

Occupational Health Guideline for n-Ethylmorpholine

INTRODUCTION

This guideline is intended as a source of information for employees, employers, physicians, industrial hygienists, and other occupational health professionals who may have a need for such information. It does not attempt to present all data; rather, it presents pertinent information and data in summary form.

SUBSTANCE IDENTIFICATION

- Formula: $C_6H_{12}ON$
- Synonyms: 4-Ethylmorpholine
- Appearance and odor: Colorless liquid with an ammonia-like odor.

PERMISSIBLE EXPOSURE LIMIT (PEL)

The current OSHA standard for N-ethylmorpholine is 20 parts of N-ethylmorpholine per million parts of air (ppm) averaged over an eight-hour work shift. This may also be expressed as 94 milligrams of N-ethylmorpholine per cubic meter of air (mg/m^3).

HEALTH HAZARD INFORMATION

• Routes of exposure

n-Ethylmorpholine can affect the body if it is inhaled, comes in contact with the eyes or skin, or is swallowed. It may enter the body through the skin.

• 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:* None known.

3. *Reporting Signs and Symptoms:* A physician should be contacted if anyone develops any signs or symptoms and suspects that they are caused by exposure to N-ethylmorpholine.

• Recommended medical surveillance

The following medical procedures should be made available to each employee who is exposed to n-ethylmorpholine at potentially hazardous levels:

1. *Initial Medical Screening:* Employees should be screened for history of certain medical conditions (listed below) which might place the employee at increased risk from n-ethylmorpholine exposure.

—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.

—Eye disease: n-Ethylmorpholine is an eye irritant and has caused corneal edema in workers. Persons with pre-existing eye disorders may be more susceptible to the effects of this agent.

—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.

—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.

2. *Periodic Medical Examination:* Any employee developing the above-listed conditions should be referred for further medical examination.

• Summary of toxicology

n-Ethylmorpholine vapor causes visual disturbances and irritates mucous membranes. Some rats died after exposure to 2000 ppm for 4 hours. In an experimental study, humans exposed to 100 ppm for 2-½ 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

These recommendations reflect good industrial hygiene and medical surveillance practices and their implementation will assist in achieving an effective occupational health program. However, they may not be sufficient to achieve compliance with all requirements of OSHA regulations.

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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.

CHEMICAL AND PHYSICAL PROPERTIES

• Physical data

1. Molecular weight: 115.2
2. Boiling point (760 mm Hg): 138.6 C (281 F)
3. Specific gravity (water = 1): 0.91
4. Vapor density (air = 1 at boiling point of N-ethylmorpholine): 4.0
5. Melting point: -63 C (-81 F)
6. Vapor pressure at 20 C (68 F): 5 mm Hg
7. Solubility in water, g/100 g water at 20 C (68 F):

Miscible in all proportions

8. Evaporation rate (butyl acetate = 1): 0.8

• Reactivity

1. Conditions contributing to instability: Heat
2. Incompatibilities: Contact of liquid N-ethylmorpholine 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.

• Flammability

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. Extinguishant: Alcohol foam, carbon dioxide, dry chemical

• Warning properties

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

2. 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 2-½ minutes. "Slight if any irritation" occurred at 50 ppm.

3. Other Information: The *Documentation of TLV's* reports that nose and throat irritation also occurred among human volunteers exposed to 100 ppm N-ethyl-

morpholine for 2-½ minutes. "Slight if any irritation" occurred at 50 ppm.

4. 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 several times greater than the permissible exposure limit, N-ethylmorpholine is treated as a material with poor warning properties.

MONITORING AND MEASUREMENT PROCEDURES

• General

Measurements to determine employee exposure are best taken so that the average eight-hour exposure is based on a single eight-hour sample or on two four-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).

• Method

Sampling and analyses may be performed by collection of N-ethylmorpholine in an adsorption tube containing silica gel, followed by desorption with sulfuric acid, and gas chromatographic analysis. Also, detector tubes certified by NIOSH under 42 CFR Part 84 or other direct-reading devices calibrated to measure N-ethylmorpholine may be used. An analytical method for N-ethylmorpholine is in the *NIOSH Manual of Analytical Methods*, 2nd Ed., Vol. 2, 1977, available from the Government Printing Office, Washington, D.C. 20402 (GPO No. 017-033-00260-6).

