NIOSH/OSHA STANDARDS COMPLETION PROGRAM

DRAFT TECHNICAL STANDARD AND

SUPPORTING DOCUMENTATION FOR

*** ETHYL BENZENE ***

NIOSH/OSHA Draft Technical Standard
and Supporting Documentation for ETHYL BENZENE

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 ETHYL BENZENE.

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 ethyl benzene in concentrations not in excess of 100 parts per million (ppm) (435 milligrams per cubic meter, mg/cu.m.) averaged over an 8-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 ethyl benzene.

(b) EMPLOYEE INFORMATION - Each employer who has a workplace in which ethyl benzene is present shall:

(1) STANDARD AVAILABILITY - Keep a copy of this section with its appendices at the workplace. This material shall be made readily available to affected employees; and

(2) PRESENCE OF ETHYL BENZENE - Inform affected employees of the quantity, location, and manner of use or storage of ethyl benzene.

(c) EXPOSURE MEASUREMENT

(1) INITIAL DETERMINATION - Each employer who has a place of employment in which ethyl benzene is released into the workplace air shall determine if any employee may be exposed to airborne concentrations of ethyl benzene 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 ethyl benzene. 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 ethyl benzene;

(ii) Any measurements of airborne concentrations of ethyl benzene taken;

(iii) Any employee complaints of symptoms which may be attributable to exposure to ethyl benzene; 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 ethyl benzene 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) INDENTIFICATION OF EXPOSED EMPLOYEES - If the exposure measurement taken under paragraph (c)(2) of this section reveals employee exposure to airborne concentrations of ethyl benzene 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 ethyl benzene 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.

(5) EXPOSURE ABOVE THE PERMISSIBLE EXPOSURE - If an employee exposure measurement reveals that an employee is exposed to airborne

concentrations of ethyl benzene 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 ethyl benzene below the action level, the employer may terminate 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 ethyl benzene 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 ethyl benzene 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 ethyl benzene is present in concentrations greater than 2500 ppm, one fourth of the lower flammable limit, the fan rotating element shall be of nonsparking material or the casing shall consist of, or be lined with, nonsparking material. There shall be sufficient clearance between the fan rotating element and the fan casing so as to prevent contact.

(2) Respirators

(i) Compliance with the permissible exposure may not be achieved by the use of respirators except:

(a) During the time period necessary to install engineering controls; or

(b) In work situations in which engineering controls are technically not feasible; or

(c) In work situations in which feasible engineering and work practice controls are insufficient to reduce employee exposure to at or below the permissible exposure. Where technically feasible engineering and work practice controls are not sufficient to reduce exposure to at or below permissible exposure, they shall be used to reduce exposure to the lowest level feasible; or

(d) For operations not exceeding 40 hours per year; or

(e) In emergencies.

(ii) Respirators shall be jointly approved by the Mining Enforcement and Safety Administration (formerly Bureau of Mines) and by the National Institute for Occupational Safety and Health under the provisions of 30 CFR Part 11.

(iii) Employers shall select and provide the appropriate respirator from Table 2 and shall ensure that the employee uses the respirator provided.

(iv) Employers shall institute a respiratory protection program in accordance with sections 1910.134(b),(d),(e),(f) and (g).

Table 2. RESPIRATORY PROTECTION FOR ETHYL BENZENE

Condition	Permissible Respiratory Protection
Vapor Concentration	
Equal to or Less than 400 ppm	cartridge(s). Any supplied-air respirator.
Equal to or Less than 1000 ppm	and organic vapor cartridge(s).
Equal to or Less than 5000 ppm	A gas mask with a front or back mounted organic vapor canister. Any supplied-air respirator with a full facepiece. Any self-contained breathing apparatus with a full facepiece.
Greater than 5000 ppm or Entry and Escape from unknown Concentrations	Self-contained breathing apparatus with a full facepiece. operated in pressure-demand (positive pressure) mode. air respirator with a full facepiece operated in pressure-demand (positive pressure) or continuous flow mode and an auxiliary self-contained air supply operated in pressure-demand mode.

Fire Fighting	Self-contained breathing apparatus with a full facepiece operated in pressure-demand (positive pressure) mode.
Escape	Any gas mask with a full facepiece proviging 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 ethyl benzene which is contained in Appendix B in order to ensure the safe handling and use of ethyl benzene.

