NIOSH/OSHA STANDARDS COMPLETION PROGRAM

DRAFT TECHNICAL STANDARD AND

SUPPORTING DOCUMENTATION FOR

*** N-ETHYLMORPHOLINE ***

NIOSH/OSHA Draft Technical Standard and Supporting Documentation for N-ETHYLMORPHOLINE

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

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

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

NIOSH/OSHA Draft Technical Standard
and Supporting Documentation for N-ETHYLMORPHOLINE

(a) Definitions. (1) "Permissible exposure" means exposure of employees to airborne concentrations of n-ethylmorpholine not in excess of 20 parts per million (ppm) (94 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 n-ethylmorpholine.

(b) Exposure determination and measurement. (1) Each employer who has a place of employment in which n-ethylmorpholine is released into the workplace air shall determine if any employee may be exposed to airborne concentrations of n-ethylmorpholine at or above the action level. The determination shall be made each time there is a change in production, process, or control measures which could result in an increase in airborne concentrations of n-ethylmorpholine.

(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 n-ethylmorpholine;

(ii) Any measurements of n-ethylmorpholine taken;

(iii) Any employee complaints of symptoms which may be attributable to exposure to n-ethylmorpholine; 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 n-ethylmorpholine 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 n-ethylmorpholine 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 n-ethylmorpholine 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 n-ethylmorpholine 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 n-ethylmorpholine 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 n-ethylmorpholine 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 n-ethylmorpholine above the permissible exposure as defined in paragraph (a)(1) of this section.

(2) Employee exposures to airborne concentrations of n-ethylmorpholine 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 n-ethylmorpholine.

(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 n-ethylmorpholine 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 n-ETHYLMORPHOLINE

CONDITION	PERMISSIBLE RESPIRATORY PROTECTION
Vapor Concentration	
1000 ppm or less	Any supplied-air respirator with a full facepiece, helmet or hood. Any self-contained breathing apparatus with a full facepiece.
2000 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 2000 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.
Fire Fighting	Self-contained breathing apparatus with a full facepiece operated in pressure-demand or other positive pressure mode.
Escape	Any gas mask providing protection against organic vapors.

	Any escape self-contained breathing apparatus.

(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 n-ethylmorpholine.

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

(3) For the purpose of compliance with § 1910.157, n-ethylmorpholine 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 n-ethylmorpholine shall be Class I, Group C.

(5) For the purpose of compliance with § 1910.106, liquid n-ethylmorpholine is classified as a Class IC flammable liquid.

(6) Where a fan is located in ductwork and where n-ethylmorpholine is present in the ductwork in concentrations greater than 2500 ppm (approximately 25 percent 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 n-ethylmorpholine presents a fire or explosion hazard.

(8) n-Ethylmorpholine 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 repeated or prolonged skin contact with liquid n-ethylmorpholine. Face shields shall comply with § 1910.133(a)(2),(a)(4), (a)(5), and (a)(6).

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

(3) Where exposure of an employee's body to liquid n-ethylmorpholine 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 n-ethylmorpholine be removed promptly and not reworn until the n-ethylmorpholine is removed from the clothing.

(5) Employers shall ensure that clothing which becomes wet with liquid n-ethylmorpholine be removed immediately and not reworn until the n-ethylmorpholine 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 n-ethylmorpholine or solutions containing n-ethylmorpholine contacting the eyes.

(7) Where there is any possibility that an employee's eyes may be exposed to liquid n-ethylmorpholine or solutions containing more than 15% n-ethylmorpholine 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 n-ethylmorpholine is spilled the employer shall immediately eliminate potential sources of ignition, provide available ventilation and then clean up the spill.

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

(h) Sanitation. (1) Employers shall ensure that employees whose skin becomes contaminated with n-ethylmorpholine promptly wash or shower to remove any n-ethylmorpholine from the skin.

(2) Employers shall ensure that employees who handle liquid n-ethylmorpholine wash their hands thoroughly before eating, smoking or using toilet facilities.

