Occupational Health Guideline for Nitrotoluene

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: Ortho: $2\text{-}NO_2C_6H_4CH_3$; Meta: $3\text{-}NO_2C_6H_4CH_3$; Para: $4\text{-}NO_2C_6H_4CH_3$

• Synonyms: Orthonitrotoluene; o-nitrotoluol; metanitrotoluene; m-nitrotoluol; paranitrotoluene; p-nitrotoluol

• Appearance and odor: Ortho: Yellow liquid or solid with a weak aromatic odor; Meta: Yellow liquid or solid with a weak aromatic odor; Para: Pale yellow solid with a weak aromatic odor.

PERMISSIBLE EXPOSURE LIMIT (PEL)

The current OSHA standard for nitrotoluene is 5 parts of nitrotoluene per million parts of air (ppm) averaged over an eight-hour work shift. This may also be expressed as 30 milligrams of nitrotoluene per cubic meter of air (mg/m^3). The American Conference of Governmental Industrial Hygienists has issued a Notice of Intended Changes of its recommended Threshold Limit Value for nitrotoluene from 5 ppm to 2 ppm with a skin notation.

HEALTH HAZARD INFORMATION

• **Routes of exposure**

Nitrotoluene can affect the body if it is inhaled, if it comes in contact with the eyes or skin, or if it is swallowed. It is readily absorbed through the skin.

• **Effects of overexposure**

Nitrotoluene may affect the ability of the blood to carry oxygen. This may cause a bluish discoloration of the skin, irritability, drowsiness, nausea, rapid pulse, headache, weakness, shortness of breath, and unconsciousness.

• **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 nitrotoluene.

• **Recommended medical surveillance**

The following medical procedures should be made available to each employee who is exposed to nitrotoluene 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 blood, nervous system, gastrointestinal system, and cardiovascular system should be stressed. The skin should be examined for evidence of chronic disorders.

—A complete blood count: Nitrotoluene has been shown to cause methemoglobinemia. Persons with blood disorders may be at increased risk from exposure. 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. Methemoglobin determinations should be performed if overexposure is suspected or signs and symptoms of toxicity occur.

• **Summary of toxicology**

Nitrotoluene, whether absorbed as vapor by inhalation or as liquid through the skin, has a potential for producing methemoglobin and subsequent anoxia. Signs and symptoms of overexposure are due to the loss of oxygen-carrying capacity of the blood. The onset of symptoms of methemoglobinemia is insidious and may be delayed up to 4 hours; headache is commonly the

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first symptom and may become quite intense as the severity of methemoglobinemia progresses. Cyanosis occurs when the methemoglobin concentration is 15% or more. Cyanosis develops early in the course of intoxication, first in the lips, the nose, and the ear lobes, and is usually recognized by fellow workers. Until the methemoglobin concentration approaches approximately 40%, the individual usually feels well, has no complaints, and will insist that nothing is wrong. At methemoglobin concentrations of over 40%, there usually is weakness and dizziness; at up to 70% concentration there may be ataxia, dyspnea on mild exertion, tachycardia, nausea, vomiting, and drowsiness.

