

# Occupational Health Guideline for Dinitrotoluene

## 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: 2,4-(NO<sub>2</sub>)<sub>2</sub>C<sub>6</sub>H<sub>3</sub>CH<sub>3</sub>
- Synonyms: 2,4-Dinitrotoluene; DNT
- Appearance and odor: Orange-yellow solid (sometimes shipped molten in tank cars) with a characteristic odor.

## PERMISSIBLE EXPOSURE LIMIT (PEL)

The current OSHA standard for dinitrotoluene is 1.5 milligrams of dinitrotoluene per cubic meter of air (mg/m<sup>3</sup>) averaged over an eight-hour work shift.

## HEALTH HAZARD INFORMATION

### • Routes of exposure

Dinitrotoluene can affect the body if it is inhaled, comes in contact with the eyes or skin, or is swallowed; It is readily absorbed through the skin. Even a small amount absorbed from clothes or shoes may cause toxic symptoms.

### • Effects of overexposure

**1. Short-term Exposure:** Dinitrotoluene affects the ability of blood to carry oxygen normally. A bluish discoloration of the skin may occur with headache, irritability, dizziness, weakness, nausea, vomiting, shortness of breath, drowsiness, and unconsciousness. If treatment is not given promptly, death may occur. The onset of symptoms may be delayed. The ingestion of alcohol may cause increased susceptibility to the effects of dinitrotoluene.

**2. Long-term Exposure:** Repeated or prolonged exposure to dinitrotoluene may cause anemia and jaundice.

**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 dinitrotoluene.

### • Recommended medical surveillance

The following medical procedures should be made available to each employee who is exposed to dinitrotoluene 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, liver, and cardiovascular system should be stressed.

—A complete blood count: Dinitrotoluene has been shown to cause methemoglobinemia. Those with blood disorders may be at increased risk. 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. Observe for Heinz bodies.

—Liver function tests: Since liver damage has been observed in humans exposed to dinitrotoluene, a profile of liver function should be obtained by using a medically acceptable array of biochemical tests.

**2. Periodic Medical Examination:** The aforementioned medical examinations should be repeated on an annual basis. Methemoglobin determinations should be performed at any time overexposure is suspected or signs and symptoms of toxicity occur. The level of dinitrotoluene in the urine should be determined; excretion of dinitrotoluene in excess of 25 mg/liter indicates significant absorption.

### • Summary of toxicology

Dinitrotoluene absorption, whether from inhalation of the vapor or absorption of the solid through skin, causes anoxia due to the formation of methemoglobin; jaundice and anemia have been reported. Signs and symptoms of

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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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overexposure are due to the loss of oxygen-carrying capacity of the blood. Rapid absorption through the intact skin is frequently the main route of entry. The onset of symptoms of methemoglobinemia is often insidious, and may be delayed for up to 4 hours; headache is commonly the first symptom and may become quite intense as the severity of methemoglobinemia progresses. Cyanosis develops early in the course of intoxication, first in the lips, the nose, and the ear lobes, and is often recognized by fellow workers. Cyanosis occurs when the methemoglobin concentration is 15% or more. The individual may feel well, have no complaints, and may insist that nothing is wrong until the methemoglobin concentrations approaches approximately 40%. 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. Ingestion of alcohol is reported to aggravate the toxic effects of dinitrotoluene.

## CHEMICAL AND PHYSICAL PROPERTIES

### • Physical data

1. Molecular weight: 182.1
2. Boiling point (760 mm Hg): Slow decomposition at 250 C (482 F); self-sustained decomposition at 270 C (518 F)
3. Specific gravity (water = 1): Solid: 1.52; Liquid: 1.32
4. Vapor density (air = 1 at boiling point of dinitrotoluene): Not applicable (too high boiling)
5. Melting point: 70 C (158 F)
6. Vapor pressure at 20 C (68 F): 1 mm Hg
7. Solubility in water, g/100 g water at 20 C (68 F): 0.03
8. Evaporation rate (butyl acetate = 1): Not applicable

### • Reactivity

1. Conditions contributing to instability: Temperatures above 250 C (482 F)
2. Incompatibilities: Contact with strong oxidizers may cause fires and explosions. Contact with caustics and chemically active metals such as tin or zinc may cause evolution of heat and increase in pressure.
3. Hazardous decomposition products: Toxic gases and vapors (such as oxides of nitrogen and carbon monoxide) may be released in a fire involving dinitrotoluene.
4. Special precautions: Liquid dinitrotoluene will attack some forms of plastics, rubber, and coatings.

### • Flammability

1. Flash point: 206.7 C (404 F) (closed cup)
2. Autoignition temperature: Data not available
3. Impact sensitivity (minimum fall of a 2 kg weight to cause at least one explosion in ten trials): Greater than 100 centimeters
4. Flammable limits in air, % by volume: Not available

4. Extinguishant: Water, dry chemical, carbon dioxide

### • Warning properties

1. Odor Threshold: No quantitative information is available concerning the odor threshold of dinitrotoluene.

2. Eye Irritation Level: Grant states that "a severe burn of the skin, eyelids, and cornea of one eye, with permanent scarring, has been attributed in one instance to hot fumes of dinitrotoluene." There is no quantitative information available concerning the concentrations which would produce these effects.