(i) Training and information. (1) Each employer who has a workplace in which n-ethylmorpholine 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 n-ethylmorpholine above the action level or employees who may have skin or eye contact with liquid n-ethylmorpholine or solutions containing n-ethylmorpholine, or employees who work where n-ethylmorpholine presents a fire or explosion hazard, shall annually:

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

(ii) Advise affected employees as to the signs and symptoms of exposure to n-ethylmorpholine.

(iii) Instruct affected employees to advise the employer of the development of signs and symptoms of exposure to n-ethylmorpholine 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 n-ethylmorpholine.

(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 n-ethylmorpholine or airborne concentrations of n-ethylmorpholine 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) Eye disease

(iii) liver disease

(iv) Kidney 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 n-ethylmorpholine which are listed in Appendix A which the employee suspects are caused by exposure to n-ethylmorpholine.

(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 n-ethylmorpholine;

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

(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 n-ethylmorpholine or would directly or indirectly aggravate any detected medical condition;

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

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

(7) No employee shall be exposed to liquid n-ethylmorpholine or airborne concentrations of n-ethylmorpholine 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 n-ethylmorpholine.

(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 n-ethylmorpholine.

(ii) This record shall include:

(A) The date of measurement;

(B) Operations involving exposure to n-ethylmorpholine 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 n-ethylmorpholine;

(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 n-ethylmorpholine which is conducted pursuant to this section.

(2) When observation of measurement of employee exposure to n-ethylmorpholine 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 n-ethylmorpholine 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

NIOSH/OSHA Draft Technical Standard
and Supporting Documentation for N-ETHYLMORPHOLINE

SUBSTANCE SAFETY DATA SHEET
FOR n-ETHYLMORPHOLINE

I. SUBSTANCE IDENTIFICATION

A. Substance: n-Ethylmorpholine

B. Permissible Exposure: 20 parts of n-ethylmorpholine per million parts of air (ppm) (94 milligrams of n-ethylmorpholine per cubic meter of air, (mg/M3)) averaged over an eight-hour work shift.

C. Appearance and Odor: Colorless liquid with an ammonia-like odor.

II. HEALTH HAZARD DATA

A. Ways in Which the Chemical Affects Your Body: n-Ethylmorpholine 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: n-Ethylmorpholine may cause irritation of the eyes, nose and throat. Eye exposure may result in foggy vision and seeing halos around lights.

2. Long-Term Exposure: Not known.

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 n-ethylmorpholine.

III. EMERGENCY FIRST AID PROCEDURES

A. Eye Exposure: If n-ethylmorpholine or solutions containing n-ethylmorpholine get into your eyes, wash the 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 n-ethylmorpholine gets on your skin promptly flush the contaminated skin with water. If n-ethylmorpholine soaks through your clothing, remove the clothing immediately and flush the skin with water.

C. Breathing: If you or any other person breathes in large amounts of n-ethylmorpholine 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 n-ethylmorpholine 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 n-ethylmorpholine. 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 n-ethylmorpholine while wearing a respirator, the respirator is not working correctly; go immediately to fresh air. If you experience difficulty breathing while wearing a respirator, tell your employer.

B. Protective Clothing: You must wear impervious clothing, gloves, face shield or other appropriate protective clothing to prevent repeated or prolonged skin contact with liquid n-ethylmorpholine. Replace or repair impervious clothing that has developed leaks.

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

V. PRECAUTIONS FOR SAFE USE, HANDLING AND STORAGE

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

B. n-Ethylmorpholine 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 n-ethylmorpholine is handled, used or stored in a manner that could create a potential fire or explosion hazard.

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

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

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

G. If your skin becomes contaminated with n-ethylmorpholine, you must promptly wash or shower to remove the n-ethylmorpholine from your skin.

H. If you handle liquid n-ethylmorpholine, you must wash your hands thoroughly with water before eating, smoking or using toilet facilites.

I. 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.

J. Ask your supervisor where n-ethylmorpholine 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 n-ethylmorpholine. In addition, your employer must instruct you in the safe use of n-ethylmorpholine, emergency procedures, and the correct use of protective equipment.