(1) Electrical - For the purposes of compliance with section 1910.309, locations classified as hazardous locations due to the presence of ethyl benzene shall be Class I Group D.

(2) Portable fire extinguishers - For the purposes of compliance with section 1910.157, ethyl benzene 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 ethyl benzene shall be Class I Group D.

(4) Flammable liquids - For the purposes of compliance with section 1910.106, liquid ethyl benzene is classified as a Class I Group D flammable liquid. Spray finishing operations shall be performed in accordance with sections 1910.107 and 1910.94(c). Dip tank operations shall be performed in accordance with sections 1910.108 and 1910.94(d).

(5) Sources of ignition - Sources of ignition such as smoking or open flames are prohibited where ethyl benzene is used, handled or stored in a manner so as to create a potential fire or explosion hazard.

tu (g) Personal Protective Equipment

(1) Skin Contact

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

(ii) Employers shall ensure that clothing contaminated with ethyl benzene is placed in closed containers. Employers shall provide for the cleaning or disposal of such clothing and if the clothing is to be laundered or otherwise cleaned, shall inform the person performing this operation of the hazardous properties of ethyl benzene.

(iii) Employers shall ensure that non-impervious clothing which becomes wet with ethyl benzene be removed promptly and not reworn until the ethyl benzene is removed from the clothing.

(iv) Employers shall ensure that clothing which becomes wet with ethyl benzene be removed immediately and not reworn until the ethyl benzene 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 ethyl benzene may occur.

(h) Spills

(1) Spills of ethyl benzene shall be cleaned up immediately after eliminating potential sources of ignition and utilizing available ventilation.

(2) Liquid ethyl benzene may not be allowed to enter a confined space, such as a sewer, because of the possibility of an explosion.

(i) Sanitation

(1) Employers shall ensure that employees whose skin becomes wet with ethyl benzene promptly wash or shower as necessary to remove any ethyl benzene from the skin.

(2) Where skin contamination may occur and showers are required for adequate cleaning of the body, employers shall provide showers as described in section 1910.141(d)(3).

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

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

(2) Medical -

(I) Advise employees as to the signs and symptoms of exposure to ethylbenzene.

(II) Instruct the employees to advise the employer of the development of signs and symptoms of exposure to ethylbenzene 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 insure that employees understand the precautions of safe use, emergency procedures, and the correct use of protective equipment relative to ethylbenzene.

(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 ethyl benzene, or airborne concentrations of ethyl benzene at or above the action level, a written statement as to whether such employee has a history of any of the following:

(i) Kidney disease

(ii) Liver disease

(iii) Chronic lung disease

(iv) Skin 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 ethyl benzene.

(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 be exposed to ethyl benzene 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 ethyl benzene.

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

(i) A copy of this regulation for ethyl benzene;

(ii) A description of the employee's duties as they relate to his exposure to ethyl benzene;

(iii) A description of any personal protective equipment 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 ethyl benzene or which could significantly interfere with the ability of the employee to follow recommended or required procedures for protecting himself from unusual or emergency exposure.

(b) Any recommended limitations upon the employee's exposure to ethyl benzene.

(c) The employee has been informed by the physician of any detected medical conditions which required further medical examination or treatment.

(ii) The written opinion shall not reveal medical information unrelated to exposure to ethyl benzene.

(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.

(l) 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 for at least one year.

(2) Exposure measurements.

(i) The employer shall keep an accurate record of all measurements taken to determine employee exposure to ethyl benzene.

(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 ethyl benzene 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 for 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 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 for at least one year.

(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 ethy

(d) A signed statement of any refusal to be examined;
(e) A copy of information provided to the physician pursuant to paragraph (k)(9) 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.

(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 ethyl benzene which is conducted pursuant to this section.

(2) Exercise of opportunity to observe monitoring.

(i) When observation of the monitoring of employee exposure to ethyl benzene 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 ethyl benzene 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 ethyl benzene 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: Ethylbenzene

PERMISSIBLE EXPOSURE: 100 parts of ethylbenzene vapor per million parts of air (ppm) or 435 milligrams of ethylbenzene vapor per cubic meter of air (mg/cu m).

APPEARANCE AND ODOR: A colorless liquid with an aromatic odor.

