

Occupational Health Guideline for Propylene Imine*

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_3H_7N
- Synonyms: 2-Methylaziridine
- Appearance and odor: Fuming, colorless liquid with a strong, ammonia-like odor.

PERMISSIBLE EXPOSURE LIMIT (PEL)

The current OSHA standard for propylene imine is 2 parts of propylene imine per million parts of air (ppm) averaged over an eight-hour work shift. This may also be expressed as 5 milligrams of propylene imine per cubic meter of air (mg/m^3).

HEALTH HAZARD INFORMATION

• Routes of exposure

Propylene imine 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:* Overexposure to propylene imine causes eye irritation.
2. *Long-term Exposure:* Repeated doses fed to animals have been shown to cause cancer.
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 propylene imine.

• Recommended medical surveillance

The following medical procedures should be made available to each employee who is exposed to propylene imine 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. Examination of the respiratory system, breasts, eyes, nervous system, and blood should be stressed. The skin should be examined for evidence of chronic disorders.

—A complete blood count: Propylene imine has been shown to cause granulocytic leukemia in rats repeatedly exposed to oral doses as little as 10 mg/kg. A complete blood count should be performed including a red cell count, a white cell count, a differential count of a stained smear, as well as hemoglobin and hematocrit.

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

• Summary of toxicology

Propylene imine vapor is a carcinogen in animals. This compound has also caused eye irritation. Exposure of rats to 500 ppm for 4 hours was fatal, but inhalation for 2 hours resulted in no deaths. Rats given 20 mg/kg by gavage twice weekly suffered from advanced flaccid paralysis after 18 weeks, and the mortality rate was high; at 10 mg/kg, paralysis occurred to a lesser extent after 30 weeks; granulocytic leukemia, squamous cell carcinoma of the ear duct, and brain tumors (glioma) were observed in different animals; females showed mammary adenocarcinomas, a number of which metastasized to the lung. When placed in the eye of a rabbit, a 5% aqueous solution produced corneal damage; it is also said to have caused injury to human eyes, but details have not been provided.

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

CHEMICAL AND PHYSICAL PROPERTIES

• Physical data

1. Molecular weight: 57
2. Boiling point (760 mm Hg): 66 C (151 F)
3. Specific gravity (water = 1): 0.8
4. Vapor density (air = 1 at boiling point of propylene imine): 2
5. Melting point: -65 C (-85 F)
6. Vapor pressure at 20 C (68 F): Data not available
7. Solubility in water, g/100 g water at 20 C (68 F): Miscible in all proportions
8. Evaporation rate (butyl acetate = 1): Data not available

• Reactivity

1. Conditions contributing to instability: Heat; contact with acids
2. Incompatibilities: Contact with acids will cause violent polymerization that may burst containers. Contact with strong oxidizers 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 propylene imine.
4. Special precautions: Liquid propylene imine will attack some forms of plastics, rubber, and coatings.

• Flammability

1. Flash point: -4 C (25 F) (closed cup)
2. Autoignition temperature: Data not available
3. Flammable limits in air, % by volume: Data not available
4. Extinguishant: Dry chemical, carbon dioxide, alcohol foam

• Warning properties

1. Odor Threshold: No quantitative information is available.
2. Eye Irritation Level: The ILO reports that "no industrial injuries (from propylene imine) have been reported, other than severe eye burns." According to Grant, the liquid "has caused severe damage when applied to rabbit eyes, similar in severity to 28% ammonium hydroxide." Patty reports that propylene imine causes acute effects which are similar to those caused by ethylene imine. Among the acute effects produced by ethylene imine are eye, nose, and throat irritation. For the purposes of this guideline, therefore, propylene imine is treated as an eye irritant.
3. Evaluation of Warning Properties: Since there are no available quantitative data relating the warning properties of propylene imine to air concentrations, it 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

At the time of publication of this guideline, no measurement method for propylene imine had been published by NIOSH.

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 skin contact with liquid propylene imine, where skin contact may occur.
- Clothing contaminated with propylene imine should be placed in closed containers for storage until it can be discarded or until provision is made for the removal of propylene imine from the clothing. If the clothing is to be laundered or otherwise cleaned to remove the propylene imine, the person performing the operation should be informed of propylene imine's hazardous properties.
- Where exposure of an employee's body to liquid propylene imine 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 propylene imine or non-impervious clothing which becomes contaminated with propylene imine should be removed immediately and not reworn until the propylene imine 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 propylene imine contacting the eyes.

- Where there is any possibility that employees' eyes may be exposed to liquid propylene imine, an eye-wash fountain should be provided within the immediate work area for emergency use.

SANITATION

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

- Eating and smoking should not be permitted in areas where liquid propylene imine is handled, processed, or stored.

- Employees who handle liquid propylene imine 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 propylene imine may occur and control methods which may be effective in each case:

Operation	Controls
Use as a polymer modifier to improve physical properties of polymer; to improve wet adhesion, brushability and freeze-to-thaw stability of paints, improve shrink-proofing agents of woolen textiles, and improve electrical properties of wire-coating materials	Process enclosure; local exhaust ventilation; general dilution ventilation; personal protective equipment
Use in manufacture of polypropylene imines and polymers for coating materials, adhesives, chelating agents, emulsifying agents, and fire-proofing agents in textile, rubber, paint, ink, and paper industries	Process enclosure; local exhaust ventilation; general dilution ventilation; personal protective equipment
Use as a chemical intermediate in pharmaceutical and chemical industries	Process enclosure; 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 propylene imine 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 propylene imine gets on the skin, immediately flush the contaminated skin with water. If propylene imine soaks 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 propylene imine, 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 propylene imine 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 propylene imine is spilled or leaked, the following steps should be taken:

1. Remove all ignition sources.
2. Ventilate area of spill or leak.
3. Dilute with water spray until no longer flammable. Add 4% acetic acid (vinegar) solution to the diluted spill until vinegar odor of acid is present, and flush the diluted and neutralized spill. Liquid propylene imine should not be allowed to enter a confined space, such as a sewer, because of the possibility of an explosion.

- Waste disposal and neutralization methods:

Propylene imine may be disposed of:

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

2. If larger quantities, by diluting with water, then adding acetic acid in excess of that required to neutralize the propylene imine.

ADDITIONAL INFORMATION

To find additional information on propylene imine, look up propylene imine 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 PROPYLENE IMINE

Condition	Minimum Respiratory Protection* Required Above 2 ppm
Vapor Concentration	
100 ppm or less	Any supplied-air respirator with a full facepiece, helmet, or hood. Any self-contained breathing apparatus with a full facepiece.
500 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 500 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 propylene imine. Any escape self-contained breathing apparatus.

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