

PICRIC ACID SAFETY GUIDELINES

Picric Acid is a trinitro-aromatic compound frequently found in forensic and histology laboratories as a staining and fixative agent. It was used in medicinal formulations in the treatment of malaria, trichinosis, herpes, smallpox and antiseptics. This compound is related to trinitrotoluene (TNT) and has been shown to be a high-power explosive and is mainly used in the ammunition and explosive industry. Therefore, careful precautions should always be taken when handling this chemical. This document discusses the properties, health and safety hazards of picric acid and how to properly handle and store picric acid. Also included are emergency procedures for dealing with accidental picric acid contact, including first aid treatment information.

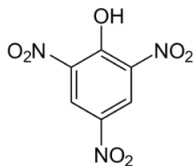
☠️*WARNING*☠️: When dry, picric acid can form unstable crystals that are shock, friction or heat sensitive and create a powerful explosion. Dry picric acid can also form even more unstable salts explosive picrate salts when in contact with concrete, amines, bases, and certain metals. Picric acid should always be kept wet with at least 10% water.

1. Properties

Names:	solid state:	picric acid; 2,4,6-trinitrophenol; 1,3,5-trinitrophenol
	aqueous solution:	saturated solution (1.3% in water)
	staining solutions:	Van Gieson's stain, Bouin's staining solution, Picro Sirius Red stain, Christmas Tree stain (all solutions contain less than 1% picric acid)

Chemical Formula: $C_6H_2(NO_2)_3OH$

Chemical Structure:



CAS #: 88-89-1

Physical aspect: bright yellow crystals
odorless, bitter taste
soluble in hot water, alcohol, ether and chloroform

Table 1 summarizes physical and toxicological properties of picric acid.

Table 1. Physical and Toxicological Properties of Picric Acid

Molar Mass	229.11 g/mol
Boiling point	>300°C (explodes)
Melting point	122.5°C
Vapor pressure	<1 mmHg at 20°C
Density	1.763 g/cm ³
pKa (water)	0.38
PEL (TWA)	0.1 mg/m ³
IDHL	100 mg/m ³

2. Hazard Classification

 For Picric acid that is wetted with at least 30% water:

WHMIS (2015):



Flammable solids (Category 1)
Acute toxicity, Oral (Category 3)
Acute toxicity, Inhalation (Category 3)
Acute toxicity, Dermal (Category 3)
Specific target organ toxicity – repeated exposures (Category 2):
liver, kidney, blood
Skin sensitisation (Category 1)

NFPA 704:



Flammability: Flammable
Health hazard: Potential acute and chronic health effects
Instability/Reactivity: Unstable (shock, heat, ignition sources, alkalis and metals) when dry. Explodes when heated to 300°C.

 For saturated picric acid solution (1.3% in water):

WHMIS (2015):



Skin sensitisation (Category 1) (limited evidences)

NFPA:



Flammability: Flash point more than 93°C
Health hazard: Normal material
Instability/Reactivity: May explode

3. Fire and Explosion Hazards

Picric acid is usually stored with at least 10% moisture content. As the water evaporates over time, the substance becomes dry picric acid crystals. Dry picric acid is highly explosive especially when it is combined with metals such as copper, lead, zinc and iron. It will also react with alkaline materials including plaster and concrete to form explosive materials. These salts are even more reactive and shock sensitive than the acid itself.

Picric acid has an explosive velocity, also known a velocity of detonation (VoD) (the velocity at which the shock wave front travels through a detonated explosive) of 7,350 m/s. The US Department of Transportation classifies picric acid with less than 30% water by mass as a Class 1.1D explosive; with greater than 10% water by volume, it is a class 4.1 flammable solid. In the wetted state, it is unlikely to be an explosive hazard. Vigorous reactions occur

with oxidising and reducing materials. Combustion of picric acid produces toxic oxides of carbon and nitrogen when heated to decomposition.



