

# Occupational Health Guideline for Dinitrobenzene (All Isomers)

## 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: 1,2-C<sub>6</sub>H<sub>4</sub>(NO<sub>2</sub>)<sub>2</sub>; Meta: 1,3-C<sub>6</sub>H<sub>4</sub>(NO<sub>2</sub>)<sub>2</sub>; Para: 1,4-C<sub>6</sub>H<sub>4</sub>(NO<sub>2</sub>)<sub>2</sub>
- Synonyms: O-dinitrobenzene; 1,2-dinitrobenzene; m-dinitrobenzene; 1,3-dinitrobenzene; p-dinitrobenzene; 1,4-dinitrobenzene
- Appearance: Pale yellow solid.

## PERMISSIBLE EXPOSURE LIMIT (PEL)

The current OSHA standard for dinitrobenzene is 1 milligram of dinitrobenzene per cubic meter of air (mg/m<sup>3</sup>) averaged over an eight-hour work shift. The American Conference of Governmental Industrial Hygienists has recommended for dinitrobenzene a Threshold Limit Value of 0.15 ppm with a skin notation.

## HEALTH HAZARD INFORMATION

- Routes of exposure  
Dinitrobenzene 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, either as solid, liquid, or vapor. Even a small amount absorbed from clothes or shoes may cause toxic symptoms.
- Effects of overexposure  
Dinitrobenzene may affect the ability of blood to carry oxygen. 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.

Consuming alcohol may make symptoms worse. Dinitrobenzene may also cause an unpleasant taste or burning sensation in the mouth, dry, throat, and thirst. The eyes, hair, and skin may become yellowish. Dinitrobenzene may cause reduced vision. In addition, liver damage may occur. Repeated or prolonged exposure to dinitrobenzene may cause anemia.

### • 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 dinitrobenzene.

### • Recommended medical surveillance

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

—A complete blood count: Dinitrobenzene 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 dinitrobenzene, 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. Methemoglobin determinations should be performed at any time overexposure is suspected or signs and symptoms of toxicity occur.

### • Summary of toxicology

Absorption of any isomer of dinitrobenzene, whether from inhalation of the vapor or dust or skin absorption

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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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of the solid, causes anoxia due to the formation of methemoglobin; chronic exposure produces anemia. Exposed workers have complained of an unpleasant taste, burning sensation in the mouth, dry throat, and thirst. Signs and symptoms of 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 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. Until the methemoglobin concentration approaches approximately 40%, the individual may feel well, have no complaints, and may insist nothing is wrong. At methemoglobin concentrations of over 40%, there usually is weakness and dizziness; up to 70% concentration there may be ataxia, dyspnea on mild exertion, tachycardia, nausea, vomiting, and drowsiness. The ingestion of alcohol has been reported to aggravate the toxic effects of dinitrobenzene. Chronic exposure of workers causes anemia; there are scattered reports of liver injury. Visual impairment has been reported in the form of reduced visual acuity and central scotomas, particularly for red and green colors; yellow discoloration of the conjunctiva and sclera is common. Yellow-brown discoloration of the hair and exposed skin of workers has been reported.

## CHEMICAL AND PHYSICAL PROPERTIES

### • Physical data

1. Molecular weight: 168.1
2. Boiling point (760 mm Hg): Ortho: 318 C (604 F); Meta: 300 C (572 F); Para: 297 C (566 F)
3. Specific gravity (water = 1): Ortho: 1.59; Meta: 1.57; Para: 1.63
4. Vapor density (air = 1 at boiling point of dinitrobenzene): 5.8
5. Melting point: Ortho: 117 C (243 F); Meta: 90 C (194 F); Para: 173 C (343 F)
6. Vapor pressure at 20 C (68 F): All isomers: Much less than 1 mm Hg
7. Solubility in water, g/100 g water at 20 C (68 F): Ortho: 0.01; Meta: 0.05; Para: 0.01
8. Evaporation rate (butyl acetate = 1): Not applicable

### • Reactivity

1. Conditions contributing to instability: Dinitrobenzene may detonate when subject to shock or when heated under confinement.
2. Incompatibilities: Contact with strong oxidizers may cause fires and explosions. Contact with caustics and metals such as tin and 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 dinitrobenzene.

