NIOSH/OSHA STANDARDS COMPLETION PROGRAM

DRAFT TECHNICAL STANDARD AND

SUPPORTING DOCUMENTATION FOR

*** ETHYLAMINE ***

NIOSH/OSHA Draft Technical Standard and Supporting Documentation for ETHYLAMINE

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 ETHYLAMINE.

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.

(a) Definitions. (1) "Permissible exposure" means exposure of employees to airborne concentrations of ethylamine not in excess of 10 parts per million (ppm) (18 milligrams per cubic meter, (mg/M3)) averaged over an eight-hour work shift (time weighted average), as stated in § 1910.1000, Table Z-1.

(2) "Action level" means one half of the permissible exposure for ethylamine.

(b) Exposure determination and measurement. (1) Each employer who has a place of employment in which ethylamine is released into the workplace air shall determine if any employee may be exposed to airborne concentrations of ethylamine 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 ethylamine.

(2) A written record of the determination shall be made and shall contain at least the following information:

(i) Any information, observations, or calculation which may indicate employee exposure to ethylamine;

(ii) Any measurements of ethylamine taken;

(iii) Any employee complaints of symptoms which may be attributable to exposure to ethylamine; and

(iv) Date of determination, work being performed at the time, location within work site, name, and social security number of each employee considered.

(3) If the employer determines that any employee may be exposed to ethylamine at or above the action level, the exposure of the employee in each work operation who is believed to have the greatest exposure shall be measured. The exposure measurement shall be representative of the maximum eight-hour time weighted average exposure of the employee.

(4) If the exposure measurement taken pursuant to paragraph (b) (3) of this section reveals employee exposure to ethylamine 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.

(5) If an employee exposure measurement reveals that an employee is exposed to ethylamine 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.

(6) If an employee exposure measurement reveals that an employee is exposed to ethylamine above the permissible exposure, the employer shall:

(i) Measure the exposure monthly of the employee so exposed; and

(ii) Institute control measures as required by paragraph (d) of this section; and

(iii) Individually notify, in writing, within five days, every employee who is found to be exposed to ethylamine above the permissible exposure. The employee shall also be notified of the corrective action being taken to reduce the exposure to at or below the permissible exposure.

(7) If two consecutive employee exposure measurements taken at least one week apart reveal that the employee is exposed to ethylamine below the action level, the employer may terminate measurement for the employee.

(8) For purposes of this paragraph, employee exposure is that which would occur if the employee were not using a respirator.

(c) Methods of measurement. (1) 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 (See Appendix B (iv) of this section).

(2) The method of measurement shall have an accuracy, to a confidence level of 95 percent, of not less than that given in Table 1.

Table 1

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

(d) Compliance. (1) No employee shall be exposed to ethylamine above the permissible exposure as defined in paragraph (a)(1) of this section.

(2) Employee exposures to airborne concentrations of ethylamine shall be controlled to at or below the permissible exposure by engineering and work practice controls:

(i) Engineering and work practice controls shall be instituted to reduce exposures to at or below the permissible exposure, except to the extent that such controls are not technically feasible.

(ii) Wherever engineering and work practice controls are not sufficient to reduce exposures to at or below the permissible exposure, they shall nonetheless be used to reduce exposure to the lowest level feasible and shall be supplemented by respirators in accordance with paragraph (d)(4) of this section.

(3) Engineering controls. When mechanical ventilation is used to control exposure, measurements which demonstrate system effectiveness, for example, air velocity, static pressure, or air volume, shall be made at least every three months. Measurements of system effectiveness shall also be made within five days of any change in production, process, or control which might result in an increase in airborne concentrations of ethylamine.

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

(i) During the time period necessary to install or implement engineering or work practice controls; or

(ii) In work situations in which engineering and work practice controls are technically not feasible; or

(iii) To supplement engineering and work practice controls when such controls fail to reduce airborne concentrations of ethylamine to at or below the permissible exposure; or

(iv) For operations which require entry into tanks or closed vessels; or

(v) In emergencies.

(5) Where respirators are needed and permitted under this paragraph to reduce employee exposure, the employer shall select and provide the appropriate respirator from Table 2 and shall ensure that the employee uses the respirator provided.

TABLE 2 RESPIRATORY PROTECTION FOR ETHYLAMINE

CONDITION	PERMISSIBLE RESPIRATORY PROTECTION
Gas Concentration	
500 ppm or less	Any supplied-air respirator with a full facepiece, helmet or hood. Any self-contained breathing apparatus with a full facepiece.
4000 ppm or less	A Type C supplied-air respirator with a full facepiece operated in pressure-demand or other positive pressure mode or with a full facepiece, helmet, or hood operated in continuous-flow mode.
Greater than 4000 ppm or entry and escape from unknown concentrations	Self-contained breathing apparatus with a full facepiece operated in pressure-demand or other positive pressure mode. A combination respirator which includes a Type C supplied-air respirator with a full facepiece operated in pressure-demand or other positive pressure or continuous-flow mode and an auxiliary self-contained breathing apparatus operated in pressure-demand or other positive pressure mode. (Supplied-air suits may be necessary
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 ethylamine. Any escape self-contained breathing apparatus.

