

Occupational Health Guideline for Ethanolamine

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: $\text{HOCH}_2\text{CH}_2\text{NH}_2$
- Synonyms: Ethylolamine; monoethanolamine; beta-aminoethyl alcohol; 2-aminoethanol; 2-hydroxyethylamine
- Appearance and odor: Colorless liquid with a mild ammonia-like odor. It can be a solid below 10.3 C (51 F).

PERMISSIBLE EXPOSURE LIMIT (PEL)

The current OSHA standard for ethanolamine is 3 parts of ethanolamine per million parts of air (ppm) averaged over an eight-hour work shift. This may also be expressed as 6 milligrams of ethanolamine per cubic meter of air (mg/m^3).

HEALTH HAZARD INFORMATION

- **Routes of exposure**
Ethanolamine can affect the body if it is inhaled or if it comes in contact with the eyes or skin. It can also affect the body if it is swallowed.
- **Effects of overexposure**
 1. **Short-term Exposure:** Ethanolamine may cause nose, eye, and skin irritation.
 2. **Long-term Exposure:** Prolonged or repeated skin contact with liquid ethanolamine may cause irritation of the skin.
 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 ethanolamine.

- **Recommended medical surveillance**

The following medical procedures should be made available to each employee who is exposed to ethanolamine 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 ethanolamine exposure.

—Skin disease: Ethanolamine may cause dermatitis on prolonged exposure. Persons with pre-existing skin disorders may be more susceptible to the effects of this agent.

—Liver disease: Ethanolamine causes liver damage in animals and this justifies consideration before exposing persons with impaired liver function.

—Kidney disease: Ethanolamine causes kidney damage in animals and this justifies special consideration before exposing those with impaired renal function.

—Chronic respiratory disease: In persons with impaired pulmonary function, especially those with obstructive airway diseases, the breathing of ethanolamine might cause exacerbation of symptoms.

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

- **Summary of toxicology**

Ethanolamine vapor is a skin, eye, and respiratory irritant, and has significant narcotic properties. In animals exposed repeatedly to 66 to 100 ppm, some animals died during 24 to 30 days of exposure, and all animals were lethargic. Dogs and cats exposed to 2.47 mg/l (990 ppm) for 4 days survived but four of six guinea pigs died from exposure to 0.58 mg/l (233 ppm) for 1 hour; pathologic changes were chiefly those of pulmonary irritation, with some non-specific changes in the liver and kidneys. No mortality or pathology resulted from 90 days of continuous exposure of dogs to 26 ppm, of rats to 12 ppm, or of guinea pigs to 15 ppm. The liquid produced moderate irritation of the skin of rabbits and

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.

U.S. DEPARTMENT OF HEALTH AND HUMAN SERVICES
Public Health Service Centers for Disease Control
National Institute for Occupational Safety and Health

U.S. DEPARTMENT OF LABOR
Occupational Safety and Health Administration

severe irritation in the eyes of rabbits. When applied to human skin for 1-½ hours, marked redness of the skin occurred. No systemic effects from industrial exposure have been reported.

CHEMICAL AND PHYSICAL PROPERTIES

• Physical data

1. Molecular weight: 61.1
2. Boiling point (760 mm Hg): 170 C (338 F)
3. Specific gravity (water = 1): 1.0
4. Vapor density (air = 1 at boiling point of ethanalamine): 2.1
5. Melting point: 10.3 C (51 F)
6. Vapor pressure at 20 C (68 F): Less than 1 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): Less than 1

• Reactivity

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

• Flammability

1. Flash point: 85 C (185 F) (closed cup)
2. Autoignition temperature: 780 C (1436 F)
3. Flammable limits in air, % by volume: Lower: 5.5 (calculated); Upper: 17 (estimated)
4. Extinguishant: Dry chemical, alcohol foam, carbon dioxide

• Warning properties

1. Odor Threshold: Ethanalamine has a mild ammonia-like odor, which the AIHA *Hygienic Guide* reports is noticeable at 2 to 3 ppm.

2. Eye Irritation Level: The *Hygienic Guide* states that ethanalamine is an eye irritant, but do not specify whether both liquid and vapor have this effect. Grant reports that "a drop of ethanalamine applied to rabbit eyes causes injury similar to that caused by ammonia, but slightly less severe." The available literature does not specifically report that the vapor of ethanalamine produces eye irritation. By analogy with ammonia, ethanalamine is treated as an eye irritant for the purposes of this guideline.

3. Other Information: The *Hygienic Guide* reports that ethanalamine is a respiratory tract irritant. The concentrations producing this irritation are not given.