II. HEALTH HAZARD DATA

A. Ways in Which the Chemical Affects Your Body: Ethylbenzene can affect your body if you inhale it, swallow it, or if it comes in contact with your skin or eyes.

B. Effects of Overexposure:

1. Short Term Effects: Irritation of eyes, nose, throat and skin. With exposure to high doses, irritating effects are more pronounced, and you may begin to feel weak, dizzy, drowsy, and become unconscious.
2. Long Term Effects: Prolonged or repeated ethylbenzene exposure of the skin may cause skin rash.
3. Reporting Signs and Symptoms: You should inform your employer if you develop any signs or symptoms associated with ethylbenzene exposure.

III. EMERGENCY FIRST AID PROCEDURES

A. Eye Exposure: If ethylbenzene gets into your eyes, wash your 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 ethylbenzene gets on your non-impervious clothing or skin remove and clean the contaminated clothing and flush the contaminated skin with water promptly. If there is skin irritation, get medical attention.

C. Breathing: If you or any other person breathes in large amounts of ethylbenzene remove the exposed person to fresh air at once. If breathing is difficult, properly trained personnel may assist the affected person with oxygen. If breathing has stopped, perform

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

D. Swallowing: If ethylbenzene has been swallowed, do not cause vomiting. Get medical attention immediately.

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 ethylbenzene. You can only be required to wear them for routine use if your employer is in the process of installing controls or other control measures prove inadequate. You may be required to wear respirators for non-routine activities or in emergencies. If respirators are worn, they must have a Mining Enforcement and Safety Administration (MESA)/National Institute for Occupational Safety and Health (NIOSH) approval label. (Older respirators may have a Bureau of Mines approval label.)

If you can smell ethylbenzene 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, and other appropriate protective clothing over any parts of your body that could repeatedly be exposed to ethylbenzene liquid.

C. EYE PROTECTION: You must wear splash-proof safety goggles if it is possible that ethylbenzene may get into your eyes.

V. PRECAUTIONS FOR SAFE USE, HANDLING, AND STORAGE

Ethylbenzene is a flammable liquid and must be stored in tightly closed containers, in a cool, well-ventilated area away from ignition sources, oxidizing agents, acids, alkalies, and ammonia. You must comply with the manufacturers recommended storage practices to prevent self-reaction. Metal ethylbenzene storage containers must be bonded and grounded when transferring liquids and must be opened and closed with non-sparking tools. If your non-impervious clothing becomes wet with ethyl benzene, you must promptly remove the clothing and not wear it again until the ethyl benzene has been removed. If your skin becomes wet with ethyl benzene, you must wash or shower promptly. Fire extinguishers, where provided, must be readily available and you should know where they are and how to operate them. Ask your supervisor where ethylbenzene is used in your work area and for any additional plant safety rules.

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APPENDIX B

SUBSTANCE TECHNICAL GUIDELINES
ETHYLBENZENE

I. PHYSICAL AND CHEMICAL DATA

A. Substance Identification

1. Synonyms: Phenylethane; ethylbenzol
2. Formula: C2H5C6H5

B. Physical Data

1. Boiling point (760 mm Hg): 136 C (277 F)
2. Specific gravity (Water): 0.865
3. Vapor density (air=1): 3.66
5. Melting point: -95 C (-139 F)
5. Vapor pressure at 20 C (68 F): 7.1 mm Hg
6. Solubility in water, % by weight at 20 C (68 F): 0.015
7. Evaporation rate (butyl acetate=1): less than 1
8. Appearance and odor: Colorless liquid, aromatic odor

II. FIRE, EXPLOSION AND REACTIVITY HAZARD DATA

A. Fire

1. Flash point: 15 C (59 F) (closed cup)
2. Autoignition temperature: 432 C (810 F)
3. Flammable limits in air, % by volume: Lower: 1.0; Upper: 6.7
4. Extinguishing media: Dry chemical, foam or carbon dioxide.
5. Special fire-fighting procedures: Do not use solid stream of water, since stream will scatter and spread fire. Use water spray to keep containers cool.
6. Unusual fire and explosion hazards: Ethylbenzene is a flammable liquid. Its vapors can easily form explosive mixtures in air. All ignition sources must be controlled when ethylbenzene is used, handled, and stored. Ethylbenzene vapors are heavier than air; thus the vapors may travel along the ground and be ignited by open flames or sparks at locations remote from the site at which the ethylbenzene is handled.
7. For the purposes of complying with 29 CFR 1910.106, ethylbenzene is classified as a Class IB flammable liquid. At 2500 ppm, one fourth of the lower flammable limit, ethylbenzene is considered to be a potential fire and explosion hazard.
8. For the purposes of complying with 29 CFR 1910.309, the classification of hazardous locations as described in Article 500 of the National Electrical Code for ethylbenzene shall be Class I, Group D.