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

(7) The employer shall institute a respiratory protection program in accordance with § 1910.134(b), (d), (e), and (f).

(e) Fire and safety. (1) The employer shall familiarize himself with the information contained in the Substance Technical Guidelines (Appendix B of this section) for ethylamine.

(2) For the purpose of compliance with § 1910.309, locations classified as hazardous locations due to the presence of ethylamine shall be Class I, Group C.

(3) For the purpose of compliance with § 1910.157, ethylamine is classified as a Class B fire hazard.

(4) For the purpose of compliance with § 1910.178, locations classified as hazardous locations due to the presence of ethylamine shall be Class I, Group C.

(5) For the purpose of compliance with § 1910.106, liquid ethylamine is classified as a Class IA flammable liquid.

(6) Where a fan is located in ductwork and where ethylamine is present in the ductwork in concentrations greater than 8800 ppm (approximately 25% 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.

(7) Sources of ignition such as smoking or open flames are prohibited where ethylamine is used, handled, or stored.

(8) Ethylamine shall be stored so as not to come in contact with strong oxidizers and strong acids.

(f) Personal protective equipment. (1) Employers shall provide and ensure that employees use impervious clothing, gloves, face shields (eight-inch minimum) and other appropriate protective clothing necessary to prevent skin contact with liquid ethylamine, where skin contact may occur. Face shields shall comply with § 1910.133(a)(2),(a)(4), (a)(5), and (a)(6).

(2) Employers shall ensure that clothing wet with liquid ethylamine is placed in closed containers for storage until it can be discarded or until the employer provides for the removal of ethylamine from the clothing. If the clothing is to be laundered or otherwise cleaned to remove the ethylamine, the employer shall inform the person performing the operation of the hazardous properties of ethylamine.

(3) Where exposure of an employee's body to liquid ethylamine may occur, employers shall provide facilities for quick drenching of the body within the immediate work area for emergency use.

(4) Employers shall ensure that non-impervious clothing which becomes contaminated with ethylamine be removed immediately and not reworn until the ethylamine is removed from the clothing.

(5) Employers shall ensure that clothing which becomes wet with liquid ethylamine be removed immediately and not reworn until the ethylamine is removed from the clothing.

(6) Employers shall provide and ensure that employees use splash-proof safety goggles (cup-cover type dust and splash safety goggles) which comply

with § 1910.133 (a)(2)-(a)(6) where there is any possibility of liquid ethylamine or solutions containing ethylamine contacting the eyes.

(7) Where there is any possibility that an employee's eyes may be exposed to liquid ethylamine or solutions containing 0.75% or more of ethylamine by weight, employers shall provide an eye-wash fountain within the immediate work area for emergency use.

(g) Spills and disposal. (1) In the event that liquid ethylamine is spilled the employer shall immediately eliminate potential sources of ignition, provide available ventilation and then clean up the spill.

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

(h) Sanitation. Employers shall ensure that employees whose skin becomes contaminated with ethylamine immediately wash or shower to remove any ethylamine from the skin.

(i) Training and information. (1) Each employer who has a workplace in which ethylamine is present shall keep a copy of this regulation with Appendixes A, B and C at the workplace. This material shall be made readily available to affected employees.

(2) Each employer who has employees exposed to ethylamine above the action level or employees who may have skin or eye contact with liquid ethylamine or solutions containing ethylamine, or employees who work where ethylamine presents a fire or explosion hazard, shall annually:

(i) Inform affected employees of the information contained in the Substance Safety Data Sheet for ethylamine (Appendix A of this section);

(ii) Advise affected employees as to the signs and symptoms of exposure to ethylamine.

(iii) Instruct affected employees to advise the employer of the development of signs and symptoms of exposure to ethylamine which are listed in Appendix A of the section;

(iv) Instruct affected employees to inform the employer if they develop any of the medical conditions listed in paragraph (j)(2) of this section; and

(v) Provide training to ensure that employees understand the precautions of safe use, emergency procedures, and the correct use of protective equipment relative to ethylamine.

(j) Medical surveillance. (1) The employer shall provide medical procedures as required by this paragraph. All medical procedures shall be performed by or under the supervision of a physician at no cost to the employee.

(2) The employer shall obtain from each employee who is exposed, or will be exposed, to liquid ethylamine or airborne concentrations of ethylamine at or above the action level, information as to whether such employee has a history of any of the following medical conditions:

(i) Chronic lung disease
(ii) Skin disease
(iii) Eye disease
(iv) Liver disease
(v) Kidney disease
(vi) Heart disease

(3) The employer shall provide a medical examination for the employee if:

(i) The employee provides a history of any of the medical conditions listed in paragraph (j)(2) of this section; or

(ii) The employee informs the employer of the development of any of the medical conditions listed in paragraph (j)(2) of this section or any of the signs or symptoms of exposure to ethylamine which are listed in Appendix A which the employee suspects are caused by exposure to ethylamine.

