

Occupational Health Guideline for Picric Acid

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: $\text{HOC}_6\text{H}_2(\text{NO}_2)_3$
- Synonyms: 2,4,6-Trinitrophenol; lyddite; pertite; shimose; melinite
- Appearance and odor: Odorless yellow solid or paste.

PERMISSIBLE EXPOSURE LIMIT (PEL)

The current OSHA standard for picric acid is 0.1 milligram of picric acid per cubic meter of air (mg/m^3) averaged over an eight-hour work shift.

HEALTH HAZARD INFORMATION

• Routes of exposure

Picric acid can affect the body if it is inhaled, if it comes in contact with the eyes or skin, or if it is swallowed.

• Effects of overexposure

Exposure to picric acid dust and fume may cause eye and skin irritation. The dust and solutions of picric acid may cause an allergic skin rash. The skin and hair may be stained yellow. Inhalation of high concentrations of dust has caused unconsciousness, weakness, muscle pain, and kidney problems. Swallowing picric acid may cause a bitter taste, headache, dizziness, nausea, vomiting, and diarrhea. High doses may cause destruction of the red blood cells and damage to the kidneys and liver with blood in the urine. High doses such as these may color the skin and other tissues yellow and cause yellow tinted vision.

• 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 picric acid.

• Recommended medical surveillance

The following medical procedures should be made available to each employee who is exposed to picric acid 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. Persons with a history of asthma, allergies, or known sensitization to picric acid may be at increased risk from exposure. Examination of the kidneys, liver, and blood should be stressed. The skin should be examined for evidence of chronic disorders.

—Urinalysis: Since kidney damage has been observed in humans exposed to picric acid, a urinalysis should be obtained to include at a minimum specific gravity, albumin, glucose, and a microscopic on centrifuged sediment.

—Liver function tests: Since liver damage has been observed in humans exposed to picric acid, 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.

• Summary of toxicology

Picric acid dust causes sensitization dermatitis. This usually occurs on the face, especially around the mouth and the sides of the nose; the condition progresses from edema, through the formation of papules and vesicles, to ultimate desquamation. The skin and hair of workers handling picric acid are stained yellow. Inhalation of high concentrations of the dust by one worker caused temporary coma followed by weakness, myalgia, anuria, and later polyuria. Following ingestion of 2 to 5 g of picric acid, which has a bitter taste, there may be

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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headache, vertigo, nausea, vomiting, diarrhea, yellow coloration of the skin, hematuria, and albuminuria; high doses cause destruction of erythrocytes, hemorrhagic nephritis, and hepatitis. High doses which cause systemic intoxication will color all tissues yellow, including the conjunctiva and aqueous humor, and cause apparent yellow-tinted vision. Corneal injury has resulted from a splash of a solution of picric acid into the eyes; dust or fume may cause eye irritation which may be aggravated by sensitization.

CHEMICAL AND PHYSICAL PROPERTIES

• Physical data

1. Molecular weight: 229.1
2. Boiling point (760 mm Hg): Greater than 300 C (572 F); explodes
3. Specific gravity (water = 1): 1.6– 1.76
4. Vapor density (air = 1 at boiling point of picric acid): Not applicable
5. Melting point: 122 C (252 F)
6. Vapor pressure at 20 C (68 F): Much less than 1 mm Hg
7. Solubility in water, g/100 g water at 20 C (68 F): 1.4
8. Evaporation rate (butyl acetate = 1): Not applicable

• Reactivity

1. Conditions contributing to instability: Explodes above 300 C (572 F)
2. Incompatibilities: Contact with copper, lead, zinc, and other metals (or with their salts) can form salts of picric acid that are initiators and much more sensitive to shock than picric acid itself. Shock-sensitive salts also include ammonium salts and calcium salts; the calcium salt may form when picric acid comes into contact with plaster or concrete.

3. Hazardous decomposition products: Toxic gases and vapors (such as oxides of nitrogen and carbon monoxide) may be released in a fire involving picric acid.

4. Special precautions: Protect from shock.

• Flammability

1. Flash point: 150 C (302 F) (closed cup)
2. Autoignition temperature: 300 C (572 F) (approx).
3. Impact sensitivity (minimum fall of a 2 kg weight to cause at least one explosion in ten trials): 82 cm
4. Explosion temperature (temperature required to cause explosion in 5 seconds): 322 C (612 F)
5. Flammable limits in air, % by volume: Data not available
6. Extinguishant: Water. Do not attempt to extinguish massive fires.

