

Occupational Health Guideline for Pyridine

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_5H_5N
- Synonyms: None
- Appearance and odor: Colorless or yellow liquid with a penetrating, sickening odor.

PERMISSIBLE EXPOSURE LIMIT (PEL)

The current OSHA standard for pyridine is 5 parts of pyridine per million parts of air (ppm) averaged over an eight-hour work shift. This may also be expressed as 15 milligrams of pyridine per cubic meter of air (mg/m^3).

HEALTH HAZARD INFORMATION

- **Routes of exposure**
Pyridine 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**
Exposure to pyridine may cause irritation of the eyes, skin, and lining of the respiratory tract. Heavy exposure may also cause gastrointestinal disturbances with diarrhea, abdominal pain, and nausea, weakness, headache, dizziness, difficulty in sleeping, nervousness, and back pain with urinary frequency. Damage to the liver and kidneys may occur. There is some evidence that permanent central nervous system damage may occur.
- **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 pyridine.

- **Recommended medical surveillance**

The following medical procedures should be made available to each employee who is exposed to pyridine 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 central nervous system, liver, and kidneys should be stressed. The skin should be examined for evidence of chronic disorders.

—Urinalysis: Kidney damage has been reported from oral administration of pyridine to humans for therapeutic purposes. A urinalysis should be performed, including at a minimum specific gravity, albumin, glucose, and a microscopic on centrifuged sediment.

—Liver function tests: Pyridine may cause liver damage. A profile of liver function should be performed by using a medically acceptable array of biochemical tests.

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

- **Summary of toxicology**

Pyridine vapor is a mild irritant to eyes and mucous membranes, and at high concentrations causes narcosis. In animals the major effects from administration of large doses by any route are local irritation and narcosis, while repeated feeding results in kidney and liver injury. Fatal injury to the liver and kidney has been reported from the prolonged oral administration of 1.8 to 2.5 ml daily for human therapeutic purposes. Workers exposed repeatedly to vapor concentrations averaging 125 ppm developed nausea and anorexia, as well as headache, dizziness, nervousness, and insomnia; in some cases, lower abdominal or back discomfort with urinary frequency was observed without associated evidence of liver or kidney damage. The possibility of permanent central nervous system injury is suggested by some case

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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Public Health Service Centers for Disease Control
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Occupational Safety and Health Administration

reports. Chemical plant workers exposed to pyridine at a concentration of 6 to 12 ppm developed headache, temporary vertigo, nervousness, sleeplessness, nausea, and vomiting. In the eye of a rabbit a 40% solution caused corneal necrosis. Skin irritation may result from prolonged or repeated contact with the vapor and liquid.

CHEMICAL AND PHYSICAL PROPERTIES

• Physical data

1. Molecular weight: 79
2. Boiling point (760 mm Hg): 115.3 C (239 F)
3. Specific gravity (water = 1): 0.98
4. Vapor density (air = 1 at boiling point of pyridine): 2.72
5. Melting point: -42 C (-43.6 F)
6. Vapor pressure at 20 C (68 F): 18 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): Data not available

• Reactivity

1. Conditions contributing to instability: Heat
2. Incompatibilities: Contact with strong oxidizers may cause fires and explosions. Contact with strong acids will 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 pyridine.
4. Special precautions: Liquid pyridine will attack some forms of plastics, rubber, and coatings.

• Flammability

1. Flash point: 20 C (68 F) (closed cup)
2. Autoignition temperature: 482 C (900 F)
3. Flammable limits in air, % by volume: Lower: 1.8; Upper: 12.4
4. Extinguishant: Alcohol foam, dry chemical, carbon dioxide

• Warning properties

1. Odor Threshold: Stern reports an odor threshold of 0.23 ppm, Summer reports 0.012 ppm, and May reports 0.013 ppm. The AIHA *Hygienic Guide*, however, notes that the odor "is an unreliable guide to concentrations exceeding 5 ppm. Olfactory fatigue occurs quickly."
2. Eye Irritation Level: Grant reports that the vapor of pyridine is irritating to the eyes, but he gives no quantitative information.
3. Other Information: Grant reports that pyridine vapors cause respiratory tract irritation, but no quantitative information is given. Persons who handle pyridine report that although olfactory fatigue occurs rapidly, a definite taste remains, thus giving adequate warning of exposure.
4. Evaluation of Warning Properties: Although olfactory fatigue occurs rapidly upon exposure to pyridine, a definite taste remains. For this reason, pyridine is treated as a material with good 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 pyridine vapors using an adsorption tube with subsequent desorption with methylene chloride and gas chromatographic analysis. Also, detector tubes certified by NIOSH under 42 CFR Part 84 or other direct-reading devices calibrated to measure pyridine may be used. An analytical method for pyridine 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 skin contact with liquid pyridine or solutions containing pyridine, where skin contact may occur.
- Clothing contaminated with pyridine should be placed in closed containers for storage until it can be discarded or until provision is made for the removal of

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

- Where exposure of an employee's body to liquid pyridine 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 pyridine should be removed promptly and not reworn until the pyridine is removed from the clothing.
- Any clothing which becomes wet with liquid pyridine should be removed immediately and not reworn until the pyridine 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 pyridine or solutions containing pyridine contacting the eyes.
- Where there is any possibility that employees' eyes may be exposed to liquid pyridine or solutions containing pyridine, an eye-wash fountain should be provided within the immediate work area for emergency use.