(4) The employer shall provide to the examining physician the following information:

(i) A copy of this regulation with Appendixes A, B and C for ethylamine;

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

(iii) A description of any personal protective equipment and respirators required to be used;

(iv) The results of any measurements which may indicate the affected employee's exposure;

(v) The affected employee's anticipated exposure; and

(vi) Upon request of the physician, any available information from previous medical examinations of the affected employee.

(5) Where a medical examination is required by paragraph (j)(3) of this section, following such examination the employer shall obtain a written opinion from the examining physician which conforms with paragraph (j)(6) of this section.

(6)(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 condition which would place the employee at increased risk of material impairment of the employee's health from exposure to ethylamine or would directly or indirectly aggravate any detected medical condition;

(B) Any recommended limitations upon the employee's exposure to ethylamine including limitations upon the use of personal protective equipment and respirators;

(C) That the employee has been informed by the physician of any detected medical conditions which require further medical examination or treatment.

(ii) The physician's written opinion shall not reveal specific medical findings or diagnoses unrelated to exposure to ethylamine.

(iii) The employer shall provide the employee with a copy of the physician's written opinion.

(7) No employee shall be exposed to liquid ethylamine or airborne concentrations of ethylamine in such a way as would put the employee at increased risk of material impairment of his health from such exposure. This determination may be based on the physician's written opinion.

(8) The employer shall provide emergency and follow-up medical examinations and treatment for any employee injured through exposure to ethylamine.

(9) 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 risk involved by refusal to be examined.

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

(k) Recordkeeping. (1) Exposure determination. (i) The employer shall keep an accurate record of all determinations required to be made pursuant to paragraph (b)(1) of this section.

(ii) This record shall include the written determination required in paragraph (b)(2) 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 ethylamine.

(ii) This record shall include:

(A) The date of measurement;

(B) Operations involving exposure to ethylamine which are being monitored;

(C) Sampling and analytical methods used and evidence of their accuracy, including the method, results and date of calibration of sampling equipment;

(D) Number, duration, and results of samples taken; and

(E) 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 an accurate record of the measurements demonstrating the effectiveness of such ventilation required by paragraph (d)(3) of this section.

(ii) This record shall include:

(A) Date of measurement;

(B) Type of measurement taken;

(C) Result of measurement.

(iii) These records shall be maintained for at least one year.

(4) Employee training and information. (i) The employer shall keep an accurate record of all employee training and information required by paragraph (i) of this section.

(ii) This record shall include:

(A) Date of training;

(B) Name and social security number of employee trained;

(C) Content or scope of training provided.

(iii) This record shall be maintained until replaced by a more recent record.

(5) Medical surveillance. (i) The employer shall keep an accurate record of employee medical surveillance required by paragraph (j) of this section.

(ii) This record shall include:

(A) Information concerning medical conditions obtained from the employee pursuant to paragraph (j)(2) of this section;

(B) Any employee medical complaints relative to exposure to ethylamine;

(C) A copy of information provided to the physician pursuant to paragraph (j)(4)(ii), (iii), (iv), (v), and (vi) of this section.

(D) Physician's written opinion; and

(E) A signed statement of any refusal to be examined.

(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 of Labor for Occupational Safety

and Health and the Director of the National Institute for Occupational Safety and Health.

(ii) Employee exposure determination and 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.

(l) Employee observation of measurement. (1) The employer shall give affected employees or their representatives an opportunity to observe any measurement of employee exposure to ethylamine which is conducted pursuant to this section.

(2) When observation of measurement of employee exposure to ethylamine requires entry into an area where the use of personal protective devices, including respirators, is required, the observer shall be provided with and required to use such equipment and comply with all other applicable safety procedures.

(3) Without interfering with the measurement, observers shall be entitled to:

(i) Receive an explanation of the measurement procedure.

(ii) Visually observe all steps related to the measurement of the airborne concentration of ethylamine that are being performed at the place of exposure; and

(iii) Record the results obtained.

NOTE: The information contained in the following appendixes is advisory in nature and is not intended, by itself, to create any additional obligations not otherwise imposed or detract from any existing obligation.

APPENDIX A

SUBSTANCE SAFETY DATA SHEET FOR ETHYLAMINE

I. SUBSTANCE IDENTIFICATION

A. Substance: Ethylamine

B. Permissible Exposure: 10 parts of ethylamine per million parts of air (ppm) (18 milligrams of ethylamine per cubic meter of air (mg/M3)) averaged over an eight-hour work shift.

C. Appearance and Odor: Colorless liquid or gas with a strong ammonia-like odor.

II. HEALTH HAZARD DATA

A. Ways in Which the Chemical Affects Your Body: Ethylamine can affect your body if you inhale it, if it comes in contact

with your eyes or skin, or if you swallow it. It may enter your body through your skin.

B. Effects of Overexposure:

1. Short-Term Exposure: Ethylamine causes severe irritation of the eyes and skin. It may also cause irritation of the nose, throat and lungs.
2. Long-Term Exposure: Repeated or prolonged exposure to ethylamine may also cause irritation of the lungs and kidney damage.
3. Reporting Signs and Symptoms: You should inform your employer if you develop any signs or symptoms and suspect they are caused by exposure to ethylamine.