4. Health Hazards

Picric acid is toxic! According to ACGIH TLV documentation (2001) systemic poisoning after absorption of picric acid in man, ingestion of 1-2 grams would cause severe poisoning. Systemic poisoning causes headache, vertigo, nausea, vomiting, diarrhea, inflammation of kidney and acute hepatitis. Red colored urine may be produced.

Based on pH value (1.3 for saturated solution) picric acid is a strong acid and it is expected to be corrosive or strong irritant. The dust is irritating to the skin and eye. A peculiar effect on the eye is “yellow” tainted vision. The skin will turn yellow in severe exposures. It is considered a skin sensitizer which can cause an allergic reaction that can spread from the hands / arms to the rest of the body. However, these symptoms would not be expected in the laboratory environment under safe usage practices. No human or animal carcinogenicity data for picric acid are available.

5. Safety Precautions for Picric Acid Use

a) Training

Students and employees who handle picric acid must have read the Safety Data Sheet (SDS) and receive training on the hazards of picric acid from their respective department. They must know what to do in the event of a spill or an exposure incident. The SDS must always be kept the immediate vicinity of the working area along with the Standard Operating Procedure (SOP) developed by the student / employee's department.

b) Ventilation

Picric acid **MUST** be handled in a well-ventilated area. Picric acid and picric acid solutions **MUST** be handled inside a certified chemical fume hood.

c) Eye Protection

Safety glasses or splash goggles **MUST** be worn when handling picric acid and picric acid solutions.

d) Gloves

Nitrile, neoprene, butyl and Viton gloves are suggested when working with picric acid (latex is not effective). However, their use should be limited to periods of 1-4h maximum. Refer to the different manufacturers' glove compatibility charts for other compatible gloves.

e) Protection Clothing

A lab coat with long sleeves **MUST** be worn when handling picric acid and picric acid solutions. **No exposed skin is allowed**; long pants, sleeves, and closed toe shoes must be worn.

f) Safe Work Practice

- Never work alone when using picric acid.
- Always dispense picric acid in a working fume hood.
- Visually inspect the container prior to use.
- Do not use metal spatulas to remove the material.
- Always clean the neck of the bottle, cap and thread with a wet cloth before recapping and seal cap with Parafilm.

6. Storage, Spill and Waste Issues

a) Storage

As picric acid is considered to be corrosive, typical guidelines used for concentrated acids should be followed. Furthermore, the following points must also be observed:

- Solid picric acid must be stored with at least 10% moisture content and regular inspections must be made to ensure that the minimum moisture content is maintained. If it is suspected that the moisture content is less than 10%, do not move or open the bottle because the potential for shock-sensitive explosion exists. **NEVER LET PICRIC ACID DRY OUT.**
- Store Picric Acid in a cool, dry, well-ventilated area, out of direct sunlight and away from sources of heat. **NEVER USE DESICCANT.**
- Use and store picric acid in containers made of polyethylene, polypropylene, Teflon or glass. Containers with metal caps should be avoided.
- Protect from freezing temperatures.
- Picric acid is incompatible and must not be stored with oxidizers, reducing agents, inorganic salts, alkaloids and metals. Picric acid can react with metals to form picrate salts which are explosive.
- An up-to-date inventory should be kept to ensure picric acid is stored in the minimum quantity necessary.
- If possible, eliminate it from your inventory by purchasing premixed stains or a 1% solution for using in stain preparation.

b) Spills

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 staff understands the hazards associated with picric acid.

1. **NEVER** 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.
2. **NEVER** attempt to sweep up dry material; always keep picric acid wet to reduce any explosion hazards.
3. Use a spill response pad or pillow damp with water to absorb spilled material.
4. Place the pads / pillows in a compatible, impervious container with water added.
5. Thoroughly wash the spill site after material pickup is complete.
6. Collect all picric acid-containing waste in plastic or glass bottles for disposal.
7. Clearly identify the waste container with "Picric Acid Waste" written on it.
8. Contact EHS (hazardouswaste@concordia.ca) to request an immediate pick-up of the containers of spilled product and contaminated absorbent material.