SANITATION

- Skin that becomes contaminated with pyridine should be immediately washed or showered to remove any pyridine.
- Employees who handle liquid pyridine or solutions containing pyridine 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 pyridine may occur and control methods which may be effective in each case:

Operation	Controls
Use in manufacture of pharmaceuticals such as antihistamines, vitamins, medicinals, CNS stimulants, and local anesthetics	Process enclosure; local exhaust ventilation; general dilution ventilation; personal protective equipment
Use as a solvent in manufacture of polycarbonate resins used in hand tools, small appliances, camera parts, safety helmets, and electrical connectors	Process enclosure; local exhaust ventilation; general dilution ventilation; personal protective equipment

Operation

Use as a starting material in manufacture of chemical intermediates and products; use in manufacture of rubber accelerators, epoxy resins, and pharmaceuticals

Use as a solvent reaction medium or catalyst in paint manufacture, carbohydrate treatment, drug manufacture, and rubber manufacture; use as a reagent in chemical analysis

Use in textile treatment as a water-proofing agent; use as a denaturant for ethyl alcohol; use as a coupling assistant in azo dye manufacture; use in purification of mercuric fulminate in explosives manufacture

During thermal decomposition of flexible polyurethane foams

Use as an inhibitor and for preparation of inhibitors; use in oil and gas well drilling

Controls

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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 liquid pyridine or solutions containing pyridine get into the eyes, wash eyes immediately with large amounts of water, lifting the lower and upper lids occasionally. If irritation is present after washing, get medical attention. Contact lenses should not be worn when working with this chemical.

• Skin Exposure

If liquid pyridine or solutions containing pyridine get on the skin, immediately flush the contaminated skin with water. If liquid pyridine or solutions containing pyridine penetrate through the clothing, remove the cloth-

ing immediately and wash the skin with water. If irritation persists after washing, get medical attention.

- **Breathing**

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

- **Waste disposal method:**

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

REFERENCES

- American Conference of Governmental Industrial Hygienists: "Pyridine," *Documentation of the Threshold Limit Values for Substances in Workroom Air* (3rd ed., 2nd printing), Cincinnati, 1974.
- American Industrial Hygiene Association: "Pyridine," *Hygienic Guide Series*, Detroit, Michigan, 1963.
- Browning, E.: *Toxicity and Metabolism of Industrial Solvents*, Elsevier, New York, 1965.
- Fairhall, L. T.: *Industrial Toxicology* (2nd ed.), Williams and Wilkins, Baltimore, 1957.
- Grant, W. M.: *Toxicology of the Eye* (2nd ed.), C. C. Thomas, Springfield, Illinois, 1974.
- Industrial Bio-Test Laboratories: *Pyridine*.
- May, J.: "Solvent Odor Thresholds for the Evaluation of Solvent Odors in the Atmosphere," *Staub-Reinhalt*, 26:9, 385-389, 1966.
- Patty, F. A. (ed.): *Toxicology*, Vol. II of *Industrial Hygiene and Toxicology* (2nd ed. rev.), Interscience, New York, 1963.
- Sax, N. I.: *Dangerous Properties of Industrial Materials* (3rd ed.), Van Nostrand Reinhold, New York, 1968.
- Schwartz, L., Tulipan, L., and Birmingham, D.: *Occupational Diseases of the Skin* (3rd ed. rev.), Lea and Febiger, Philadelphia, 1957.
- Smyth, H. F., and Carpenter, C. P.: "Chemical Burns of the Rabbit Cornea," *American Journal of Ophthalmology*, 29:1363-72, 1946.
- Smyth, H. F., et al.: "Range-Finding Toxicity Data, List IV," *Archives of Industrial Hygiene*, 4:2, 119-121, 1951.
- Stern, A. C. (ed.): *Air Pollution* (2nd ed.), Academic Press, New York, 1968.
- Summer, W.: *Odor Pollution of Air: Causes and Control*, L. Hill, London, 1975.
- Teisinger, J.: "Mild Chronic Intoxication with Pyridine," *Journal of Industrial Hygiene and Toxicology*, 30:58, 1948.
- von Oettingen, W. F.: *Poisoning: A Guide to Clinical Diagnosis and Treatment* (2nd ed.), Saunders, Philadelphia, 1958.

RESPIRATORY PROTECTION FOR PYRIDINE

Condition	Minimum Respiratory Protection* Required Above 5 ppm
Vapor Concentration	
250 ppm or less	A chemical cartridge respirator with a full facepiece and an organic vapor cartridge(s). A gas mask with a chin-style or a front- or back-mounted organic vapor canister. Any supplied-air respirator with a full facepiece, helmet, or hood. Any self-contained breathing apparatus with a full facepiece.
3600 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 3600 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.

**Use of supplied-air suits may be necessary to prevent skin contact while providing respiratory protection from airborne concentrations of pyridine; 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 3600 ppm, an auxiliary self-contained breathing apparatus operated in positive pressure mode should also be worn.