III. EMERGENCY FIRST AID PROCEDURES

A. Eye Exposure: If ethylamine or solutions containing ethylamine get into your eyes, wash your eyes immediately with large amounts of water, lifting the lower and upper lids occasionally. Get medical attention immediately. Contact lenses should not be worn when working with this chemical.

B. Skin Exposure: If ethylamine gets on your skin, immediately flush the contaminated skin with water. If ethylamine soaks through your clothing, remove the clothing immediately and flush the skin with water. If irritation persists after washing, get medical attention.

C. Breathing: If you or any other person breathes in large amounts of ethylamine move the exposed person to fresh air at once. If breathing has stopped, perform artificial respiration. Keep the affected person warm and at rest. Get medical attention as soon as possible.

D. Swallowing: When ethylamine has been swallowed, give the person large quantities of water immediately. After the water has been swallowed, try to get the person to vomit by having him touch the back of his throat with his finger. Do not make an unconscious person vomit. 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 ethylamine. You can only be required to wear them for routine use if your employer is in the process of installing controls or 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) or 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 there use is required. If you can smell ethylamine 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. Supplied-air suits: in some work situations the wearing of supplied-air suits may be necessary. Your employer should instruct you in their proper use and operation.

C. Protective Clothing: You must wear impervious clothing, gloves, face shield or other appropriate protective clothing to prevent skin contact with liquid ethylamine, where skin contact may occur. Replace or repair impervious clothing that has developed leaks.

D. Eye Protection: You must wear splash-proof safety goggles where there is any possibility of liquid ethylamine or solutions containing ethylamine contacting your eyes.

V. PRECAUTIONS FOR SAFE USE, HANDLING AND STORAGE

A. Ethylamine is a flammable liquid and its vapors can easily form explosive mixtures in air.

B. Ethylamine must be stored in tightly closed containers in a cool, well ventilated area away from heat, sparks, flames, strong oxidizers, and strong acids.

C. Sources of ignition such as smoking and open flames are prohibited wherever ethylamine is handled, used or stored.

D. You must use non-sparking tools when opening or closing metal containers of ethylamine, and containers must be bonded and grounded when pouring or transferring liquid ethylamine.

E. You must immediately remove any non-impervious clothing that becomes contaminated with liquid ethylamine and this clothing must not be reworn until the ethylamine is removed from the clothing.

F. Clothing wet with liquid ethylamine can be easily ignited. You must immediately remove this clothing and it must not be reworn until the ethylamine is removed from the clothing.

G. If your skin becomes contaminated with ethylamine, you must immediately wash or shower to remove the ethylamine from your skin.

H. Fire extinguishers, eye flushing facilities and quick drenching facilities, where provided, must be readily available and you should know where they are and how to operate them.

I. Ask your supervisor where ethylamine is used in your work area and for any additional plant safety and health rules.

VI. ACCESS TO INFORMATION

A. Each year your employer is required to inform you of the information contained in this Substance Safety Data Sheet for ethylamine. In addition, your employer must instruct you in the safe use of ethylamine, emergency procedures, and the correct use of protective equipment.

B. Your employer is required to determine whether you are being exposed to ethylamine. You or your representative have the

right to observe employee exposure measurements and to record the results obtained. If your employer determines that you are being overexposed, he is required to inform you of the exposure and of the actions which are being taken to reduce your exposure.

C. Your employer is required to keep records of exposure determinations, exposure measurements, and medical surveillance. Your employer is required to make records of exposure determinations and your exposure measurements available to you or your representative upon your request. Your employer is required to release your medical records to your physician upon your written request.

APPENDIX B

SUBSTANCE TECHNICAL GUIDELINES FOR ETHYLAMINE

I. PHYSICAL AND CHEMICAL DATA

A. Substance Identification

1. Synonyms: Ethylamine, anhydrous; aminoethane; monoethylamine
2. Formula: $C_2H_5NH_2$
3. Molecular weight: 45.1

B. Physical Data

1. Boiling point (760 mm Hg): 16.7 C (62 F)
2. Specific gravity (water=1): 0.7
3. Vapor density (air = 1 at boiling point of ethylamine): 1.6
4. Melting point: -81 C (-114 F)
5. Vapor pressure at 20 C (68 F): 1.18 atmospheres
6. Solubility in water, % by weight at 20 C (68 F): Miscible in all proportions
7. Evaporation rate (butyl acetate = 1): Greater than 1
8. Appearance and odor: Colorless liquid or gas with a strong ammonia-like odor.

II. FIRE, EXPLOSION AND REACTIVITY HAZARD DATA

A. Fire

1. Flash point: Less than -18 C (less than 0 F) (closed cup)
2. Autoignition temperature: 385 C (725 F)
3. Flammable limits in air, % by volume: Lower: 3.5; Upper: 14.0
4. Extinguishing media: Alcohol foam, carbon dioxide, dry chemical
5. Special fire-fighting procedures: Do not use a solid stream of water since the stream will scatter and spread the fire. Use water spray to cool containers exposed to a fire.