• Warning properties

The ILO states, "The effects of picric acid on the eyes include irritation, corneal injury and strange visual effects, e.g. yellow appearance of objects, and yellow colouring of the tissues." Grant also states that "picric acid dust or fumes cause irritation of the eyes of men

and animals, and this may be aggravated by sensitization." No quantitative information is available concerning the air concentrations which produce these effects, however. Information is not available concerning the threshold of eye irritation.

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 an adsorption tube with a subsequent chemical analysis of the adsorption tube. Also, detector tubes certified by NIOSH under 42 CFR Part 84 or other direct-reading devices calibrated to measure picric acid may be used. An analytical method for picric acid 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 skin contact with solid picric acid or liquids containing picric acid, where skin contact may occur.

- If employees' clothing may have become contaminated with picric acid, employees should change into uncontaminated clothing before leaving the work premises.
- Clothing which may have become contaminated with picric acid should be placed in closed containers for storage until it can be discarded or until provision is made for the removal of picric acid from the clothing. If the clothing is to be laundered or otherwise cleaned to remove the picric acid, the person performing the operation should be informed of picric acid's hazardous properties.
- Non-impervious clothing which becomes contaminated with picric acid should be removed promptly and not reworn until the picric acid is removed from the clothing.
- Employees should be provided with and required to use dust- and splash-proof safety goggles where solid picric acid or liquids containing picric acid may contact the eyes.

SANITATION

- Workers subject to skin contact with solid picric acid or liquids containing picric acid should wash any areas of the body which may have contacted picric acid at the end of each work day.
- Skin that becomes contaminated with picric acid should be promptly washed or showered with soap or mild detergent and water to remove any picric acid.
- Eating and smoking should not be permitted in areas where solid picric acid or liquids containing picric acid is handled, processed, or stored.
- Employees who handle solid picric acid or liquids containing picric acid 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 picric acid may occur and control methods which may be effective in each case:

Operation	Controls
Use in munitions and explosives manufacturing	Material substitution; process enclosure; local exhaust ventilation; personal protective equipment

Use in synthesis of dyes and dye intermediates in textile industry; use in manufacture of medicinals; use in etching of metal on printing plates of copper, steel, or other metals

Material substitution; process enclosure; local exhaust ventilation; personal protective equipment

Use in manufacture of pyrotechnics and compounds for pyrotechnics as color intensifiers and as an oxidizer in matches

Material substitution; process enclosure; local exhaust ventilation; personal protective equipment

Use as a chemical reagent in identification, isolation, and purification of other compounds; use in manufacture of colored glass; and in the manufacture of electric batteries

Material substitution; 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 picric acid or liquids containing picric acid get into the eyes, wash eyes immediately with large amounts of water, lifting the lower and upper lids occasionally. If irritation is present after washing, get medical attention immediately. Contact lenses should not be worn when working with this chemical.

• Skin Exposure

If picric acid or liquids containing picric acid get on the skin, promptly wash the contaminated skin using soap or mild detergent and water. If picric acid or liquids containing picric acid penetrate 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 picric acid, 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 picric acid or liquids containing picric acid 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 picric acid is spilled, the following steps should be taken:

1. Remove all ignition sources.
2. Ventilate area of spill.
3. Attempt to reclaim spilled material; however, do not sweep or burn unless this is supervised by explosive experts.

- Waste disposal method:

Picric acid may be disposed of only by explosives experts.

ADDITIONAL INFORMATION

To find additional information on picric acid, look up picric acid in the following documents:

- Medical Surveillance for Chemical Hazards
- Respiratory Protection for Chemical Hazards
- Personal Protection and Sanitation for Chemical Hazards

These documents are available through the NIOSH Division of Technical Services, 4676 Columbia Parkway, Cincinnati, Ohio 45226.

REFERENCES

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RESPIRATORY PROTECTION FOR PICRIC ACID

Condition	Minimum Respiratory Protection* Required Above 0.1 mg/m ³
Particulate Concentration	
0.5 mg/m ³ or less	Any dust and mist respirator, except single-use.**
1 mg/m ³ or less	Any dust and mist respirator, except single-use respirator or quarter-mask.** Any fume respirator or high efficiency particulate filter respirator.** Any supplied-air respirator.** Any self-contained breathing apparatus.**
5 mg/m ³ or less	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.
100 mg/m ³ or less	A powered air-purifying respirator with a full facepiece and a high efficiency particulate filter. 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 100 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 dust and mist respirator, except single-use. Any escape self-contained breathing apparatus.

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

**If eye irritation occurs, full-facepiece respiratory protective equipment should be used.