
2. Specific gravity (water=1): 0.9
3. Vapor density (air=1 at boiling point of 2-butoxy ethanol): 4.1
4. Melting point: -70 C (-94 F)
5. Vapor pressure at 20 C (68 F): 0.6 mm Hg
6. Solubility in water, % by weight at 20 C (68 F): Miscible in all proportions below 48 C (118 F)
7. Evaporation rate (butyl acetate=1): 0.1
8. Appearance and odor: Colorless liquid with a mild odor

II. FIRE, EXPLOSION AND REACTIVITY HAZARD DATA

A. Fire

1. Flash point: 61 C (141 F) (closed cup)
2. Autoignition temperature: 244 C (472 F)
3. Flammable limits in air, % by volume: Lower: 1.1; Upper: 10.6
4. Extinguishing media: Carbon dioxide, dry chemical, alcohol foam
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: 2-Butoxy ethanol is a combustible liquid. At elevated temperatures its vapors can form explosive mixtures with air. All ignition sources must be controlled where 2-butoxy ethanol is used, handled or stored in a manner that could create a potential fire or explosion hazard.
7. For purposes of complying with the requirements of 29 CFR 1910.106, 2-butoxy ethanol is classified as a Class IIIA

NIOSH/OSHA Draft Technical Standard
and Supporting Documentation for 2-BUTOXY ETHANOL

combustible liquid. For example, 2800 ppm, approximately one-fourth of the lower flammable limit, is one situation in which 2-butoxy ethanol 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 2-butoxy ethanol 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 decomposition.
3. Hazardous decomposition products: Toxic gases and vapors (such as carbon monoxide) may be released in a fire involving 2-butoxy ethanol.
4. Special precautions: 2-Butoxy ethanol will attack some forms of plastics, rubber and coatings.

III. SPILL, LEAK AND DISPOSAL PROCEDURES

- A. If 2-butoxy ethanol is spilled or leaked, the following steps should be taken:
 1. Remove all ignition sources.
 2. Ventilate area of spill or leak.
 2. For small quantities, absorb on paper towels. Remove to a safe place (such as a fume hood) and burn the paper. Large quantities can 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.
- C. Waste disposal methods: 2-Butoxy ethanol 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 2-butoxy ethanol to plus or minus 35%.

NIOSH/OSHA Draft Technical Standard
and Supporting Documentation for 2-BUTOXY ETHANOL

- 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 2-butoxy ethanol to plus or minus 25%. Methods meeting these accuracy requirements are available from NIOSH.

V. MISCELLANEOUS PRECAUTIONS

- A. Store 2-butoxy ethanol in tightly closed containers in a well-ventilated area away from Heat..
- B. Employers should advise employees of all plant areas and operations where exposure to 2-butoxy ethanol could occur.

VI. COMMON OPERATIONS

Common operations in which exposure to 2-butoxy ethanol is likely to occur are: during its production; its use as a solvent for resins and gums; in the formulation and use of lacquers, varnishes, enamels, latex paints, lubricants, cutting oils, hydraulic fluids, and dry cleaning soaps; and as a chemical intermediate.

RESPIRATOR TABLE DOCUMENTATION

SUBSTANCE: 2-Butoxy ethanol

D. O. L. STANDARD: 50 ppm

WARNING PROPERTIES:

Odor Threshold: According to Patty 2-butoxy ethanol has a mild ethereal odor, but no quantitative information is available concerning the odor threshold of this material.

Eye Irritation Level: Browning reports that "in some investigations by Carpenter et al. on volunteer subjects, those inhaling 113 ppm for 4h reported nasal and ocular with a slight increase in nasal discharge and occasional eructation." Since this is not specifically stated to be the threshold of eye irritation, only full facepiece respirators are allowed.

Other Information: Browning also reports that "in a second experiment a year later 3 subjects inhaled 195 ppm for two 4-h periods separated by an interval of 30 min . . . They all noted immediate irritation of the nose and throat and later of the eyes, and disturbed taste." Patty points out that in sensitive individuals 100 ppm can cause eye, nose, and throat irritation.

Evaluation of Warning Properties: Through its irritant effects, 2-butoxy et can be detected at concentration only several times the permissible exposure limit. For the purposes of this standard, therefore, 2-butoxy ethanol is treated as a material with good warning properties. Gas sorbent respiratory equipment is permitted.

IDLH: 700 ppm

Basis for IDLH Value: This IDLH is based upon the 7-hour mouse LC50 of 700 ppm reported in Patty, Browning, and the Documentation of TLV's. There is no other useful information available upon which to base the IDLH. The chosen IDLH is probably conservative, since Patty states that exposure of human beings for several hours to 300 - 600 ppm 2-butoxy ethanol would probably only cause "respiratory and eye irritat narcosis, and damage to the kidney and liver." Both Patty and the Documentation of TLV's note that humans appear to be more resistant

NIOSH/OSHA Draft Technical Standard
and Supporting Documentation for 2-BUTOXY ETHANOL

to the toxic effects of 2-butoxy ethanol, which further indicates that the chosen IDLH (700 ppm) might be conservative.