6. Unusual fire and explosion hazards: Ethylamine is a flammable liquid. Its vapors can easily form explosive mixtures with air. All ignition sources must be controlled where ethylamine is handled, used or stored. Ethylamine vapors are heavier than air and may travel along the ground and be ignited by open flames or sparks at locations remote from the site at which ethylamine is handled.
7. For purposes of conforming with the requirements of 29 CFR 1910.106, ethylamine is classified as a Class IA flammable liquid. For example, 8800 ppm, approximately one-fourth of the lower flammable limit, is one situation in which ethylamine 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 ethylamine shall be Class I Group C.

B. Reactivity
1. Conditions contributing to instability: Heat.
2. Incompatibilities: Contact of the liquid with strong acids will cause violent spattering. Contact with strong oxidizers may cause fires and explosions.
3. Hazardous decomposition products: Toxic gases and vapors (such as oxides of nitrogen and carbon monoxide) may be released in a fire involving ethylamine.
4. Special precautions: Liquid ethylamine will attack some forms of plastics, rubber and coatings.

III. SPILL AND LEAK PROCEDURES

A. If ethylamine is spilled or leaked, the following steps should be taken:
1. Remove all ignition sources.
2. Ventilate area of spill or leak.
3. Allow ethylamine to evaporate. Ethylamine 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.

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 eight-hour sample or two (2) 4-hour samples. Several short time interval samples (up to 30 minutes) may also be used to determine the average exposure level. Air samples should be taken in the employee's breathing zone (air that would most nearly represent that inhaled by the employee). Sampling and analyses may be performed by instruments such as detector tubes certified by NIOSH under 42 CFR part 84, portable direct-reading instruments, dosimeters, or gas and vapor adsorption tubes

with subsequent chemical analyses. The method of measurement must determine the concentration of ethylamine to plus or minus 35%.

B. EXPOSURE ABOVE THE PERMISSIBLE EXPOSURE: The monitoring and measurements 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. The method of measurement must determine the concentration of ethylamine to plus or minus 25%.

C. METHODS: Methods meeting these accuracy requirements are available from the National Technical Information Service, U. S. Department of Commerce, Springfield, Virginia 22161 under the title "NIOSH Analytical Methods for Set K" (Order number XXXXXXXXXX).

D. QUALIFIED PERSONS: Since many of the duties relating to employee protection are dependent on the results of monitoring and measuring procedures, employers should assure that the evaluation of employee exposures is performed by a competent industrial hygienist or other technically qualified person.

V. MISCELLANEOUS PRECAUTIONS

A. Store ethylamine in tightly closed containers in a cool, well ventilated area.

B. High exposures to ethylamine can occur when transferring the liquid from one container to another.

C. Non-sparking tools must be used to open and close metal ethylamine containers. These containers must be effectively grounded and bonded prior to pouring.

D. Use of supplied-air suits or other impervious coverings may be necessary to prevent skin contact with ethylamine where the concentration of ethylamine is unknown or is greater than 4000 ppm. Supplied-air suits should be selected, used, and maintained under the immediate supervision of persons knowledgeable in the limitations and potential life endangering characteristics of supplied-air suits.

E. Employers should advise employees of all areas and operations where exposure to ethylamine could occur.

VI. COMMON OPERATIONS

Common operations in which exposure to ethylamine is likely to occur are: during its production and its use as a catalyst for curing resins; as a solvent;as a corrosion inhibitor; as an intermediate in the synthesis of detergents, pharmaceuticals, rubber chemicals (e.g. rubber latex), agricultural chemicals, photographic chemicals and other chemical substances; and its use as a deflocculent in the ceramics industry.

APPENDIX C - MEDICAL SURVEILLANCE GUIDELINES

I. ROUTE OF ENTRY

Inhalation.

II. TOXICOLOGY

Ethylamine vapor is a primary irritant to mucous membranes, eyes, and skin. Exposure to 8000 ppm for 4 hours was lethal to rats. Rabbits survived exposures to 50 ppm daily for 6 weeks but showed pulmonary irritation and some myocardial degeneration; corneal damage was observed after 2 weeks of exposure. In the rabbit eye, 1 drop of a 70 per cent solution of ethylamine caused immediate, severe irritation. Eye irritation and corneal edema in humans have been reported from industrial exposure. A 70 per cent solution of the base dropped on the skin of guinea pigs caused prompt skin burns leading to necrosis; when held in contact with guinea pig skin for 24 hours there was severe skin irritation with extensive necrosis and deep scarring.

III. SIGNS AND SYMPTOMS

Severe eye irritation and skin burns; possible respiratory irritation; dermatitis from repeated exposure.

IV. SPECIAL TESTS

None in common usage.

V. TREATMENT

Remove from exposure. Immediately flush eyes and skin with water. If a solution is swallowed and the person is conscious, immediately administer water by mouth and induce vomiting. Give artificial resuscitation if indicated. Recovery may be delayed. Consideration should be given to hospitalization and observation for delayed onset of pulmonary edema.

VI. SURVEILLANCE AND PREVENTIVE CONSIDERATIONS

A. GENERAL

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

B. PREPLACEMENT

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

1. Chronic respiratory disease -- Ethylamine causes lung irritation in animals. In persons with impaired pulmonary function, especially those with obstructive airway diseases, the breathing of ethylamine might cause exacerbation of symptoms due to its irritant properties.

