



Guidelines for the Safe Handling of Picric Acid

1) Introduction

Picric acid (Trinitrophenol, picronic acid) is a pale yellow, odorless crystal that is slightly soluble in water. Outside of laboratories picric acid has primarily been used for explosives and fireworks. Within the lab, picric acid is used in many common fixatives for histology applications such as staining of microscopic specimens as well as pharmaceutical applications. Picric acid can be safely used when it is diluted or hydrated with water or moisture, but it poses a potential explosion hazard when it dries.

2) Physical Properties

Compound: Picric Acid

Synonyms: 2,4,6-trinitrophenol, picronic acid, phenol trinitrate, 2-hydroxy-1,3,5-trinitrobenzene, carbazotic acid, nitroxanthic acid

CAS No: CAS No. 88-89-1

Mol. Formula: $C_6H_2(NO_2)_3OH$ or [C₆H₃N₃O₇](#)

Molecular Weight: 229.104 g/mol

Boiling Point: > 300 °C (572 °F; 573 K) Detonates

Specific gravity: 1.76 at 20°C (water = 1)

Vapor density: 7.9 (air = 1)

pKa: 0.3

Description: Pale yellow, odorless crystal that is slightly soluble in water.

Solubility: Slightly soluble in water

Flammability: Explosive above 300°C (Highly Flammable)

3) Chemical Properties

Picric acid is an odorless, yellow, crystalline organic solid. It should always be stored under a volume of water to protect against explosion. The aqueous phase becomes yellow with 1-2% dissolved picric acid. Picric acid is not compatible with metals which include copper, lead and zinc (corrodes the metal to form shock-sensitive salts), aluminum and water (ignites after a delay), ammonia, concrete (forms explosive calcium picrate), plaster, salts, oxidizers. Picrate salts are often more explosive/shock sensitive than the picric acid itself. Avoid heat, flame, ignition sources, shock, dryness and the many incompatible materials which may cause explosion. It will also react with alkaline materials including plaster and concrete to form explosive materials. The rapid decomposition generates nitrogen, carbon dioxide, water, and other toxic substances.

4) Toxicity

Inhalation: Picric acid is toxic by inhalation, in contact with skin, and if swallowed.

Toxicity may occur following systemic absorption by any exposure route and consists of

lassitude, a bitter taste in the mouth, myalgias, anuria, polyuria, gastrointestinal disturbances, and hepatic and kidney injuries. Animal experiments indicate that ingestion of less than 40 gram may be fatal and can cause serious complications.

Ingestion: Picric acid has an intense bitter taste. Several human poisonings have occurred after the ingestion of 1-2 grams picric acid. Symptoms include gastroenteritis, toxic hepatitis, inflammation of the kidney (nephritis), blood in the urine (haematuria) and other urinary symptoms. Symptoms may not be evident until several hours after exposure. At about 15% concentration of blood methemoglobin there is observable cyanosis of the lips, nose and earlobes. Symptoms may be absent although euphoria, flushed face and headache are commonly experienced. At 25-40%, cyanosis is marked but little disability occurs other than that produced on physical exertion. At 40-60%, symptoms include weakness, dizziness, lightheadedness, increasingly severe headache, ataxia, rapid shallow respiration, drowsiness, nausea, vomiting, confusion, lethargy and stupor. Above 60% symptoms include dyspnea, respiratory depression, tachycardia or bradycardia, and convulsions. Levels exceeding 70% may be fatal.

Eye Contact: Although picric acid is said not to be an irritant, direct eye contact does have an effect on the eyes. It causes discomfort by conjunctival redness.

Inhalation: Inhalation of picric acid for long periods of time can lead to respiratory discomfort and distress. Symptoms include cough, sore throat, and respiratory irritation. According to OSHA, the legal permissible exposure limit (PEL) 0.1 mg/m³.

5) Working with Picric Acid

1) Preparation

Before any researcher uses Picric Acid, they should do the following:

- Read the Safety Data Sheet (SDS) for Picric Acid.
- Read this document and consult the references below.
- Review or create a Standard Operating Procedure (SOP) for the process in which picric acid is used, incorporating information contained in this document.
- Contact the Office of Research Safety Affairs (telephone number 901-448-6114) with any questions.

2) Personal Protective Clothing

When using picric acid, you must wear at least the following protective clothing:

- Laboratory coat (fully extended sleeves)
- Safety glasses

- Gloves (nitrile, neoprene, or other picric acid gloves)
- Close-toed shoes and long pants

3) Safe Laboratory Practices

- Make sure any stored picric acid is always wet.
- Clean bottleneck, cap and threads with a wet cloth before re-sealing.
- Check for evidence of dried crystals and rehydrate contents every 6 months with DI water as needed. Document on the bottle.
- Don't allow picric acid to come in long-term contact with metal surfaces.
- Never work alone while using picric acid.
- Do not store large amounts of picric acid.
- Store in original containers in approved flame-proof area.
- Store in a fireproof cabinet.
- Use picric acid in a fume hood to reduce exposure
- Maintain a log for regular inspection of containers, usage, and the dates of receipt and opening.
- Provide fire extinguishers near or around storage area.
- Contact the Research Safety Affairs for pick-up of unwanted chemicals.