In the event of a large spill located outside a chemical fume hood, the spill must be cleaned by only the Concordia Spill Response Team.

1. Advise and warn co-workers.
2. Evacuate the area immediately.
3. Restrict the access to the area.
4. Notify CSPS (Campus Safety and Prevention Services) at ext. **3717** or **514 848-3717**, providing them with the following information:
 - a. Name of hazardous material
 - b. Quantity involved
 - c. Related health risks and precautions to be taken
5. Provide Safety Data Sheet (SDS) or appropriate documentation.

c) Waste Handling

Picric acid should be disposed as a hazardous waste within 2 years of initial receipt. If you decide to dispose of **your wet picric acid**, some options are available:

1. Make sure that any picric acid disposed of still has some water content.
2. Contact EHS for disposal (for wet solutions of picric acid only).
3. **DO NOT** pour picric acid down the drain; it could react with copper or iron piping to form the explosive salts.

If an old container of picric acid is found and either:

- Crystals are present around the lid and/or container or;
- Picric acid inside does not seem to be wet and has solidified.

Do not touch the container as it might be highly unstable and shock sensitive.

Any attempts to move or open the container might result into an explosion. Visually inspect the container in order to identify the content and to look for an expiration date. If any signs of crystallization is present:

1. Evacuate the laboratory and secure the area by restricting access.
2. Call CSPS at ext. **3717** indicating the possibility of dry picric acid being present in the laboratory.

7. Emergency Procedures

a) Skin Contact

1. Immediately rinse the affected area thoroughly with large amounts of water 15 minutes.
2. Remove all contaminated clothing while continuing to flush with water.
3. While the victim is rinsing the affected area, someone should call CSPS at ext. **3717** and ask for medical assistance.

b) Eye Contact

1. Immediately flush the eyes with plenty of water for at least 15 minutes.
2. While cold water may be used, warm water is must.
3. While the victim is rinsing the affected area, someone should call CSPS at ext. **3717** for emergency medical assistance.

c) Inhalation

1. Immediately move the victim to fresh air.
2. Call CSPS at ext. **3717** and ask for medical assistance.

d) Ingestion

1. Have the victim rinse mouth thoroughly with water.
2. While the victim is rinsing his/her month, someone should someone should call CSPS at ext. **3717** and ask for medical assistance.
3. Do not induce vomiting.
4. 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.

In all cases of exposures, a copy of the Safety Data Sheet (SDS) must be brought to the emergency room as the treating physician might be unaware of the treatment measures for picric acid. All picric acid incidents must be reported to your Supervisor and to Environmental Health & Safety. An [injury/near-miss report](#) must be filled for any incident involving picric acid spill or exposure.

If you have any concerns about the use of picric acid at Concordia University, please contact EHS at ehs@concordia.ca.

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Revised: August 2016; July 2024

References (Updated in June 2024):

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- Sigma-Aldrich [SDS](#) for Picric acid.
- Sigma-Aldrich [SDS](#) for Picric acid solution (1.3% in H₂O (saturated)).
- [NIOSH Pocket Guide](#) - Picric acid – Consulted in July 2024.
- [Lab incident summary: Dry picric acid](#) - The University of Texas at Austin EHS – Consulted in July 2024.
- [Information on picric acid](#) - Stanford EHS – Consulted in July 2024.
- [Picric acid hazards](#) - Mark Cameron, CIH – Consulted in July 2024.
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- UBC Safety & Risk Services – [Working Safely with Picric Acid](#) – Consulted in July 2024.
- Chandra, T.; Zebrowski, J. P.; McClain, R.; Lenertz, L. Y. Generating Standard Operating Procedures for the manipulation of hazardous chemicals in academic laboratories. *ACS Chem. Health Saf.* **2021**, *28*, 19-24. <https://dx.doi.org/10.1021/acs.chas.0c00092>.