2. Eye disease -- Ethylamine is an eye irritant and has caused corneal edema in workers. Persons with preexisting eye disorders may be more susceptible to the effects of this agent.

3. Skin disease -- Ethylamine is a primary skin irritant. Persons with preexisting skin disorders may be more susceptible to the effects of this agent.

4. Liver disease -- Although ethylamine 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.

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

6. Cardiovascular disease -- Ethylamine causes myocardial degeneration in animals. Persons with cardiac disease may be at increased risk.

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.

VII. REFERENCES

1. American Conference of Governmental Industrial Hygienists: "Ethylamine," Documentation of the Threshold Limit Values for Substances in Workroom Air (3d ed., 2d printing), Cincinnati, 1974, p. 103.

2. Patty, Frank A.: Industrial Hygiene and Toxicology, Vol. II - Toxicology (2d ed. revised), Interscience Publishing Company, New York, 1963, pp. 2038, 2040, 2042, 2044, 2045, 2047, 2052, 2053.

3. Brieger, H. and W.A. Hodes: "Toxic Effects of Exposure to Vapors of Aliphatic Amines," AMA Archives of Industrial Hygiene and Occupational Medicine, 3:287-291, 1951.

REFERENCES AND SOURCES
ETHYLAMINE
1910.93

(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: Grant, "Toxicology of the Eye;" Patty, "Industrial Hygiene and Toxicology;" "Ethylamine," Union Carbide; Smyth et al., "Range - Finding Toxicity Data: List VI," AIHA Journal 23:2, 1962, p. 95 - 107

Skin: Patty, "Industrial Hygiene and Toxicology;" "Ethylamine," Union Carbide; "Ethylamine," Coast Guard, Characteristics of Liquid Chemicals

Ingestion: "Ethylamine," Union Carbide; "Ethylamine," Coast Guard; Sax, "Dangerous Properties of Industrial Materials"

COMMENTS

Eye - Classification: 1 and 2

Output statement numbers: 9, 13

Exceptions: Statement 10 is deleted and statement 9 is used to require eye protection for all situations involving potential eye exposure to ethylamine.

According to Patty, "a drop of undiluted liquid in rabbit eyes rated 9 on a scale of 10. (after 24 hours)." Smyth et al. are the source of Patty's data and the grading scale. Union Carbide, interpreting the significance of a grade of 9, reports "rabbit eyes were severely burned by a 5% concentrated solution of ethylamine. A 1% concentrated solution caused severe irritation only." A classification of 1 is concluded to be warranted for the pure substance and solutions containing more than 0.75% of it. Solutions with lower concentrations are given a classification of 2. The cutoff of 0.75% is intentionally lower than the 1% reported to cause severe irritation.

Skin - Classification: 2

Output statement numbers: 2, 7b, 8b, 14g, 14i, 21

Exceptions: See below

According to Patty, "severe skin irritation with extensive necrosis and deep scarring resulted from 0.1 ml of a 70% ethylamine base held in contact with guinea pig skin for 24 hours." He continues, "prompt and necrotic skin burns resulted from 70% ethylamine base dropped on guinea pig skin." A rat skin LD50 of 0.39 ml/kg was noted. The Coast Guard reported a rabbit skin penetration LD50 of greater than 0.3 ml/kg. Union Carbide gives a rabbit skin penetration LD50 of 0.53 ml/kg. They note "skin penetration in harmful amounts can occur. This covered application caused severe burns as would wearing saturated clothing for a short period of time." The boiling point of the substance is 62 F; at 20 C its vapor pressure is 950 mm Hg. Its

flashpoint is less than its boiling point and it is miscible in all proportions with water. A classification of 2 is concluded to be warranted if statement 2 is modified to prevent contact where it "may occur" and statements 14g and 14i are used instead of statements numbered 16 or 17. Statement 20a not felt necessary because of its volatilit

Ingestion - Classification: 0
Output statement numbers: None
Exceptions: None

Union Carbide reports an oral rat LD50 of 0.54 g/kg. They note ingestion causes "severe burns of mouth and throat" probably due to ethylamine's alkalinity. The Coast Guard gives a rat LD50 of greater than 300 mg/kg and notes there are no cumulative toxic effects. Amines are well absorbed from the gut and present a hazard from their local corrosive action on the gastrointestinal tract. Sax substantiates this, noting that ingestion produces a severe acute local reaction. Because of the high volatility of the substance, it is concluded that ingestion would not be a problem in industry.