B. Your employer is required to determine whether you are being exposed to n-ethylmorpholine. 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 n-ETHYLMORPHOLINE

I. PHYSICAL AND CHEMICAL DATA

A. Substance Identification

1. Synonyms: 4-ethylmorpholine
2. Formula: C6H13ON
3. Molecular weight: 115.2

B. Physical Data

1. Boiling point (760 mm Hg): 138.6 C (281 F)
2. Specific gravity (water = 1): 0.91

3. Vapor density (air = 1 at boiling point of n-ethylamorpholine): 4.0
4. Melting point: -63 C (-81 F)
5. Vapor pressure at 20 C (68 F): 5 mm Hg
6. Solubility in water, % by weight at 20 C (68 F): Miscible in all proportions
7. Evaporation rate (butyl acetate = 1): 0.8
8. Appearance and odor: Colorless liquid with an ammonia-like odor

II. FIRE, EXPLOSION AND REACTIVITY HAZARD DATA

A. Fire

1. Flash point: 32.2 C (90 F) (closed cup)
2. Autoignition temperature: 185 C (365 F)
3. Flammable limits in air, % by volume: Lower: 1.0; Upper: 9.8
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: n-Ethylmorpholine is a flammable liquid. Its vapors can easily form explosive mixtures with air. All ignition sources must be controlled where n-ethylmorpholine is handled, used or stored in a manner that could create a potential fire or explosion hazard. n-Ethylmorpholine vapors are heavier than air and may travel along the ground and be ignited by open flames or sparks at locations remote from the site at which n-ethylmorpholine is handled.
7. For purposes of conforming with the requirements of 29 CFR 1910.106, n-ethylmorpholine is classified as a Class IC flammable liquid. For example, 2500 ppm, one-fourth of the lower flammable limit, is one situation in which n-ethylmorpholine 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 n-ethylmorpholine shall be Class I, Group C.

B. Reactivity

1. Conditions contributing to instability: Heat.
2. Incompatibilities: Contact of 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 ammonia, oxides of nitrogen and carbon monoxide) may be released in a fire involving n-ethylmorpholine.
4. Special precautions: Liquid n-ethylmorpholine will attack some forms of plastics, rubber and coatings.

III. SPILL, LEAK, AND DISPOSAL PROCEDURES

A. If n-ethylmorpholine 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). Allow sufficient time for vapors to completely clear hood ductwork, then burn the paper. Large quantities can be collected and atomized in a suitable combustion chamber equipped with an appropriate effluent gas cleaning device. n-Ethylmorpholine may not be allowed to enter a confined space, such as a sewer, because of the possibility of an explosion.

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

C. Waste disposal methods: n-Ethylmorpholine may be disposed of by atomizing in a suitable combustion chamber equipped with an appropriate effluent gas cleaning device.

IV. MONITORING AND MEASUREMENT PROCEDURES

A. EXPOSURE ABOVE THE ACTION LEVEL: Measurements taken for the purpose of determining employee exposure under this section are best taken 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 n-ethylmorpholine 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 n-ethylmorpholine 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 n-ethylmorpholine in tightly closed containers in a cool, well ventilated area.

B. High exposures to n-ethylmorpholine can occur when transferring the liquid from one container to another.

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

D. Employers should advise employees of all areas and operations where exposure to n-ethylmorpholine could occur.

VI. COMMON OPERATIONS

Common operations in which exposure to n-ethylmorpholine is likely to occur are: during its production and its use as a catalyst for the production of polyester and polyurethane foamed plastics; in polymer technology; and in the manufacture of pharmaceuticals, dyes, and in organic synthesis.

APPENDIX C - MEDICAL SURVEILLANCE GUIDELINES

I. ROUTE OF ENTRY

Inhalation; skin absorption.

II. TOXICOLOGY

n-Ethylmorpholine vapor causes visual disturbances and is an irritant to mucous membranes. Some rats died after exposure to 2000 ppm for 4 hours. In an experimental study, humans exposed to 100 ppm for 2 1/2 minutes experienced irritation of eyes, nose and throat, while 50 ppm produced lesser irritation. Workers exposed to low vapor concentrations for several hours reported temporarily fogged vision with rings around lights; corneal edema was observed; this effect is thought to occur when air concentrations of substituted morpholines are 40 ppm or higher; the symptoms usually appear at the end of the work day and clear within 3 to 4 hours after cessation of exposure. The liquid when placed into the eye of a rabbit caused corneal haziness, sloughing and irregularities of the surface, characteristic of severe desiccation. On the skin of a rabbit, the undiluted liquid produced no reaction, unlike unsubstituted morpholine, which is a severe skin irritant.

