

Occupational Health Guideline for Nitromethane

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: CH_2NO_2
- Synonyms: None
- Appearance and odor: Colorless liquid with a mild, fruity odor.

PERMISSIBLE EXPOSURE LIMIT (PEL)

The current OSHA standard for nitromethane is 100 parts of nitromethane per million parts of air (ppm) averaged over an eight-hour work shift. This may also be expressed as 250 milligrams of nitromethane per cubic meter of air (mg/m^3).

HEALTH HAZARD INFORMATION

• Routes of exposure

Nitromethane 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

In man, mild skin irritation has occurred from repeated exposure of the skin. Animal exposure to nitromethane has produced irritation of the respiratory tract, with breathing difficulties which might be delayed in onset. Irritation of the eyes, anesthesia, convulsion, and death have also occurred.

• 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 nitromethane.

• Recommended medical surveillance

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

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

—Liver disease: Nitromethane 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.

—Convulsive disorders: Nitromethane causes convulsions in animals. Persons with a history of such disorders may be more susceptible to the effects of this agent.

—Kidney disease: Nitromethane 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.

—Skin disease: Nitromethane is a defatting agent and can cause dermatitis on prolonged exposure. Persons with pre-existing skin 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

Nitromethane is a mild skin irritant due to its solvent action. In animals the vapor affects the central nervous system by causing convulsions and narcosis and is a mild pulmonary irritant. It also causes liver damage in animals. Rabbits died from exposure to 10,000 ppm for 6 hours; there was weakness, ataxia and muscular incoordination.

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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dination followed by convulsions after a latent period. This concentration for 3 hours was not fatal. Autopsy of animals exposed to lethal concentrations revealed focal necrosis in the liver and moderate kidney damage. Lower concentrations produced slight irritation of the respiratory tract, followed by mild narcosis, weakness, and salivation, but no evidence of eye irritation. However, a single monkey exposed to 1000 ppm for eight 6-hour exposures died. No systemic effects have been reported in humans.

CHEMICAL AND PHYSICAL PROPERTIES

• Physical data

1. Molecular weight: 61
2. Boiling point (760 mm Hg): 101.2 C (214 F)
3. Specific gravity (water = 1): 1.14
4. Vapor density (air = 1 at boiling point of nitromethane): 2.1
5. Melting point: -29 C (-20 F)
6. Vapor pressure at 20 C (68 F): 27.8 mm Hg
7. Solubility in water, g/100 g water at 20 C (68 F): 9.5
8. Evaporation rate (butyl acetate = 1): 1.39

• Reactivity

1. Conditions contributing to instability: Overheating of closed containers may cause detonation.
2. Incompatibilities: Contact with amines, strong acids, and alkalis may sensitize nitromethane so that it will readily explode. Contact with strong oxidizers may cause fires and explosions. Mixtures of nitromethane and hydrocarbons (or other combustible materials) are highly flammable. Contact with some metallic oxides may cause decomposition and development of pressure.
3. Hazardous decomposition products: Toxic gases and vapors (such as oxides of nitrogen and carbon monoxide) may be released in a fire involving nitromethane.
4. Special precautions: Liquid nitromethane will attack some forms of plastics, rubber, and coatings.

• Flammability

1. Flash point: 35 C (95 F) (closed cup)
2. Autoignition temperature: 418 C (785 F)
3. Flammable limits in air, % by volume: Lower: 7.3; Upper: Data not available
4. Extinguishant: Alcohol foam, carbon dioxide, and dry chemical

• Warning properties

1. Odor Threshold: According to the AIHA *Hygienic Guide*, "the odor is very strong above 100 ppm and irritating at 200 ppm, but cannot be relied on for warning properties." No further explanation is offered. Patty also states, however, that "the odors of nitroparaffins are easily detectable, and concentrations below 200 ppm are disagreeable to most observers. The odor and sensory symptoms are not dependable warning properties."

2. Eye Irritation Level: The *Hygienic Guide* states that "severe eye and respiratory irritation was noted in

animals at 500 ppm and above." This is not specifically stated to be the threshold of eye irritation.

3. Evaluation of Warning Properties: Patty states that "the odor and sensory symptoms (of nitroparaffins) are not dependable 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 nitromethane is in the *NIOSH Manual of Analytical Methods*, 2nd Ed., Vol. 6, 1980, available from the Government Printing Office, Washington, D.C. 20402 (GPO No. 017-033-00369-6).

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 nitromethane.

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

- Any clothing which becomes wet with liquid nitromethane should be removed immediately and not reworn until the nitromethane is removed from the clothing.
- Employees should be provided with and required to use splash-proof safety goggles where liquid nitromethane may contact the eyes.

SANITATION

- Skin that becomes wet with liquid nitromethane should be promptly washed or showered to remove any nitromethane.
- Employees who handle liquid nitromethane should wash their hands thoroughly before eating or smoking.

COMMON OPERATIONS AND CONTROLS

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

Operation	Controls
Use as a solvent in coatings and adhesives on cellulose esters and synthetic resins	Process enclosure; local exhaust ventilation; personal protective equipment
Liberation during application by dipping, roller coating, tumbling, knifing, or application of coatings and adhesives	General dilution ventilation; process enclosure; local exhaust ventilation; personal protective equipment
Use as an intermediate in synthesis of organic dyes, textiles, surfactants, insecticides, pharmaceuticals, and explosives	General dilution ventilation; process enclosure; local exhaust ventilation; personal protective equipment
Use as a propellant or fuel additive; use as a reaction-media fluid for Friedel-Crafts reaction; use as a recrystallization solvent; use as a solvent in manufacture of coatings and adhesives on cellulose esters or synthetic resins	General dilution ventilation; process enclosure; local exhaust ventilation; personal protective equipment
Use as a stabilizer for halogenated alkanes, aerosol formulations, and paste formulations for inks	General dilution ventilation; process enclosure; local exhaust 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 nitromethane gets into the eyes, wash eyes immediately with large amounts of water, lifting the lower and upper lids occasionally. If irritation persists after washing, get medical attention. Contact lenses should not be worn when working with this chemical.

• Skin Exposure

If liquid nitromethane gets on the skin, promptly wash the contaminated skin using soap or mild detergent and water. If liquid nitromethane soaks through the clothing, remove the clothing promptly 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 nitromethane, 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 nitromethane 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 liquid nitromethane 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 and burn in a suitable combustion chamber which allows burning in an unconfined condition and is equipped with an effluent gas cleaning device. Large quantities can be collected, diluted in fuel oil, and atomized in a suitable combustion chamber equipped with an appropriate effluent gas cleaning device. Liquid nitromethane should not be allowed to enter a confined space, such as a sewer, because of the possibility of an explosion.

• **Waste disposal method:**

Liquid nitromethane may be disposed of by diluting with fuel oil and atomizing in a suitable combustion chamber equipped with an effluent gas cleaning device.

REFERENCES

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RESPIRATORY PROTECTION FOR NITROMETHANE

Condition	Minimum Respiratory Protection* Required Above 100 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 escape self-contained breathing apparatus.

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