SUBSTANCE TECHNICAL GUIDELINES

The references cited for this document include:

National Fire Protection Association, "Fire Protection Guide on Hazardous Materials," 5th edition, 1973 (NFPA)
Pennwalt Corp., Material Safety Data Sheet (Penn)
Union Carbide Corp., "Chemicals and Plastics - Physical Properties," 1974 (UCC)
Kirk-Othmer, "Encyclopedia of Chemical Technology," 2nd edition, Vol. 2, p. 122 (K-O)

Sources of data items used:

I. A. 1. Synonyms: Penn
2. Formula: NFPA-49
3. Molecular weight: UCC

B. 1. Boiling point: NFPA-325M; Penn; UCC
2. Specific gravity: Penn
3. Vapor density: NFPA-325M; Penn
4. Melting point: UCC
5. Vapor pressure: Perry's Chemical Engr. Handbook, 4th Ed.
6. Solubility in water: NFPA-49; Penn; UCC
7. Evaporation rate: ADL
8. Appearance and odor: NFPA-49; Penn

II. A. 1. Flash point: NFPA-325M
2. Autoignition temperature: NFPA-325M
3. Flammable limits: NFPA-325M; Penn
4. Extinguishing media: NFPA-49; Penn
5. Special fire fighting procedures: NFPA-49; ADL
6. Unusual fire and explosion hazards: NFPA-49; ADL

B. 1. Conditions contributing to instability: ADL
2. Incompatibilities: NFPA-49; Penn
3. Hazardous decomposition products: ADL
4. Special precautions: ADL

III. A. Steps if released or spilled: NFPA-49; Penn

C. Waste disposal method: Penn; ADL

V. Miscellaneous precautions: ADL; Penn

USE/EXPOSURE AND CONTROL DOCUMENT

References used in the preparation of this document include:

"Amines, Alkyl and Alkylene," Product Bulletin, Union Carbide Chemicals Company, 1959 (Union Carbide)

Considine, D. M. - editor, "Chemical and Process Technology Encyclopedia," McGraw-Hill Book Company, New York, 1974 (Considine)

"Ethylamine," Characteristics of Liquid Chemicals Proposed for Bulk Water Movement, U. S. Coast Guard (Coast Guard)

"Ethylamine," Hazard Process Index," Hazard Entry No. 75, NIOSH, HSM-99-73-62 (HPI)

"Ethylamine," Material Safety Data Sheet, U. S. Department of Labor, Form OSHA-20, May 1971 (Safety)

Faith, W. L., Keys, D. P. and Clark, R. L., "Industrial Chemicals," John Wiley and Sons, 3rd edition, 1965 (Faith)

Hawley, G. G. - editor, "The Condensed Chemical Dictionary," Van Nostrand Reinhold Company, 8th edition, 1971 (Hawley)

International Labour Organization, "Encyclopedia of Occupational Health and Safety," Geneva, 1972 (ILO)

Jacobs, M., "The Analytical Chemistry of Industrial Poisons, Hazards and Solvents," Interscience Publishers, 1956 (Jacobs)

Kirk, R. and Othmer, D., "Encyclopedia of Chemical Technology," Interscience Publishers, Division of John Wiley and Sons, Inc., 1st edition, 1954 (Chem Tech)

Kirk, R. and Othmer, D., "Encyclopedia of Chemical Technology," Interscience Publishers, Division of John Wiley and Sons, Inc., 2nd edition, 1968 (K-O)

LeFaux, R., "Practical Toxicology of Plastics," CRC Press, International Science Series, Cleveland, Ohio, 1968 (LeFaux)

"Merck Index of Chemicals and Drugs," Merck and Company, Rahway, New Jersey, 8th edition, 1968 (Merck)

Stanford Research Institute, "Chemical Economics Handbook," Menlo Park, California (SRI)

References for Specific Use/Exposure

1. HPI, SRI, Faith, Coast Guard
2. HPI, SRI, Merck, Hawley, Faith, Coast Guard, ILO
3. Merck, Hawley
4. HPI
5. Considine
6. HPI, SRI, K-O
7. SRI, Coast Guard
8. HPI, SRI, Jacobs
9. K-O, Merck, Hawley, Union Carbide
10. K-O, Merck, Union Carbide
11. HPI, Merck
12. HPI, Union Carbide
13. K-O, Union Carbide
14. Hawley, Coast Guard

References for Specific Control Methods

Merck, Safety and K-O were the references used for numbers 1 - 14.

RESPIRATOR TABLE DOCUMENTATION

NIOSH/OSHA Draft Technical Standard
and Supporting Documentation for ETHYLAMINE

SUBSTANCE: Ethylamine
D. O. L. STANDARD: 10 ppm
WARNING PROPERTIES:
Odor Threshold: There are no quantitative data available concerning the odor threshold of ethylamine.
Eye Irritation Level: Patty and the Documentation of TLV's report that in repeated exposure experiments, "100 ppm ethylamine produced irritation of the cornea" in rabbits. In addition, corneal injury, which was delayed until 2 weeks, was produced in rabbits exposed repeatedly to 50 ppm ethylamine. Since this concentration (50 ppm) is not specifically stated to be the lowest concentration producing eye injury, only full facepiece respiratory equipment is permitted.
Other Information: Patty and the Documentation of TLV's report that rabbits exposed both to 100 ppm and to 50 ppm ethylamine for 7 hours per day, 5 days per week for 6 weeks, experienced lung irritation.
Evaluation of Warning Properties: Since there is no available information concerning the odor threshold of ethylamine, and since the irritant effects produced by this substance are not stated to occur immediately upon exposure, ethylamine is treated as a substance with poor warning properties. Gas sorbent respiratory equipment is not permitted.
IDLH: 4000 ppm
Basis for IDLH Value: The chosen IDLH of 4000 ppm ethylamine is based upon the report in the Chemical Company Guides of Union Carbide Corporation that a 4-hour exposure to a concentration of 4000 ppm ethylamine killed 1 out of 6 rats.
Other Toxicological Information: Patty reports that repeated exposure of rabbits to concentrations of ethylamine of 100 ppm and 50 ppm have been shown to produce "kidney damage, lung irritation, some myocardial degeneration, eye irritation, corneal erosions, and edema."