4. Evaluation of Warning Properties: Since ethanalamine has an odor threshold which is at or below the permissible exposure limit, it 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 ethanalamine 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 repeated or prolonged skin contact with liquid or solid ethanalamine.

• If employees' clothing may have become contaminated with solid ethanalamine, employees should change into uncontaminated clothing before leaving the work premises.

• Clothing contaminated with liquid or solid ethanalamine should be placed in closed containers for storage until it can be discarded or until provision is made for the removal of ethanalamine from the clothing. If the clothing is to be laundered or otherwise cleaned to remove the ethanalamine, the person performing the operation should be informed of ethanalamine's hazardous properties.

- Non-impervious clothing which becomes contaminated with liquid or solid ethanolamine should be removed promptly and not reworn until the ethanolamine 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 or solid ethanolamine contacting the eyes.
- Where there is any possibility that employees' eyes may be exposed to liquid or solid ethanolamine, an eye-wash fountain should be provided within the immediate work area for emergency use.

SANITATION

- Skin that becomes contaminated with liquid or solid ethanolamine should be promptly washed or showered to remove any ethanolamine.

COMMON OPERATIONS AND CONTROLS

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

Operation	Controls
Use in production of monoalkanolamides for nonionic detergents, emulsifiers, and soaps; fuel oil additives; water-in-oil emulsifiers; pharmaceuticals; agricultural chemicals; cosmetics; emulsion paints; polishers, and cleansers	Process enclosure; local exhaust ventilation
Use during synthesis of acelethanolamine in manufacture of inks, paper, glues, textiles, and polishes; syntheses of phenylethanolamine for acetate rayon dyes, dyestuffs; synthesis of tolyethanolamine in emulsifiers and dyestuffs	Process enclosure; local exhaust ventilation
Use during synthesis of 2-mercaptothiazole in rubber vulcanization acceleration	Process enclosure; local exhaust ventilation; personal protective equipment

Operation

Use in recovery and removal of acid gases from natural, fuel, and process gas in synthesis of ammonia; use in dry ice manufacture

Controls

Process enclosure; 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 ethanolamine gets 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 ethanolamine gets on the skin, promptly flush the contaminated skin with water. If ethanolamine soaks through the clothing, remove the clothing promptly and flush the skin with water. If irritation persists after washing, get medical attention.

• Breathing

If a person breathes in large amounts of ethanolamine, 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 ethanolamine has been swallowed and the person is conscious, 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 ethanolamine 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 liquid form, 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 reclaimed or collected and atomized in a suitable combustion chamber equipped with an appropriate effluent gas cleaning device.

4. If in solid form, allow to melt and follow (3) above.

• Waste disposal methods:

Ethanolamine may be disposed of:

1. By absorbing it in vermiculite, dry sand, earth or a similar material and disposing in a secured sanitary landfill.

2. By atomizing in a suitable combustion chamber equipped with an appropriate effluent gas cleaning device.

REFERENCES

- American Conference of Governmental Industrial Hygienists: "Ethanolamine," *Documentation of the Threshold Limit Values for Substances in Workroom Air* (3rd ed., 2nd printing), Cincinnati, 1974.
- American Industrial Hygiene Association: "Ethanolamine," *Hygienic Guide Series*, Detroit, Michigan, 1968.
- Christensen, H. E., and Luginbyhl, T. L. (eds.): *NIOSH Toxic Substances List*, 1974 Edition, HEW Publication No. 74-134, 1974.
- Grant, W. M.: *Toxicology of the Eye* (2nd ed.), C. C. Thomas, Springfield, Illinois, 1974.
- Patty, F. A. (ed.): *Toxicology*, Vol. II of *Industrial Hygiene and Toxicology* (2nd ed. rev.), Interscience, New York, 1963.
- Weeks, M. H., et al.: "The Effects of Continuous Exposure of Animals to Ethanolamine Vapor," *Journal of Industrial Hygiene Association*, 21:374-381, 1960.

RESPIRATORY PROTECTION FOR ETHANOLAMINE

Condition	Minimum Respiratory Protection* Required Above 3 ppm
Vapor Concentration	
30 ppm or less	A chemical cartridge respirator which provides protection against ethanolamine.** Any supplied-air respirator.** Any self-contained breathing apparatus.**
150 ppm or less	A chemical cartridge respirator with a full facepiece and cartridge(s) which provides protection against ethanolamine. Any supplied-air respirator with a full facepiece, helmet, or hood. Any self-contained breathing apparatus with a full facepiece. A gas mask with a chin-style or a front- or back-mounted canister which provides protection against ethanolamine.
1000 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 1000 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 ethanolamine. Any escape self-contained breathing apparatus.

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

**If eye irritation occurs, full-facepiece respiratory protective equipment should be used.