B. Reactivity
1. Conditions contributing to instability: heat
2. Incompatibilities: Contact with strong oxidizing agents may cause fire and explosions.
3. Hazardous Decomposition Products: Toxic gases and vapors (such as carbon monoxide) may be released in a fire involving ethylbenzene.
4. Special Precautions: none

III. SPILL AND LEAK PROCEDURES

A. If ethylbenzene is spilled or leaked, the following steps should be taken:
1. Remove all ignition sources
2. Ventilate area of spill or leak
3. For small quantities, absorb on paper towels. Evaporate in a safe place (such as a fume hood) and burn the paper. Large quantities, can be collected and atomized in a suitable combustion chamber. Combustion may be improved by mixing with a more flammable liquid. Ethylbenzene 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:
Ethylbenzene may be disposed of:
1. By absorbing it in vermiculite, dry sand, earth or a similar material and disposing in a sanitary land fill.
2. By atomizing in a suitable combustion chamber. Combustion may be improved by mixing with a more flammable liquid.

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 in a fashion such that the average 8-hour exposure may be determined from a single sample or two (2) 4-hour samples. Short term interval samples (up to 30 minutes) may also be used to determine average exposure level if a minimum of five (5) measurements are taken in a random manner over the 8-hour work shift. Random sampling means that any portion of the work shift has the same chance of being sampled as any other. The arithmetic average of all such random equal duration samples taken on one (1) work shift is an estimate of an employee's average level of exposure for that work shift. Air samples should be taken in the employee's breathing zone (air that would most nearly represent that inhaled by the employee). Sampling and analyses may be performed by instruments such as detector tubes certified by NIOSH under 42 CFR Part 84, portable direct-reading instruments, gas and vapor adsorption tubes with subsequent chemical analyses, or dosimeters. The method of measurement must determine the concentration of ethylbenzene 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 ethylbenzene to plus or minus 25%. Methods meeting these accuracy requirements are available in the "NIOSH Monitoring Methods Manual".

V. MISCELLANEOUS PRECAUTIONS

A. High exposures to ethylbenzene can occur when transferring the liquid from one container to another.

B. Non-sparking tools must be used to open and close metal ethylbenzene containers which must then be effectively grounded and bonded prior to pouring.

C. Store ethylbenzene in tightly closed containers in a cool, well-ventilated area away from ignition sources, oxidizing agents, acids, alkalies, and ammonia.

D. Employers must advise employees of all plant areas and operations where exposure to ethylbenzene could occur.

VI. COMMON OPERATIONS

Some common operations in which exposure to ethylbenzene is likely to occur are all operations involved in the synthesis of ethylbenzene from benzene and ethylene and in its conversion to styrene by catalytic dehydrogenation.

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APPENDIX C - MEDICAL SURVEILLANCE GUIDELINES

I. Route of Entry

Inhalation; insignificant skin absorption.

II. Toxicology

Ethyl benzene is primarily an irritant of skin and, to some degree, of eyes and upper respiratory tract. Systemic absorption causes depression of the central nervous system with narcosis at very high concentrations. Aspiration of small amounts causes extensive edema and hemorrhage of lung tissue. It is readily metabolized and excreted chiefly as mandelic acid in the urine.

III. Signs and Symptoms

Irritation of eyes and mucous membranes of upper respiratory tract, headache, excessive skin contact may produce a dermatitis. At sustained high levels narcosis, leading to coma may occur.

IV. Special Tests

None in common usage.

V. Treatment

None specific. Remove from exposure, give artificial resuscitation if indicated, and wash eyes and contaminated skin. Recovery is usually rapid and complete.