III. SIGNS AND SYMPTOMS

Eye, nose and throat irritation; visual aberrations; severe eye irritation from splashes.

IV. SPECIAL TESTS

None in common usage.

V. TREATMENT

Remove from exposure. Immediately flush eyes and skin with water. If swallowed and the person is conscious, immediately administer water by mouth and induce vomiting. Give artificial resuscitation if indicated. Recovery is usually rapid and complete.

VI. SURVEILLANCE AND PREVENTIVE CONSIDERATIONS

A. GENERAL

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

B. PREPLACEMENT

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

1. Chronic respiratory disease -- In persons with impaired pulmonary function, especially those with obstructive airway diseases, the breathing of n-ethylmorpholine might cause exacerbation of symptoms due to its irritant properties.

2. Eye disease -- n-Ethylmorpholine 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. Liver disease -- Although n-Ethylmorpholine 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.

4. Kidney disease -- Although n-Ethylmorpholine 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.

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: "n-Ethylmorpholine," Documentation of the Threshold Limit Values for Substances in Workroom Air (3d ed., 2d printing), Cincinnati, 1974, p. 113.

2. Patty, Frank A.: Industrial Hygiene and Toxicology, Vol. II - Toxicology (2d ed. revised), Interscience Publishing Company, New York, 1963, pp. 2204-2205.

3. Dernehl, C.U.: "Health Hazards Associated with Polyurethane Foams," Journal of Occupational Medicine, 8:59-62, 1966.

4. Mellerio, J. and R.A. Weale: "Miscellanea: Hazy Vision in Amine Plant Operatives," British Journal of Industrial Medicine, 23:153-154, 1966.

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REFERENCES AND SOURCES
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(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. 31.

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

Eyes: "n-Ethylmorpholine," Jefferson Chemical Co.; Grant, "Toxicology of the Eye;" Carpenter, Charles and Smyth, Henry, "Chemical Burns of the Rabbit Cornea," Am. J. Opth., 29, 1363 - 72, 1946

Skin: "Industrial Hygiene and Toxicology;" Smyth et al., "Range Finding Toxicity Data," J. Ind. Hyg. Toxicol., 31, 60, 1949; "Documentation of TLV"

Ingestion: "Documentation of TLV;" Patty, "Industrial Hygiene and Toxicology"

COMMENTS

Eyes - 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 n-ethylmorpholine.

Jefferson reports that n-ethylmorpholine is a severe eye irritant and overexposure results in "hazy vision as a film over the eye." Grant notes "applying a drop (of undiluted n-ethylmorpholine) to a rabbit's eye causes the cornea to become hazy in about five minutes and the epithelium to slough from the surface." The degree of corneal injury in rabbit eyes is graded 7 on a scale of 10 after 24 hours. According to Smyth et al., grade 7 i an excess of 15% solution causes less than severe injury after 24 hours and that a 40% solution causes severe injury.

Since there are sufficient data on this substance to make a distinction, the pure substance and solutions greater than 15% in strength are given a classification of 1. More dilute solutions are assigned a classification of 2. It is to be noted that another concentration between 15 and 40% may be more technically correct for this differentation, but data do not presently exist to support a value higher than 15%.

Skin - Classification: 2
Output statement numbers: 2, 7a, 8b, 17g, 17i, 20a, 21
Exceptions: See below

Patty reports that n-ethylmorpholine, a fat soluble amine, is absorbed through the intact skin. In tests done on the clipped skin of (albino) rabbits, a 24-hour application of 0.01 ml of n-ethylmorpholine gave a grade 1 injury on a scale of 1 to 10. According to Smyth et al. "grade 1 indicates the least visible capillary injection from the undiluted chemical." The Documentation of TLV's has the notation "skin" after the name of the

compound, thus indicating that it is absorbed through the skin. By analogy to n-methylmorpholine, which has a rabbit skin penetration LD50 of 1.35 ml/kg, and n-aminoethylmorpholine, which has one of 0.3 ml/kg as reported by Patty, it can be safely assumed that n-ethylmorpholine has a LD50 of less than 3 ml/kg. The substance is miscible in all proportions with water. It has a vapor pressure at 20 C of 5 mm Hg and a flash point of 90 F.