4) Transporting Picric Acid

- **Do not touch, move, or open a container of dry picric acid!** Contact Research Safety Affairs IMMEDIATELY (901-448-6114) upon discovery of dry picric acid.
- Use extreme caution with containers that contain picric acid.
- Keep picric acid away from heat.

5) Managing Picric Acid Containing Waste

- Always make sure picric acid is always disposed of in excess water.
- Do not pour picric acid down the drain due to its reactivity with metal.
- Contact Office of Research Safety Affairs for waste disposal by calling 901-448-6114 or emailing labsafety@uthsc.edu

6) First Aid

Symptoms of picric acid exposure are often delayed up to several hours. If you suspect you may have been exposed to picric acid, but you are not experiencing any immediate symptoms, apply immediate first aid. A quick response can reduce injury.

Skin Contact

- Immediately rinse the affected area thoroughly with large amounts of water 15 minutes.

- Use emergency shower if necessary and remove all contaminated clothing while continuing to flush with water.
- Inform a lab manager/supervisor and call for medical assistance.

Eye Contact

- Use emergency eyewash station to immediately flush the eyes with water for at least 15 minutes.
- While the victim is rinsing the affected area, someone should call 911 for medical assistance.

Inhalation

- Immediately move the victim to fresh air.
- Inform lab staff and call 911 for medical assistance.

Ingestion

- Have the victim rinse mouth thoroughly with water.
- While the victim is rinsing his/her mouth, someone should call 911 and ask for medical assistance.
- Do not induce vomiting.
- Have victim drink 240 to 300 mL (8 to 10 oz.) of water to dilute material in the stomach. If milk is available, it may be administered after the water has been given.

7) Picric Acid Spills

Review the “Chemical Spills” procedure on the Office of Research Safety Affairs website (<https://www.uthsc.edu/research/safety/chemical-spills.php>). This document provides criteria to assist in determining when a chemical spill can be addressed by local researchers (minor spills) or when outside help is required (major spills). It also offers guidance on how to cleanup a minor spill. No researcher is responsible for addressing a spill themselves if they are not comfortable doing so, even if the spill meets the characteristics of a “minor” one.

If a major picric acid spill occurs, follow the Emergency Chemical Spill Procedures described in the “Chemical Spill” Policy:

- Cease all activities and immediately evacuate the affected area (make sure that all personnel in the area are aware of the spill and also evacuate).
- If chemical exposure has occurred to the skin or eyes, the affected personnel should be taken to the nearest safety shower and eye wash station.
- Dial 901-448-4444, which will contact the UTHSC Police Department (UTHSC PD). The UTHSC PD will contact the Office of Research Safety Affairs to initiate an emergency chemical spill response and clean up. If the situation is, or could become an emergency (e.g. chemical exposure has occurred, a fire or explosion has occurred), the UTHSC PD will be able to contact the appropriate authorities such as

the fire department and administration. Be prepared to provide the following information

- Name of person reporting
- Any injuries or exposures
- The location of the spill (building and room number)
- The type of material(s) and approximate volume spilled
- Control measures already implemented
- Control access to the spill location until the spill response team arrives. This can be done by closing doors, posting signs or otherwise preventing personnel from entering the vicinity of the spill or areas where toxic vapors may be present.

In the case of a small spill restricted inside a chemical fume hood, the spill can be cleaned by laboratory staff assuming that the correct equipment is present and that the staffs understands the hazards associated with picric acid.

- Do not allow spilled material to dry - dampen spilled solids with water or a 2% v/v aqueous solution of acetone without stirring to keep picric acid wet.
- NEVER attempt to sweep up dry material; always keep picric acid wet to reduce any explosion hazards.
- Use a spill response pad or pillow damp with water to absorb spilled material.
- Place the pads / pillows in a compatible, impervious container with water added.
- Thoroughly wash the spill site after material pickup is complete.
- Collect all picric acid-containing waste in plastic or glass bottles for disposal.
- Clearly identify the waste container with "Picric Acid Waste" written on it.
- Contact Office of Research Safety Affairs 901-448-6114 or email (labsafety@uthsc.edu) to request an immediate pick-up of the containers of spilled product and contaminated absorbent material.

References:

(Concordia University, 2016)

(Santa Cruz Biotechnology, Inc, 2010)

(Environment, Health & Safety Department- University of Wisconsin-Madison, 2017)