VI. Surveillance and Preventive Considerations

A. General

Most reported effects of ethyl benzene are caused by its irritant properties. No bone marrow effects have been reported as in benzene. It is important that the physician become familiar with plant operating conditions in which exposure to ethyl benzene 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 examinations 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 ethyl benzene exposure. Only those giving positive history of these conditions must be referred for further medical examinations.

1. Kidney disease -- Although ethyl benzene is not known as a kidney toxin, the importance of the organ in the elimination of toxic substances justifies special consideration in those with possible impairment of renal function.

2. Liver disease -- Although ethyl benzene 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. Skin disease -- Ethyl benzene is a defatting agent and can cause dermatitis on prolonged exposure. Persons with pre-existing skin disorders may be more susceptible to the effects of ethyl benzene.

4. Chronic respiratory diseases -- In persons with impaired pulmonary function, especially those with obstructive airway diseases, the breathing of ethyl benzene might cause exacerbation of symptoms due to its irritant properties or psychic reflex bronchospasm.

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.

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"Ethylbenzene," Union Carbide
Wolf et al., "Toxicological Studies of Certain Alkylated Benzenes and Benzene," AMA Arch. Ind. Hth. 14 (4) 387-99 (1956)
"Ethylbenzene," Industrial Hygiene Association

COMMENTS

Eye - Classification: 2
Output statement numbers: 10
Exceptions: None

Union Carbide notes that "flooding the rabbit eye with an excess of the chemical caused a reaction no more serious than moderate inflammation." According to Wolf et al., the instillation of undiluted ethyl benzene into the eyes of rabbits caused perceptible irritation of the conjuctival membranes but no corneal injury. Grant reports it causes "slight transient irritation and no corneal injury demonstrable by fluorescein staining. Standard testing on rabbit eyes gave an injury grade of 2 on a scale of 10" after 24 hours.

A classification of 2 is concluded to be appropriate.

Skin - Classification: 2
Output statement numbers: 2, 7b, 17g, 21, 17i
Exceptions: None

Browning reports that repeated application to the skin of rabbits caused reddening, some exfoliation, and "actual blistering." Union Carbide lists a rabbit single skin penetration LD50 of 17.8 ml/kg and notes "This result suggests that skin penetration in harmful amounts is not apt to occur." They add, "while animal experiments have shown only moderate irritation, human experience has shown ethyl benzene to be a pronounced irritant . . . particularly when held in skin contact by wet clothing." According to Wolf et al., "repeated skin contact to rabbits results in definite erythema and the development of edema and superficial necrosis resulting in a chapped appearance and exfoliation of large patches of skin." They also note ethyl benzene causes blistering when confined.

Ethylbenzene is only 0.015% soluble in water. It has a vapor pressure of 7.1 mm Hg at 20 degrees C and a flash point of 59 degrees F.

A classification of 2 is concluded to be appropriate to prevent the cited effects. Statement 20a is not used because the amounts of chemical towards which it is directed would not produce significant effects.

Ingestion - Classification: 0
Output statement numbers: None
Exceptions: None
The ILO states that "animal experiments have shown that digestive absorption (of ethyl benzene) causes symptoms of poisoning similar to those resulting from inhalation." The symptoms of acute vapor poisoning are noted as, "irritation of the mucous membranes, eyes and mouth, followed by necrosis, cramps and death . . . due to respiratory-anter paralysis." They add, "the main pathological findings are marked edema of the brain and lungs, foci of epithehal necrosis in the renal tubules and nepatic dystrophy." Acute oral LD50's of 3.5 g/kg and 5.46 g/kg are reported for rats by Wolf et al. and Union Carbide. According to Wolf et al., six-month rat studies of 130 feedings caused no effects at daily doses of 13.6 and 136 mg/kg, but at levels of 408 and 608 mg/kg daily there were slight changes in liver and kidney weight and histopathology. They remark, "histopathological changes were slight in nature and were characterized by a cloudy swelling of the parenchymal cells of the liver and a cloudy swelling of the tubular epithelium in the kidney." The Industrial Hygiene Association, quoting Gerarde, note that one complication of ingestion is that "the low viscosity of ethyl benzene allows it to be spread over large areas - a property that may be responsible for the observation that aspiration of the liquid into the lungs will cause chemical pneumonia characterized by pulmonary edema and hemorrhage."

The chronic feeding data from Wolf et al. indicate that, in the context of this standard, ingestion of harmful quantities should not be a hazard in the industrial environment.