RESPIRATORS

• Good industrial hygiene practices recommend that engineering controls be used to reduce environmental concentrations to the permissible exposure level. However, there are some exceptions where respirators may be used to control exposure. Respirators may be used when engineering and work practice controls are not technically feasible, when such controls are in the process of being installed, or when they fail and need to be supplemented. Respirators may also be used for operations which require entry into tanks or closed vessels, and in emergency situations. If the use of respirators is necessary, the only respirators permitted are those that have been approved by the Mine Safety and Health Administration (formerly Mining Enforcement and Safety Administration) or by the National Institute for Occupational Safety and Health.

• In addition to respirator selection, a complete respiratory protection program should be instituted which includes regular training, maintenance, inspection, cleaning, and evaluation.

PERSONAL PROTECTIVE EQUIPMENT

- Employees should be provided with and required to 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.
- Clothing contaminated with N-ethylmorpholine should be placed in closed containers for storage until it can be discarded or until provision is made 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 person performing the operation should be informed of N-ethylmorpholine's hazardous properties.
- Where exposure of an employee's body to liquid N-ethylmorpholine may occur, facilities for quick drenching of the body should be provided within the immediate work area for emergency use.
- Non-impervious clothing which becomes contaminated with N-ethylmorpholine should be removed promptly and not reworn until the N-ethylmorpholine is removed from the clothing.
- Any clothing which becomes wet with liquid N-ethylmorpholine should be removed immediately and not reworn until the N-ethylmorpholine is removed from the clothing.
- Employees should be provided with and required to use splash-proof safety goggles where there is any possibility of liquid N-ethylmorpholine or solutions containing N-ethylmorpholine contacting the eyes.
- Where there is any possibility that employees' eyes may be exposed to N-ethylmorpholine or solutions containing more than 15% N-ethylmorpholine by weight, an eye-wash fountain should be provided within the immediate work area for emergency use.

SANITATION

- Skin that becomes contaminated with N-ethylmorpholine should be promptly washed or showered to remove any N-ethylmorpholine.
- Employees who handle liquid N-ethylmorpholine should wash their hands thoroughly before eating, smoking, or using toilet facilities.

COMMON OPERATIONS AND CONTROLS

The following list includes some common operations in which exposure to N-ethylmorpholine may occur and control methods which may be effective in each case:

Operation

Controls

Use as a catalyst for flexible, semi-flexible, and rigid polyurethane foam production

Local exhaust ventilation; personal protective equipment

Use in polymer technology as a promoter for resin surface curing, and as a stabilizer for fiber spinning solutions

Local exhaust ventilation; personal protective equipment

Use in manufacture of vat dyes; use in manufacture of pharmaceuticals in purification of Penicillin G

Local exhaust ventilation; personal protective equipment

Use in organic synthesis as a special solvent, pH regulator, and for preparation of chemical intermediates

Local exhaust ventilation; personal protective equipment

EMERGENCY FIRST AID PROCEDURES

In the event of an emergency, institute first aid procedures and send for first aid or medical assistance.

• Eye Exposure

If N-ethylmorpholine or solutions containing N-ethylmorpholine get into the eyes, wash 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.

• Skin Exposure

If N-ethylmorpholine gets on the skin, promptly flush the contaminated skin with water. If N-ethylmorpholine soaks through the clothing, remove the clothing immediately and flush the skin with water.

• Breathing

If a 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.

• 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.

• Rescue

Move the 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. Under-

stand the facility's emergency rescue procedures and know the locations of rescue equipment before the need arises.

SPILL, LEAK, AND DISPOSAL PROCEDURES

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

- 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 evaporating vapors to completely clear the hood ductwork. Burn the paper in a suitable location away from combustible materials. Large quantities can be collected and atomized in a suitable combustion chamber equipped with an appropriate effluent gas cleaning device. n-Ethylmorpholine should not be allowed to enter a confined space, such as a sewer, because of the possibility of an explosion.

- Waste disposal method:

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

ADDITIONAL INFORMATION

To find additional information on N-ethylmorpholine, look up N-ethylmorpholine in the following documents:

- Medical Surveillance for Chemical Hazards
- Respiratory Protection for Chemical Hazards
- Personal Protection and Sanitation for Chemical Hazards

These documents are available through the NIOSH Division of Technical Services, 4676 Columbia Parkway, Cincinnati, Ohio 45226.

REFERENCES

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RESPIRATORY PROTECTION FOR N-ETHYLMORPHOLINE

| Condition | Minimum Respiratory Protection* Required Above 20 ppm |
|---|---|
| <i>Vapor Concentration</i> | |
| 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. |

*Only NIOSH-approved or MSHA-approved equipment should be used.