3. Evaluation of Warning Properties: Since no quantitative information is available relating the warning properties of dinitrotoluene to air concentration, 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

An analytical method for dinitrotoluene is in the *NIOSH Manual of Analytical Methods*, 2nd Ed., Vol. 4, 1978, available from the Government Printing Office, Washington, D.C. 20402 (GPO No. 017-033-00317-3).

## 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 molten dinitrotoluene.
- 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 dinitrotoluene or liquids containing dinitrotoluene, where skin contact may occur.
- If employees' clothing may have become contaminated with solid dinitrotoluene, employees should change into uncontaminated clothing before leaving the work premises.
- Clothing contaminated with dinitrotoluene should be placed in closed containers for storage until it can be discarded or until provision is made for the removal of dinitrotoluene from the clothing. If the clothing is to be laundered or otherwise cleaned to remove the dinitrotoluene, the person performing the operation should be informed of dinitrotoluene's hazardous properties.
- Where exposure of an employee's body to dinitrotoluene or liquids containing dinitrotoluene 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 wet with molten dinitrotoluene or liquids containing dinitrotoluene should be removed immediately and non-impervious clothing which becomes contaminated with solid dinitrotoluene should be removed promptly and such clothing should not be reworn until the dinitrotoluene is removed from the clothing.
- Employees should be provided with and required to use splash-proof safety goggles where there is any possibility of molten dinitrotoluene contacting the eyes.

## SANITATION

- Skin that becomes wet with molten dinitrotoluene or liquids containing dinitrotoluene should be immediately washed or showered with soap or mild detergent and water to remove any dinitrotoluene.
- Workers subject to skin contact with dinitrotoluene or liquids containing dinitrotoluene should wash with soap or mild detergent and water any areas of the body which may have contacted dinitrotoluene at the end of each work day.
- Skin that becomes contaminated with dinitrotoluene should be promptly washed or showered with soap or mild detergent and water to remove any dinitrotoluene.
- Eating and smoking should not be permitted in areas where dinitrotoluene or liquids containing dinitrotoluene are handled, processed, or stored.
- Employees who handle dinitrotoluene or liquids containing dinitrotoluene should wash their hands thor-

oughly 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 dinitrotoluene may occur and control methods which may be effective in each case:

Operation	Controls
Use in the manufacture of toluene diisocyanate for production of polyurethane plastics	Process enclosure; local exhaust ventilation; general dilution ventilation; personal protective equipment
Use in production of military and some commercial explosives; use to plasticize cellulose nitrate in explosives; use to moderate burning rate of propellants and explosives; use in manufacture of gelatin explosives (less sensitive to shock or friction); use as a water-proofing coating for some smokeless powders; use as an intermediate in TNT manufacture	Process enclosure; local exhaust ventilation; general dilution ventilation; personal protective equipment
Use in manufacture of azo dye intermediates; use in organic synthesis in preparation of toluidines, dyes, and explosives	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 dinitrotoluene or liquids containing dinitrotoluene get into the eyes, wash eyes immediately with large amounts of water, lifting the lower and upper lids occasionally. Get medical attention immediately. If molten dinitrotoluene gets into the eyes, flush the eyes immediately with large amounts of water to remove heat. Get medical attention immediately. Contact lenses should not be worn when working with this chemical.

### • Skin Exposure

If dinitrotoluene or liquids containing dinitrotoluene get on the skin, immediately wash the contaminated skin using soap or mild detergent and water. If dinitro-

luene or liquids containing dinitrotoluene penetrate through the clothing, remove the clothing immediately and wash the skin using soap or mild detergent and water. Get medical attention immediately. If molten dinitrotoluene gets on the skin, immediately flush the skin with water to remove heat. Wash the skin with soap or mild detergent and water. Get medical attention immediately.

#### • Breathing

If a person breathes in large amounts of dinitrotoluene, 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 dinitrotoluene 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 AND DISPOSAL PROCEDURES

• Persons not wearing protective equipment and clothing should be restricted from areas of spills until cleanup has been completed.

• If dinitrotoluene is spilled, the following steps should be taken:

1. Remove all ignition sources.
2. Ventilate area of spill.
3. For small quantities, sweep onto paper or other suitable material and burn in a suitable combustion chamber which allows burning in an unconfined condition and is equipped with an appropriate effluent gas cleaning device. Large quantities may be reclaimed; however, if this is not practical, dissolve in fuel oil and atomize in a suitable combustion chamber equipped with an appropriate effluent gas cleaning device.
4. If in the molten form, allow to cool and solidify and treat as in (3) above.

• Waste disposal methods:

Dinitrotoluene may be disposed of:

1. By making packages of dinitrotoluene in paper or other flammable material and burning in a suitable combustion chamber which allows burning in an unconfined condition and is equipped with an appropriate effluent gas cleaning device.

2. By dissolving dinitrotoluene in fuel oil and atomizing in a suitable combustion chamber equipped with an appropriate effluent gas cleaning device.

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## RESPIRATORY PROTECTION FOR DINITROTOLUENE

<b>Condition</b>	<b>Minimum Respiratory Protection* Required Above 1.5 mg/m<sup>3</sup></b>
<b>Particulate or Vapor Concentration</b>	
15 mg/m <sup>3</sup> or less	Any supplied-air respirator. Any self-contained breathing apparatus.
75 mg/m <sup>3</sup> or less	Any supplied-air respirator with a full facepiece, helmet, or hood. Any self-contained breathing apparatus with a full facepiece.
200 mg/m <sup>3</sup> 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 200 mg/m <sup>3</sup> 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.

