

# Occupational Health Guideline for Ethylenediamine

## 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:  $\text{NH}_2\text{CH}_2\text{CH}_2\text{NH}_2$
- Synonyms: 1,2-Diaminoethane; ethylenediamine, anhydrous; 1,2-ethanediamine
- Appearance and odor: Colorless liquid or solid with an ammonia-like odor.

## PERMISSIBLE EXPOSURE LIMIT (PEL)

The current OSHA standard for ethylenediamine is 10 parts of ethylenediamine per million parts of air (ppm) averaged over an eight-hour work shift. This may also be expressed as 25 milligrams of ethylenediamine per cubic meter of air ( $\text{mg}/\text{m}^3$ ).

## HEALTH HAZARD INFORMATION

### • Routes of exposure

Ethylenediamine 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:** Ethylenediamine vapors may cause irritation of the eyes, nose, and throat. If splashed on the skin, it may cause severe irritation, skin damage, and blistering. If splashed in the eyes, it may cause damage. It may cause tingling of the face.

**2. Long-term Exposure:** Repeated or prolonged overexposure to ethylenediamine may cause dermatitis. A person may become allergic to ethylenediamine (skin rash and asthma). Liver, kidney, and lung damage may occur from repeated exposure to this chemical.

**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 ethylenediamine.

### • Recommended medical surveillance

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

#### 1. Initial Medical Examination:

—A complete history and physical examination: The purpose is to detect pre-existing conditions that might place the exposed employee at increased risk, and to establish a baseline for future health monitoring. Persons with a history of asthma, allergies, or known sensitization to ethylenediamine would be expected to be at increased risk from exposure. Examination of the respiratory system, liver, and kidneys should be stressed. The skin should be examined for evidence of chronic disorders.

**2. Periodic Medical Examination:** The aforementioned medical examinations should be repeated on an annual basis.

### • Summary of toxicology

Ethylenediamine vapor is a sensitizer and primary irritant to the skin, mucous membranes, and respiratory tract. Exposure of rats to 4000 ppm for 8 hours was uniformly fatal as a result of kidney injury, although some lung injury also occurred; 2000 ppm was not lethal. Rats exposed daily for 30 days to 484 ppm did not survive; injury to lungs, liver, and kidneys was observed; at 132 ppm there was no mortality. In human subjects, inhalation of 400 ppm for 5 to 10 seconds caused intolerable nasal irritation; 200 ppm caused tingling of the face and slight nasal irritation; 100 ppm was not irritating. In the eye of a rabbit the liquid caused extreme irritation and corneal damage; partial corneal opacity was produced by a 5% solution. The undiluted liquid applied to the shaved skin of rabbits and left uncovered produced severe irritation and ne-

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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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crossis. Cutaneous sensitization in man has been observed.

## CHEMICAL AND PHYSICAL PROPERTIES

### • Physical data

1. Molecular weight: 60.1
2. Boiling point (760 mm Hg): 117 C (242 F)
3. Specific gravity (water = 1): 0.91
4. Vapor density (air = 1 at boiling point of ethylenediamine): 2.1
5. Melting point: 11 C (52 F)
6. Vapor pressure at 20 C (68 F): 10 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): 0.91

### • Reactivity

1. Conditions contributing to instability: Heat
2. Incompatibilities: Contact of liquid ethylenediamine with strong acids will cause violent spattering. Contact with strong oxidizers and chlorinated organic compounds 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 ethylenediamine.

4. Special precautions: Liquid ethylenediamine will attack some forms of plastics, rubber, and coatings.

### • Flammability

1. Flash point: 34 C (93 F) (closed cup)
2. Autoignition temperature: 379.4 C (715 F)
3. Flammable limits in air, % by volume: Lower: 5.8; Upper: 11.1

4. Extinguishant: Alcohol foam, carbon dioxide, dry chemical

### • Warning properties

1. Odor Threshold: The AIHA *Hygienic Guide* states that the ammonia-like odor of ethylenediamine is detectable at 10 ppm.

2. Eye Irritation Level: Grant notes that "workmen exposed to ethylenediamine are said occasionally to see haloes around objects and to have some blurring of vision, presumably attributable to an effect on the corneal epithelium." Grant does not give any quantitative information, however.

The *Hygienic Guide* reports that ethylenediamine vapor causes eye irritation, but the exact concentrations producing the irritation are not given. They also state that "a chemical cartridge respirator with a cartridge designed for amine vapors may be used for protection against concentrations of ethylenediamine that do not cause eye irritation."

3. Other Information: The *Documentation of TLV's* states that "human subjects found 100 ppm for a few seconds to be inoffensive, but higher concentrations, 200 and 400 ppm, produced noticeable irritation of the nasal mucosa."

4. Evaluation of Warning Properties: Since the odor of ethylenediamine is noticeable at the permissible expo-

sure, this material is treated as a substance with adequate 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

An analytical method for ethylenediamine is in the *NIOSH Manual of Analytical Methods*, 2nd Ed., Vol. 4, 1978, available from the Government Printing Office, Washington, D.C. 20402 (GPO No. 017-033-00317-3).

