

Occupational Health Guideline for Nicotine

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: $C_{10}H_{14}N_2$
- Synonyms: 3-(1-Methyl-2-pyrrolidyl)pyridine
- Appearance and odor: Pale yellow to dark brown liquid with a slight fishy odor when warm.

PERMISSIBLE EXPOSURE LIMIT (PEL)

The current OSHA standard for nicotine is 0.5 milligram of nicotine per cubic meter of air (mg/m^3) averaged over an eight-hour work shift.

HEALTH HAZARD INFORMATION

• Routes of exposure

Nicotine can affect the body if it is inhaled, if it comes in contact with the eyes or skin, or if it is swallowed. It may rapidly enter the body through the skin.

• Effects of overexposure

1. Short-term Exposure: The action of nicotine is rapid either after breathing it, swallowing it, or absorbing it through the skin. Exposure to it may cause a burning sensation of the mouth and throat, abdominal pain, nausea, vomiting, and diarrhea. It may also cause headache, sweating, dizziness, hearing and visual disturbances, confusion, weakness, and incoordination. The heart may beat irregularly or stop. Trembling and convulsions, faintness, shortness of breath, and collapse may occur which may be followed by death from respiratory paralysis. Exposure of the eyes and skin may cause irritation. Nicotine has caused abnormalities in the offspring of laboratory animals.

2. Long-term Exposure: None known.

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 nicotine.

• Recommended medical surveillance

The following medical procedures should be made available to each employee who is exposed to nicotine 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 nervous system and cardiovascular system should be stressed.

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

• Summary of toxicology

Nicotine in solution causes a transient stimulation, followed by depression or paralysis of the central nervous system, peripheral autonomic ganglia, and nerve endings in skeletal muscle; it also directly stimulates smooth muscle. Many fatal human cases of nicotine intoxication have occurred, usually as a result of accidental or suicidal ingestion of nicotine insecticides. Nicotine is readily absorbed through the skin; in fatal cases of intoxication, death nearly always occurs within 1 hour and has occurred within 1 minute; the fatal adult dose is about 60 mg. Symptoms include nausea, salivation, abdominal pain, vomiting, diarrhea, cold sweat, headache, dizziness, disturbed hearing and vision, confusion, weakness, and incoordination. Initially, respiration is deep and rapid, blood pressure is elevated, and the pulse is slow; intense vagal stimulation may cause transient cardiac standstill or paroxysmal atrial fibrillation; the pupils are generally constricted. Excitation of the central nervous system results in tremor and sometimes clonic-tonic convulsions. As central nervous system

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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depression ensues the pupils dilate, the blood pressure falls, and the pulse becomes rapid and often irregular; faintness, prostration, dyspnea, and paralysis of respiratory muscles are followed by death. Recovery usually occurs if the victim survives 1 to 4 hours. Skeletal system malformations occurred in the offspring of pregnant mice injected subcutaneously with nicotine between days 9 to 11 of pregnancy.

CHEMICAL AND PHYSICAL PROPERTIES

• Physical data

1. Molecular weight: 162
2. Boiling point (760 mm Hg): 266 C (511 F)
3. Specific gravity (water = 1): 1.0
4. Vapor density (air = 1 at boiling point of nicotine): 5.6
5. Melting point: -79 C (-110 F)
6. Vapor pressure at 20 C (68 F): 0.0425 mm Hg
7. Solubility in water, g/100 g water at 20 C (68 F): Miscible in all proportions below 60 C (140 F)
8. Evaporation rate (butyl acetate = 1): Not applicable

• Reactivity

1. Conditions contributing to instability: None
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 nicotine.
4. Special precautions: Nicotine will attack some forms of plastics, rubber, and coatings.

• Flammability

1. Flash point: 95 C (203 F) (calculated)
2. Autoignition temperature: 244 C (471 F)
3. Flammable limits in air, % by volume: Lower: 0.7; Upper: 4.0
4. Extinguishant: Alcohol foam, carbon dioxide, dry chemical

• Warning properties

1. Odor Threshold: No quantitative information is available.
2. Eye Irritation Level: Grant reports one case where exposure caused "a severe pain, much conjunctival reaction and corneal infiltration. Eventually the eye healed with partial opacification of the cornea."
3. Evaluation of Warning Properties: Since no quantitative information is available relating warning properties to air concentrations of nicotine, this substance 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 nicotine on resin with subsequent desorption with ethyl acetate and gas chromatographic analysis. Also, detector tubes certified by NIOSH under 42 CFR Part 84 or other direct-reading devices calibrated to measure nicotine may be used. An analytical method for nicotine 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 any possibility of skin contact with liquid nicotine.
- Clothing which has had any possibility of being contaminated with liquid nicotine should be placed in closed containers for storage until it can be discarded or until provision is made for the removal of nicotine from the clothing. If the clothing is to be laundered or otherwise cleaned to remove the nicotine, the person performing the operation should be informed of nicotine's hazardous properties.
- Where there is any possibility of exposure of an employee's body to liquid nicotine, 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 liquid nicotine should be removed immediately and not reworn until the nicotine 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 nicotine contacting the eyes.
- Where there is any possibility that employees' eyes may be exposed to liquid nicotine, an eye-wash fountain should be provided within the immediate work area for emergency use.

SANITATION

- Skin that becomes contaminated with liquid nicotine should be immediately washed or showered with soap or mild detergent and water to remove any nicotine.
- Eating and smoking should not be permitted in areas where liquid nicotine is handled, processed, or stored.
- Employees who handle liquid nicotine should wash their hands thoroughly with soap or mild detergent and water before eating, smoking, or using toilet facilities.

COMMON OPERATIONS AND CONTROLS

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

Operation	Controls
Application as a pesticide and fumigant on vegetable crops, fruit, grasses and turf, and greenhouse plants and crops	Personal protective equipment
Formulation of pesticide products and fumigants	Process enclosure; local exhaust ventilation; general mechanical ventilation; personal protective equipment
Liberation as a by-product during tobacco processing and manufacture of tobacco products	Process enclosure; local exhaust ventilation; general mechanical ventilation; personal protective equipment
Extraction and handling of nicotine	Process enclosure; local exhaust ventilation; general mechanical 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 liquid nicotine or solutions of nicotine 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 liquid nicotine or solutions of nicotine get on the skin, immediately flush the contaminated skin with water. If liquid nicotine or solutions of nicotine soak through the clothing, remove the clothing immediately and flush the skin with water. Get medical attention immediately.

• Breathing

If a person breathes in large amounts of nicotine, 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 liquid nicotine or solutions of nicotine have 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 nicotine is spilled or leaked, the following steps should be taken:

1. Ventilate area of spill or leak.
2. 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.

- Waste disposal methods:

Nicotine 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.

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RESPIRATORY PROTECTION FOR NICOTINE

Condition	Minimum Respiratory Protection* Required Above 0.5 mg/m ³
Particulate or Vapor Concentration	
5 mg/m ³ or less	Any supplied-air respirator. Any self-contained breathing apparatus.
25 mg/m ³ or less	Any supplied-air respirator with a full facepiece, helmet, or hood. Any self-contained breathing apparatus with a full facepiece.
35 mg/m ³ or less	A Type C supplied-air respirator operated in pressure-demand or other positive pressure or continuous-flow mode.
Greater than 35 mg/m ³ ** 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 and particulates, including pesticide respirators which meet the requirements of this class. 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 nicotine; 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 35 mg/m³, an auxiliary self-contained breathing apparatus operated in positive pressure mode should also be worn.