4. Special precautions: Liquid dinitrobenzene will attack some forms of plastics, rubber, and coatings.

### • Flammability

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

5. Extinguishant: None

### • Warning properties

Grant states that "surface contact (with dinitrobenzene) may cause yellowing of the skin, and purportedly of the conjunctiva and cornea, but no original observations on corneal changes were found in the literature." According to Grant, "2,4-dinitrobenzene caused no inflammatory response when this substance was brought into contact with the uveal tract, retina, or conjunctiva" of guinea pigs.

## 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 dinitrobenzene 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 skin contact with dinitrobenzene or liquids containing dinitrobenzene, where skin contact may occur.

- If employees' clothing may have become contaminated with solid dinitrobenzene, employees should change into uncontaminated clothing before leaving the work premises.

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

- Where exposure of an employee's body to liquids containing dinitrobenzene 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 liquids containing dinitrobenzene should be removed immediately and non-impervious clothing which becomes contaminated with dinitrobenzene should be removed promptly and such clothing should not be reworn until the dinitrobenzene is removed from the clothing.

- Employees should be provided with and required to use dust- and splash-proof safety goggles where dinitrobenzene or liquids containing dinitrobenzene may contact the eyes.

## SANITATION

- Skin that becomes wet with liquids containing dinitrobenzene should be immediately washed or showered with soap or mild detergent and water to remove any dinitrobenzene.

- Skin that becomes contaminated with dinitrobenzene should be promptly washed or showered with soap or mild detergent and water to remove any dinitrobenzene.

- Workers subject to skin contact with dinitrobenzene should wash with soap or mild detergent and water any areas of the body which may have contacted dinitrobenzene at the end of each work day.

- Eating and smoking should not be permitted in areas

where dinitrobenzene or liquids containing dinitrobenzene are handled, processed, or stored.

- Employees who handle dinitrobenzene or liquids containing dinitrobenzene 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 dinitrobenzene may occur and control methods which may be effective in each case:

Operation	Controls
Use in preparation of dyes and dye intermediates; use in organic synthesis in chemical industry as photographic developers, and as explosives	Process enclosure; general dilution ventilation; local exhaust ventilation; personal protective equipment
Use in plastics industry as a substitute for camphor in production of celluloid; as a polymerization inhibitor	Process enclosure; general dilution ventilation; local exhaust ventilation; personal protective equipment
Use as an explosive by substituting for TNT; use in explosive shells	Material substitution

## 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 dinitrobenzene or liquids containing dinitrobenzene 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 dinitrobenzene or liquids containing dinitrobenzene get on the skin, immediately wash the contaminated skin using soap or mild detergent and water. If dinitrobenzene or liquids containing dinitrobenzene penetrate through the clothing, remove the clothing immediately and wash the skin using soap or mild detergent and water. Get medical attention promptly.

### • Breathing

If a person breathes in large amounts of dinitrobenzene, 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 dinitrobenzene or liquids containing dinitroben-

zene 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 AND DISPOSAL PROCEDURES

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

- If dinitrobenzene 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.

- Waste disposal methods:

Dinitrobenzene may be disposed of:

1. By making packages of dinitrobenzene 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 dinitrobenzene 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 DINITROBENZENE (ALL ISOMERS)

<b>Condition</b>	<b>Minimum Respiratory Protection* Required Above 1 mg/m<sup>3</sup></b>
<b>Particulate Concentration</b>	
<b>5 mg/m<sup>3</sup> or less</b>	Any dust and mist respirator, except single-use.
<b>10 mg/m<sup>3</sup> or less</b>	Any dust and mist respirator, except single-use or quarter-mask respirator. Any fume respirator or high efficiency particulate filter respirator. Any supplied-air respirator. Any self-contained breathing apparatus.
<b>50 mg/m<sup>3</sup> or less</b>	A high efficiency particulate filter respirator with a full facepiece. Any supplied-air respirator with a full facepiece, helmet, or hood. Any self-contained breathing apparatus with a full facepiece.
<b>200 mg/m<sup>3</sup> or less</b>	A powered air-purifying respirator with a high efficiency particulate filter. A Type C supplied-air respirator operated in pressure-demand or other positive pressure or continuous-flow mode.
<b>Greater than 200 mg/m<sup>3</sup> or entry and escape from unknown concentrations</b>	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.
<b>Fire Fighting</b>	Self-contained breathing apparatus with a full facepiece operated in pressure-demand or other positive pressure mode.
<b>Escape</b>	Any dust and mist respirator, except single-use. Any escape self-contained breathing apparatus.

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