RESPIRATOR TABLE DOCUMENTATION

SUBSTANCE: Ethyl Benzene
D. O. L. STANDARD: 100 ppm
WARNING PROPERTIES:

Odor Threshold: According to the Department of Transportation's "CHRIS Hazardous Chemical Data,", ethyl benzene has an odor threshold of 140 ppm.

Eye Irritation Level: According to the AIHA Hygienic Guides, "the vapor caused a noticeable eye irritation in humans at

concentrations of 200 ppm."

Evaluation of Warning Properties: Through its odor and irritant effects, ethyl benzene can be detected at a concentration less than two times the permissible exposure limit. Therefore, for the purposes of this standard, ethyl benzene is treated as a material with adequate warning properties. Gas sorbent respiratory equipment is permitted.

IDLH: 2000 ppm

Basis for IDLH Value: This IDLH is based upon the report in Patty and in the Documentation of TLV's that 2000 ppm caused vertigo in man after a brief exposure (5 minutes, according to the Documentation of TLV's).

Other Toxicological Information: According to the Hygienic Guides, "men entering an atmosphere of 1000 ppm reported a burning and smarting irritation of the eyes accompanied by profuse lacrimation. This irritation gradually decreased on continued exposure but a concentration of 2000 ppm was not tolerable . . . (The IDLH concentration is) unknown in man. Yant et al. reported that guinea pigs could not be killed in a few minutes in air saturated with ethyl benzene at 20°C. Guinea pigs succumbed in a few hours when exposed to a concentration of 10,000 ppm, but no deaths were reported at 5000 ppm for 8 hours. However, exposure to a concentration of 4000 ppm for four hours killed three of six rats."

Patty states that men exposed to 2000 ppm ethyl benzene experienced "immediate, severe eye irritation, lacrimation, and irritation of the mucous membranes of the nose. The irritation diminished with continued exposure but dizziness became apparent in 6 minutes, when the exposure was terminated. Exposure to a concentration of 5000 ppm ethyl benzene causes intolerable irritation of the eyes and mucous membranes of the nose."

LFL: 10,000 ppm

VAPOR PRESSURE AT 20 C: 7.1 mm Hg

SATURATED CONCENTRATION AT 20 C: 9340 ppm

NIOSH/OSHA Draft Technical Standard
and Supporting Documentation for ETHYL BENZENE

USE/EXPOSURE AND CONTROL DOCUMENT
ETHYL BENZENE

	Use/Exposure	Principal Route of Entry	Currently Used Control Methods
1.	Inhalation of vapor during manufacture of ethyl benzene from benzene	A	Local exhaust ventilation
2.	Inhalation of vapor during manufacture of styrene monomer	A	Local exhaust ventilation
3.	Inhalation of vapor and skin contact with liquid during spray application of vinyl resin surface coatings	A,B	Local exhaust ventilation personal protective equip (gloves, aprons, protecti clothing, respiratory protection)
4.	Inhalation of vapor during manufacture of paints, varnishes, and other surface coatings	A	Local exhaust ventilation general dilution ventilat
5.	Inhalation of vapor and skin contact with liquid during manufacture and use of rubber adhesives	A,B	General dilution ventilat local exhaust ventilation personal protective equip (gloves and barrier cream
6.	Inhalation of vapor and skin contact with liquid during electroplating of aluminum on copper or steel	A,B	Local exhaust ventilation for open surface tanks
7.	Inhalation of vapor during oven baking and drying of surface coatings	A	Local exhaust ventilation for ovens
8.	Inhalation of vapor during application of surface coatings by dipping, flow coating, and roller coating	A	Local exhaust ventilation
9.	Inhalation of vapor during use as an intermediate in dye manufacture	A	General dilution ventilat
10.	Inhalation of vapor and skin contact with liquid during use as heat-transfer medium	A,B	General dilution ventilat personal protective equip (gloves and barrier cream
11.	Inhalation of vapor and skin	A,B	General dilution ventilat

	contact with liquid during use as a dielectric		personal protective equip (gloves)
12.	Inhalation of vapor during production of acetophenone by oxidation of ethyl benzene	A	General dilution ventilat

A -- Inhalation
B -- Skin contact resulting in localized irritation
C -- Ingestion
D -- Skin contact resulting in absorption and subsequent systemic poisoning