Other Toxicological Information: According to the Documentation of TLV's, "Werner and his associates compared the toxicity of butyl cellosolve with some other glycol ethers in experimental animals. The minimal lethal concentration of butyl cellosolve vapor on single 7-hour exposure of mice was 700 ppm. Severe hemoglobinuria was common at concentrations near the lethal levels. Dyspnea was the most common sign of intoxication. Lung, kidney, and liver changes were seen. During repeated exposures of rats to 320 ppm for 5 weeks, effects attributable to a mild hemolytic anemia were observed. Dogs exposed to 400 ppm for 12 weeks developed only mild effects, from which it was concluded that dogs were more resistant to the hemolytic effects of butyl cellosolve than rodents.

"Carpenter and his associates exposed mice, rats, rabbits, guinea pigs, dogs, and monkeys to butyl cellosolve vapor, and observed the effects of hemolytic anemia and its sequelae. While rodents did not tolerate repeated exposure to 200 parts per million, this level was only slightly injurious to dogs. The authors suggested that humans were less susceptible than the experimental animals. In several single 8-hour exposures of humans to levels of 200 and 100 ppm, no objective effects were seen except for urinary excretion of butoxyacetic acid. Subjectively, these concentrations were found to be uncomfortable, and mild irritation followed exposure. Butyl cellosolve penetrates the skin readily and toxic action from excessive skin exposure may be more likely than from vapor inhalation.

"Smyth considered 200 ppm too high.

"From the above data, the threshold limit value was reduced to 50 ppm in 1957; it is believed that this represents a level of exposure that will prevent irritation, as well as systemic effects."

Patty states that "exposure of human beings to high concentrations of ethylene glycol monobutyl ether vapors, probably in the range of 300 to 600 ppm, for several hours would be expected to cause respiratory and eye irritation, narcosis, and damage to the kidney and liver. Deaths that occur promptly from inhalation in animals are generally attributed to narcosis, but if they are delayed several days they are likely to be caused by pneumonitis and/or kidney injury." In addition, Patty points out that "it appears that this chemical is one of the few materials to which the human is more resistant than the usual experimental animals. This appears to be due, in part, at least, to the fact that humans are more resistant than are most laboratory animals to the hemolytic effects caused by these materials themselves or their metabolites."

The NIOSH Toxic Substances List gives the following skin absorption LD50's for 2-butoxy ethanol: 500 mg/kg for the rabbit and 230 mg/kg for the guinea pig.

LFL: 11,000 ppm

VAPOR PRESSURE AT 20 C: 0.6 mm Hg

SATURATED CONCENTRATION AT 20 C: Approximately 790 ppm

NIOSH/OSHA Draft Technical Standard
and Supporting Documentation for 2-BUTOXY ETHANOL

USE/EXPOSURE AND CONTROL DOCUMENT
2-BUTOXY ETHANOL

Use/Exposure	Principal Route of Entry	Currently Used Control Methods
1. Inhalation of vapor and skin and eye contact with vapor and liquid during the spray application of lacquers, varnishes and enamels containing 2-butoxy ethanol	A,B,D	Process enclosure; local exhaust ventilation; personal protective equipment (goggles, gloves)
2. Inhalation of vapor and skin and eye contact with vapor and liquid during the brush application of lacquers, varnishes, and enamels containing 2-butoxy ethanol	A,B,D	General dilution ventilation; personal protective equipment (goggles, gloves)
3. Inhalation of vapor and skin and eye contact with vapor and liquid during the manufacture of 2-butoxy ethanol	A,B,D	General dilution ventilation; personal protective equipment (goggles, gloves)
4. Inhalation of vapor and skin and eye contact with vapor and liquid during the preparation of 2-butoxy ethanol esters for textile treatment to produce "scroop"	A,B,D	Process enclosure; general dilution ventilation; personal protective equipment (goggles, gloves)
5. Inhalation of vapors and skin and eye contact with vapor and liquid during the application as an industrial solvent	A,B,D	General dilution ventilation; personal protective equipment (goggles, gloves)
6. Inhalation of vapors and skin and eye contact with vapor and liquid during the production of di 2-butoxy ethyl phthalate (a plasticizer for polyvinyl chloride and acetate)	A,B,D	Process enclosure: general dilution ventilation; personal protective equipment (goggles, gloves)
7. Inhalation of vapor and skin and eye contact with vapor and liquid during use as a stabilizing agent in metal cleaners	A,B,D	General dilution ventilation; personal protective equipment (chemical goggles, gloves)

NIOSH/OSHA Draft Technical Standard
and Supporting Documentation for 2-BUTOXY ETHANOL

and liquid household
cleaners

- | | | | |
|----|--|-------|--|
| 8. | Inhalation of vapor and
skin and eye contact with
vapor and liquid during
use in hydraulic fluids,
insecticides, herbicides
and rust removers | A,B,D | General dilution ventila-
tion; personal protective
equipment (chemical goggles,
rubber gloves) |
|----|--|-------|--|
-
- | | | |
|--|---|--|
| | A -- Inhalation | |
| | B -- Skin contact resulting in
localized irritation | |
| | C -- Ingestion | |
| | D -- Skin contact resulting in
absorption and subsequent
systemic poisoning | |

----- JES2 JOB STATISTICS -----

1,288 CARDS READ

0 SYSOUT PRINT RECORDS

0 SYSOUT PUNCH RECORDS

0.00 MINUTES EXECUTION TIME