

Occupational Health Guideline for Triethylamine

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: $(C_2H_5)_3N$
- Synonyms: None
- Appearance and odor: Colorless liquid with a fishy odor.

PERMISSIBLE EXPOSURE LIMIT (PEL)

The current OSHA standard for triethylamine is 25 parts of triethylamine per million parts of air (ppm) averaged over an eight-hour work shift. This may also be expressed as 100 milligrams of triethylamine per cubic meter of air (mg/m^3).

HEALTH HAZARD INFORMATION

• Routes of exposure

Triethylamine 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:* Triethylamine causes irritation of the eyes, nose, and throat. If the liquid is splashed in the eyes, it may cause severe eye damage.

2. *Long-term Exposure:* Repeated or prolonged exposure to triethylamine may cause skin and lung irritation. Heart, liver, and kidney damage have been reported in animal experiments.

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 triethylamine.

• Recommended medical surveillance

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

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

—Cardiovascular disease: Triethylamine causes myocardial degeneration in animals. In persons with impaired cardiovascular function, the inhalation of triethylamine might cause exacerbation of pre-existing disorders.

—Liver disease: Triethylamine causes liver damage in animals. 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: Triethylamine causes kidney damage in animals. The importance of this organ in the elimination of toxic substances justifies special consideration in those with impaired renal function.

—Eye disease: Triethylamine 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.

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

• Summary of toxicology

Triethylamine vapor is a primary irritant of mucous membranes and eyes. Exposure to 1000 ppm for 4 hours was lethal to rats. Rabbits survived exposures to 100 ppm daily for 6 weeks, but showed pulmonary irritation, myocardial degeneration, and cellular necrosis of

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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liver and kidney; at 50 ppm the effects on lung, liver, and kidney were less severe, but there was also damage to the cornea. In the eye of a rabbit, 1 drop of liquid triethylamine caused severe injury. Eye irritation and corneal edema in humans have been reported from industrial exposure. Closely related amines cause skin irritation.

CHEMICAL AND PHYSICAL PROPERTIES

• Physical data

1. Molecular weight: 101.2
2. Boiling point (760 mm Hg): 89.5 C (193 F)
3. Specific gravity (water = 1): 0.73
4. Vapor density (air = 1 at boiling point of triethylamine): 3.5
5. Melting point: -115 C (-175 F)
6. Vapor pressure at 20 C (68 F): 54 mm Hg
7. Solubility in water, g/100 g water at 20 C (68 F): 5.5
8. Evaporation rate (butyl acetate = 1): 5.6

• Reactivity

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

• Flammability

1. Flash point: -6.7 C (20 F) (closed cup)
2. Autoignition temperature: 450 C (842 F)
3. Flammable limits in air, % by volume: Lower: 1.2; Upper: 8.0
4. Extinguishant: Alcohol foam, carbon dioxide, dry chemical

• Warning properties

1. Odor Threshold: Grant reports that triethylamine has a "strong ammoniacal odor," but no quantitative information concerning the odor threshold is available.
2. Eye Irritation Level: Grant reports that "chronic exposure of rabbits to triethylamine vapors at concentrations as low as 50 ppm in air causes multiple erosions of the cornea and conjunctiva . . . in the course of 6 weeks."
3. Other Information: Patty reports that rabbits repeatedly exposed to 50 ppm triethylamine over a 6-week period experienced lung irritation.
4. Evaluation of Warning Properties: Since information concerning the odor threshold is not available, and since the only quantitative information concerning its irritant effects is from chronic exposures, triethylamine 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 triethylamine in a bubbler containing sulfuric acid, followed by treatment with sodium hydroxide, and gas chromatographic analysis. Also, detector tubes certified by NIOSH under 42 CFR Part 84 or other direct-reading devices calibrated to measure triethylamine may be used. An analytical method for triethylamine is in the *NIOSH Manual of Analytical Methods*, 2nd Ed., Vol. 3, 1977, available from the Government Printing Office, Washington, D.C. 20402 (GPO No. 017-033-00261-4).

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 triethylamine.
- Clothing wet with liquid triethylamine should be placed in closed containers for storage until it can be discarded or until provision is made for the removal of

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

- Where exposure of an employee's body to liquid triethylamine may occur, facilities for quick drenching of the body should be provided within the immediate work area for emergency use.

- Any clothing which becomes wet with triethylamine or non-impervious clothing which becomes contaminated with triethylamine should be removed immediately and not reworn until the triethylamine 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 triethylamine or liquids containing triethylamine contacting the eyes.

- Where there is any possibility that employees' eyes may be exposed to liquid triethylamine or liquids containing 1% or more of triethylamine by weight, an eye-wash fountain should be provided within the immediate work area for emergency use.

SANITATION

- Skin that becomes contaminated with triethylamine should be immediately washed or showered to remove any triethylamine.

COMMON OPERATIONS AND CONTROLS

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

Operation	Controls
Use in polymer technology as a catalyst for curing epoxy resins, for polyurethane foams, and for thermosetting polymers; as a stabilizing agent and chain-transfer agent; use in preparation of film-forming resins, as a solvent, pH stabilizer, and to improve water solubility in polymers	Local exhaust ventilation; general dilution ventilation
Use in extraction and purification of antibiotics; use in herbicides and pesticides, and in preparation of emulsifiers for pesticides	Local exhaust ventilation; general dilution ventilation

Operation

Use in organic synthesis of quarternary ammonium compounds in textile-treating chemicals, emulsifiers, surfactants, in paper manufacture, non-nutritive sweeteners, ketenes, and salts

Use as a corrosion inhibitor and chemical stabilizer for chlorinated solvents, in transmission fluids, oil well piping, engine parts, and gum inhibitors for gasoline

Use in paints and coatings to control viscosity and to prevent livering; to develop water resistance in resins; as a pH stabilizer; and to improve gloss of appliance finishes

Use as a dye assist; miscellaneous uses in rocket fuels to shorten ignition delays; ingredient of photographic development accelerator, for drying of printing inks, and in carpet cleaners

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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 triethylamine or liquids containing triethylamine 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 triethylamine gets on the skin, immediately wash the contaminated skin using soap or mild detergent and water. If triethylamine soaks through the clothing, remove the clothing immediately and wash the skin using soap or mild detergent and water. If irritation persists after washing, get medical attention.

- **Breathing**

If a person breathes in large amounts of triethylamine, 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 triethylamine 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 triethylamine 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. Triethylamine should not be allowed to enter a confined space, such as a sewer, because of the possibility of an explosion.

- **Waste disposal method:**

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

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RESPIRATORY PROTECTION FOR TRIETHYLAMINE

Condition	Minimum Respiratory Protection* Required Above 25 ppm
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.
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 triethylamine. Any escape self-contained breathing apparatus.

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