The capability of this substance to be at least somewhat readily absorbed through the skin indicates that a classification of 2 is appropriate if statements 17g and 17i are used and if statement 8b is included for "extensive" exposures.

Ingestion - Classification: 2
Output statement numbers: 20a
Exceptions: None

The Documentation of TLV's notes an oral rat LD50 of 1.78 g/kg (1.49 - 2.12 g/kg) after 14 days. Ingestion results in "irritation of the intestinal tract with hemorrhage . . . and some indication of liver and kidney injury, clouding and congestion." The moderately toxic nature of the substance leads to the conclusion that a classification of 2 is appropriate.

SUBSTANCE TECHNICAL GUIDELINES

The references cited for this document include:

National Fire Protection Association, "Fire Protection Guide on Hazardous Materials," 5th edition, 1973 (NFPA)
Jefferson Chemical Co., "Thancot MEM Catalyst," Data Sheet and Material Safety Data Sheet (Jeff)
Union Carbide Corp., Material Safety Data Sheet and "Chemicals and Plastics - Physical Properties," 1974 (UCC)
Kirk-Othmer, "Encyclopedia of Chemical Technology," 2nd edition, Vol. 13, p. 667 (K-O)

Sources of data items used:

1. A. 1. Synonyms: NFPA-325M
2. Formula: NFPA-325M
3. Molecular weight: UCC

B. 1. Boiling point: UCC
2. Specific gravity: NFPA-325M; Jeff; UCC
3. Vapor density: NFPA-325M
4. Melting point: Jeff; UCC
5. Vapor pressure: Jeff; UCC
6. Solubility in water: Jeff; UCC
7. Evaporation rate: Jeff (UCC reports 0.65)
8. Appearance and odor: Jeff

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

B. 1. Conditions contributing to instability: UCC
2. Incompatibilities: UCC
3. Hazardous decomposition products: Jeff; UCC
4. Special precautions: ADL

III. A. Steps if released or spilled: Jeff; UCC
C. Waste disposal method: Jeff; UCC; ADL

V. Miscellaneous precautions: ADL

USE/EXPOSURE AND CONTROL DOCUMENT

References used in the preparation of this document include:

Benning, C. J. "Plastic Foams," Vol. 1, Interscience, 1969 (Benning)
Chemical Abstracts 41-50 (1947-56); 51-55 (1957-61); 56-65 (1962-66); 66-75 (1967-71; 79 (1973); 80 (1974), Chemical Abstracts Service (CA)
"n-Ethylmorpholine," Hazard Process Index, Hazard Entry No. 132, NIOSH-HSM-99-73-62 (HPI)
"n-Ethylmorpholine," Jefferson Chemical Co., "Thancat Amine Catalysts for the Urethane Industry, Thancat NEM Catalyst," (Jefferson Thancat)
"n-Ethylmorpholine," Jefferson Chemical Co., Material Safety Data Sheet, February 3, 1972 (Jefferson MSDS)
"n-Ethylmorpholine," Union Carbide Material Safety Data Sheet (Carbide MSDS)
Hawley, G. G., "The Condensed Chemical Dictionary," 8th edition, Van Nostrand-Reinhold, 1971 (Hawley)
International Labour Organization, "Encyclopedia of Occupational Health and Safety," Geneva, 1972 (ILO)
Kirk, R., and Othmer, D., "Encyclopedia of Chemical Technology," Interscience, 2nd ed., 1972 (K-O)
Mark, H. F., Gaylord, N. G., Bikales, N. M., "Encyclopedia of Polymer Science and Technology," Interscience, 1964 (Polymer Sci)
Patty, F. A., "Industrial Hygiene and Toxicology," Vol. 11, Interscience, 1962 (Patty)
Stanford Research Institute, "Chemical Economics Handbook," Menlo Park, California (SRI)
Wiley, R. H., ed., "Chemistry of Heterocyclic Compounds, Five-and-Six-Membered Compounds with Nitrogen and Oxygen," Interscience, 1962 (Wiley)