Deichmann and Gerarde report that the maximum survival time for rats exposed to a saturated concentration of ethylamine was 2 minutes. These authors also report that 2 out of 6 rats died following a 4-hour exposure to 8000 ppm ethylamine.

The Chemical Company Guides of Union Carbide Corporation state that "breathing 4000 parts per million killed one of six animals after four hours exposure while 16,000 parts per million was fatal to all in the same period of time." Union Carbide also notes that "while this chemical is not highly toxic by inhalation, the very high vapor pressure permits the rapid development of dangerous concentrations of vapor in case of a spill or leak."

Union Carbide Corporation's Chemical Company Guides report a single skin penetration LD50 in rabbits of 0.53 ml/kg for ethylamine (70 per cent solution).

LFL: 35,000 ppm
VAPOR PRESSURE AT 20 C: Gas.

NOTE: Since all organic vapor cartridges may not be efficient in removing

ethylamine only those cartridges and canisters which provide protection against ethylamine are permitted.

NIOSH/OSHA Draft Technical Standard
and Supporting Documentation for ETHYLAMINE

USE/EXPOSURE AND CONTROL DOCUMENT
ETHYLAMINE

	Use/Exposure	Principal Route of Entry	Currently Used Control Methods
1.	Inhalation of vapor and skin contact with liquid during use in the synthesis of agricultural chemicals such as the herbicides atrazine and simazine	A,B	General dilution ventilation; local exhaust ventilation
2.	Inhalation of vapor and skin contact with liquid during use in the synthesis of n-ethylmorpholine. This compound is used as a dyestuff intermediate; as a solvent for dyes, resins and oils, as a catalyst for polyurethane foams; and in pharmaceuticals, emulsifying agents and vulcanization accelerator's for sulfur cured rubbers.	A,B	General dilution ventilation;local exhaust ventilation
3.	Inhalation of vapor and skin contact with liquid during use as a stabilizer for rubber latex	A,B	General dilution ventilation; local exhaust ventilation; personal protective equipment (respiratory protective devices, gloves, aprons and goggles)
4.	Inhalation of vapor and skin contact with liquid during manufacture of ethylamine and during maintenance of processing equipment. Ethylamine is manufactured either from ethanol and ammonia or ethyl chloride and ammonia.	A,B	General dilution ventilation; local exhaust ventilation; personal protective equipment (respiratory protective devices, gloves, aprons and goggles)
5.	Inhalation of vapor and skin contact with liquid during use as a catalyst for curing epoxy resins	A,B	General dilution ventilation; local exhaust ventilation; personal protective equipment (respiratory protective devices, gloves, aprons and goggles)

6.	Inhalation of vapor and skin contact with liquid during use in the synthesis of dimethylolethyltriazone, a wash and wear agent for cotton fabrics	A,B	General dilution ventilation;local exhaust ventilation
7.	Inhalation of vapor and skin contact with liquid during use in the synthesis of 1,3-diethylthiourea, a corrosion inhibitor	A,B	General dilution ventilation;local exhaust ventilation
8.	Inhalation of vapor and skin contact with liquid during use in the synthesis of n-ethylethanolamine. This compound is used as a solvent and has a chemical intermediate for other organic compounds.	A,B	General dilution ventilation;local exhaust ventilation
9.	Inhalation of vapor and skin contact with liquid during use as a selective solvent in the refining of petroleum and vegetable oils	A,B	General dilution ventilation
10.	Inhalation of vapor and skin contact with liquid during conversion to amides for use as plasticizers and in the refining of lubricating oils	A,B	General dilution ventilation;local exhaust ventilation
11.	Inhalation of vapor and skin contact with liquid during use in the synthesis of alkyl isocyanates. These compounds are subsequently used as intermediates in the manufacture of organic products such as pharmaceuticals and resins.	A,B	General dilution ventilation;local exhaust ventilation

12.	Inhalation of vapor and skin contact with liquid during use in the synthesis of m-ethylaminophenol, an intermediate in the production of rhodamine dyes	A,B	General dilution ventilation;local exhaust ventilation
13.	Inhalation of vapor and skin contact with liquid during use as a deflocculating agent in the ceramics industry	A,B	General dilution ventilation; local exhaust ventilation; personal protective equipment (respiratory protective devices, gloves, aprons and goggles)
14.	Inhalation of vapor and skin contact with liquid during use in the manufacture of detergents	A,B	General dilution ventilation;local exhaust ventilation

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