CHEMICAL AND PHYSICAL PROPERTIES

- **Physical data**
  1. Molecular weight: 137.1
  2. Boiling point (760 mm Hg): Ortho: 222 C (432 F); Meta: 232 C (450 F); Para: 238 C (460 F)
  3. Specific gravity (water = 1): Ortho: 1.16; Meta: 1.16; Para: 1.3
  4. Vapor density (air = 1 at boiling point of nitrotoluene): 4.7
  5. Melting point: Ortho: −4 C (25 F); Meta: 16 C (61 F); Para: 52 C (126 F)
  6. Vapor pressure at 20 C (68 F): Ortho and Meta: 0.15 mm Hg; Para: 0.12 mm Hg
  7. Solubility in water, g/100 g water at 20 C (68 F): Ortho: 0.06; Meta: 0.05; Para: 0.004
  8. Evaporation rate (butyl acetate = 1): Not applicable
- **Reactivity**
  1. Conditions contributing to instability: Heat
  2. Incompatibilities: Contact with strong oxidizers or sulfuric acid 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 nitrotoluene.
  4. Special precautions: Nitrotoluene will attack some forms of plastics, rubber, and coatings.
- **Flammability**
  1. Flash point: Ortho: 106 C (223 F) (closed cup); Meta: 101 C (214 F); Para: 106 C (223 F)
  2. Autoignition temperature: Data not available
  3. Flammable limits in air, % by volume: Lower: Ortho: 2.2 (calculated); Meta and para: 1.6 (calculated)
  4. Extinguishant: Carbon dioxide, dry chemical, foam
- **Warning properties**
  1. Odor Threshold: Information is not available.
  2. Eye Irritation Level: Nitrotoluene is not known to be an eye irritant.
  3. Evaluation of Warning Properties: 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 vapors using a silica gel adsorption tube with subsequent desorption using methanol and gas chromatographic analysis. Also, detector tubes certified by NIOSH under 42 CFR Part 84 or other direct-reading devices calibrated to measure nitrotoluene may be used. An analytical method for nitrotoluene 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 solid or liquid nitrotoluene.
- Non-impervious clothing which becomes contaminated with nitrotoluene should be removed promptly and not reworn until the nitrotoluene is removed from the clothing.

• Employees should be provided with and required to use dust- and splash-proof safety goggles where solid or liquid nitrotoluene may contact the eyes.

SANITATION

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

COMMON OPERATIONS AND CONTROLS

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

Operation	Controls
Use in the manufacture of toluidines for the production of dyes, intermediates for vulcanization accelerators, gasoline inhibitors, and flotation agents; use as an analytical reagent	Process enclosure; local exhaust ventilation; general dilution ventilation; personal protective equipment
Use in the manufacture of dinitrotoluenes for production of explosives; manufacture of nitrotoluene-sulfonic acids for production of azo and stilbene dyes	Process enclosure; local exhaust ventilation; general dilution ventilation; personal protective equipment
Use in organic synthesis for intermediates of dyes, sun screening agents, and fuchsin— a red dye used in textile and leather 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 solid or liquid nitrotoluene 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 solid or liquid nitrotoluene gets on the skin, promptly wash the contaminated skin using soap or mild detergent and water. If solid or liquid nitrotoluene penetrates through the clothing, remove the clothing immediately and wash the skin using soap or mild detergent and water. Get medical attention immediately
• **Breathing**
If a person breathes in large amounts of nitrotoluene, 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 solid or liquid nitrotoluene 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 nitrotoluene is spilled or leaked, the following steps should be taken:
1. Ventilate area of spill or leak.
2. For small quantities of liquid nitrotoluene, absorb on paper towels. For small quantities of solid nitrotoluene, sweep onto paper or other suitable material. Remove to a safe place (such as a fume hood) and burn the paper. Large quantities of liquid nitrotoluene can be collected and atomized in a suitable combustion chamber equipped with an appropriate effluent gas cleaning device. Large quantities of solid nitrotoluene can be reclaimed; however, if this is not practical, dissolve in a flammable solvent (such as alcohol) and atomize in a suitable combustion chamber equipped with an appropriate effluent gas cleaning device.
• Waste disposal methods:
Nitrotoluene may be disposed of:
1. For liquid nitrotoluene, by absorbing it in vermiculite, dry sand, earth or a similar material and disposing in a secured sanitary landfill.
2. By atomizing liquid nitrotoluene in a suitable combustion chamber equipped with an appropriate effluent gas cleaning device.
3. By making packages of solid nitrotoluene in paper or

other suitable material or by dissolving in a flammable solvent (such as alcohol) and burning in a suitable combustion chamber equipped with an appropriate effluent gas cleaning device.

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RESPIRATORY PROTECTION FOR NITROTOLUENE

Condition	Minimum Respiratory Protection* Required Above 5 ppm
Vapor or Particulate Concentration	
50 ppm or 280 mg/m³ or less	Any supplied-air respirator. Any self-contained breathing apparatus.
200 ppm or 1120 mg/m³ or less	Any supplied-air respirator with a full facepiece, helmet, or hood. Any self-contained breathing apparatus with a full facepiece. A Type C supplied-air respirator operated in pressure-demand or other positive pressure or continuous-flow mode.
Greater than 200 ppm or 1120 mg/m³ 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. Any escape self-contained breathing apparatus.

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