References for Specific Use/Exposure

1. K-O, HPI, CA, Polymer Sci, Hawley, SRI, Jefferson Thancat
2. Benning, HPI, CA, Wiley
3. CA, Jefferson Thancat, K-O
4. Hawley, CA
5. Hawley, CA
6. Hawley, CA

References for Control Methods

Patty, Hawley, ILO, Jefferson Thancat, Jefferson MSDS, Carbide MSDS

RESPIRATOR TABLE DOCUMENTATION

SUBSTANCE: n-Ethylmorpholine

D. O. L. STANDARD: 20 ppm

WARNING PROPERTIES:

Odor Threshold: According to the Documentation of TLV's, in a study with human volunteers, at 25 ppm the ammonia odor of n-ethylmorpholine is noticeable. The odor becomes stronger at higher concentrations, but olfactory fatigue occurs.

Eye Irritation Level: Grant reports the occurrence of "transient

edema of the corneal epithelium in workers exposed to 40 ppm or more in air during the work day."

The Documentation of TLV's reports that eye irritation was noted in human volunteers exposed to 100 ppm n-ethylmorpholine for 2 1/2 minutes. "Slight if any irritation" occurred at 50 ppm.

Other Information: The Documentation of TLV's reports that nose and throat irritation also occurred among human volunteers exposed to 100 ppm n-ethylmorpholine for 2 1/2 minutes. "Slight if any irritation" occurred at 50 ppm.

Evaluation of Warning Properties: Since olfactory fatigue occurs during exposure to n-ethylmorpholine, odor is not considered to be a good warning property. In addition, since irritation does not definitely occur until a concentration which is several times greater than the permissible exposure limit, n-ethylmorpholine is treated as a material with poor warning properties. Gas sorbent respiratory equipment is not permitted.

IDLH: 2000 ppm

Basis for IDLH Value: This IDLH is based upon the statement in the Documentation of TLV's that 1 out of 6 rats died following a 4-hour exposure to 2000 ppm n-ethylmorpholine.

Other Toxicological Information: Very little information is available concerning the acute inhalation toxicity of n-ethylmorpholine. The Documentation of TLV's notes that 1 out of 6 rats died following a 4-hour exposure to 2000 ppm n-ethylmorpholine.

LFL: 10,000 ppm

VAPOR PRESSURE: 5 mm Hg at 20 deg. C.

SATURATED CONCENTRATION AT 20 DEG. C.: 6600 ppm

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	Use/Exposure	Principal Route of Entry	Currently Used Control Methods
1.	Inhalation of vapor and skin contact with liquid during use as catalyst for flexible, semi-flexible, and rigid polyurethane foam production.	A,B,D	Local exhaust ventilation; personal protective equipment (gloves, goggles, protective clothing)
2.	Inhalation of vapor and skin contact with liquid during manufacture and distribution of n-ethylmorpholine and during maintenance of storage containers	A,B,D	Local exhaust ventilation; personal protective equipment (gloves, goggles, protective clothing)
3.	Inhalation of vapor and skin contact with liquid during use in polymer technology (as promoter for resin surface curing, as stabilizer for fiber spinning solutions	A,B,D	Local exhaust ventilation; personal protective equipment (gloves, goggles, protective clothing)
4.	Inhalation of vapor and skin contact with liquid during use in the manufacture of vat dyes	A,B,D	Local exhaust ventilation; personal protective equipment (gloves, goggles, protective clothing)
5.	Inhalation of vapor and skin contact with liquid during use in the manufacture of pharmaceuticals (used for purification of Penicillin G)	A,B,D	Local exhaust ventilation; personal protective equipment (gloves, goggles, protective clothing)
6.	Inhalation of vapor and skin contact with liquid during use in organic synthesis (as special solvent, pH regulator, for preparation of chemical intermediates)	A,B,D	Local exhaust ventilation; personal protective equipment (gloves, goggles, protective clothing)

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

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systemic poisoning