## 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 any possibility of skin contact with solid or liquid ethylenediamine.

- If employees' clothing has had any possibility of being contaminated with solid ethylenediamine, employees should change into uncontaminated clothing before leaving the work premises.

- Clothing which has had any possibility of being contaminated with solid or liquid ethylenediamine should be placed in closed containers for storage until it can be discarded or until provision is made for the removal of ethylenediamine from the clothing. If the

clothing is to be laundered or otherwise cleaned to remove the ethylenediamine, the person performing the operation should be informed of ethylenediamine's hazardous properties.

- Where there is any possibility of exposure of an employee's body to solid or liquid ethylenediamine, facilities for quick drenching of the body should be provided within the immediate work area for emergency use.
- Any clothing which becomes wet with liquid ethylenediamine or non-impervious clothing which becomes contaminated with ethylenediamine should be removed immediately and not reworn until the ethylenediamine is removed from the clothing.
- Employees should be provided with and required to use dust- and splash-proof safety goggles where there is any possibility of solid or liquid ethylenediamine or solutions containing ethylenediamine contacting the eyes.
- Where there is any possibility that employees' eyes may be exposed to liquid or solid ethylenediamine or solutions containing more than 5% ethylenediamine by weight, an eye-wash fountain should be provided within the immediate work area for emergency use.

## SANITATION

- Skin that becomes contaminated with ethylenediamine should be immediately washed or showered to remove any ethylenediamine.
- Workers subject to skin contact with solid or liquid ethylenediamine should wash any areas of the body which may have contacted ethylenediamine at the end of each work day.
- Eating and smoking should not be permitted in areas where solid or liquid ethylenediamine are handled, processed, or stored.
- Employees who handle solid or liquid ethylenediamine 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 ethylenediamine may occur and control methods which may be effective in each case:

### Operation

### Controls

Use in manufacture of carbamate fungicides, pesticides, and weed killers

Local exhaust ventilation; general dilution ventilation; personal protective equipment

Use in manufacture of chelating agents in dyes, soaps, and cleaning compounds, water treatment, in agriculture, in rubber processing, in pulp and paper processing, and in metal cleaning and electroplating

Local exhaust ventilation; general dilution ventilation; personal protective equipment

Use in manufacture of urea resins for use in textile and paper finishing; use in production of textile finishing compounds, resins, rubber products, insecticides, and medicinals

Local exhaust ventilation; general dilution ventilation; personal protective equipment

Use as an activator for epoxy resin menders; in preparation of Spandex, adhesives, inks, surface coatings, cross-linking agents, plasticizers, resins curing compounds, and as a dye assist

Local exhaust ventilation; general dilution ventilation; personal protective equipment

Use in manufacture of surfactants, emulsifying agents, wetting agents, dispersants, corrosion inhibitors, detergents, and textile surface treatments

Local exhaust ventilation; general dilution ventilation; personal protective equipment

Use in organic synthesis for preparation of dye intermediates, heterocyclic compounds, pharmaceuticals, corrosion inhibitors, adhesives, and salts

Local exhaust ventilation; general dilution ventilation; personal protective equipment

Miscellaneous uses in brightening agent for electroplating, anti-tarnish agent in detergents, lubricant stabilizer, soldering fluxes, processing chemicals for rubber, solvent for casein, albumin, shellac, and sulfur

Local exhaust ventilation; general dilution 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 solid or liquid ethylenediamine or solutions containing ethylenediamine 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 solid or liquid ethylenediamine gets on the skin, immediately flush the contaminated skin with water. If solid or liquid ethylenediamine penetrates through the clothing, remove the clothing immediately and flush the skin with water. If irritation persists after washing, get medical attention.

### • Breathing

If a person breathes in large amounts of ethylenediamine, 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 ethylenediamine 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. Understand 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 ethylenediamine is spilled or leaked, the following steps should be taken:

1. Remove all ignition sources.
2. Ventilate area of spill or leak.
3. If in the liquid form, 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. Ethylenediamine should not be allowed to enter a confined space, such as a sewer, because of the possibility of an explosion.

4. If in the solid form, collect, allow to melt, and dispose of the liquid as above.

### • Waste disposal method:

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

## REFERENCES

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## RESPIRATORY PROTECTION FOR ETHYLENEDIAMINE

Condition	Minimum Respiratory Protection* Required Above 10 ppm
Vapor Concentration	
500 ppm or less	A chemical cartridge respirator with a full facepiece and a cartridge(s) providing protection against ethylenediamine.  A gas mask with a chin-style or a front- or back-mounted canister providing protection against ethylenediamine.  Any supplied-air respirator with a full facepiece, helmet, or hood.  Any self-contained breathing apparatus with a full facepiece.
12000 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 ethylenediamine.  Any escape self-contained breathing apparatus.

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

\*\*Use of supplied-air suits may be necessary to prevent skin contact while providing respiratory protection from airborne concentrations of ethylenediamine; however, this equipment should be selected, used, and maintained under the immediate supervision of trained personnel. Where supplied-air suits are used above a concentration of 2000 ppm, an auxiliary self-contained breathing apparatus operated in positive pressure mode should also be worn.