

<p>Carnegie Mellon University Environmental Health & Safety FIRE LAB WORK</p>	<p>Environmental Health and Safety Preparation and Use of Piranha Solutions - Guideline</p>
<p>Date of Issuance: 03/2023</p>	<p>Revision Date:</p>
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1. Purpose

The mission of Environmental Health and Safety (EHS) is to support the University's mission and values by sustaining and enhancing a safe and healthy environment for the CMU community.

2. Scope

This Guideline provides information for the safe preparation and use of Piranha solutions, as it applies to Carnegie Mellon University faculty, staff, and students engaged in the storage or use of such materials.

3. Overview

Piranha solutions are used to remove organic residues from substrates, particularly in micro-fabrications labs. The traditional piranha solution is a 3:1 mixture of sulfuric acid and 30% hydrogen peroxide. The solution may be mixed before application or directly applied to the material, applying the sulfuric acid first, followed by the peroxide. Piranha solutions are extremely energetic, they can self-heat to up to 120°C (248°F). This may result in explosion or skin burns if not handled properly.

Considering these hazards, users are encouraged to use an alternative chemical, called Nano-Strip. It is a pre-mixed, stabilized solution with lower quantities of peroxide.

4. Roles and Responsibilities

- a. Carnegie Mellon University EHS is responsible for:
 - i. Developing the written Preparation and Use of Piranha Solutions Safety Guidelines and revising as necessary;
 - ii. Recommending engineering controls, administrative controls and personal protective equipment;
 - iii. Providing guidance to employees, as appropriate, and;
 - iv. Conducting inspections at least annually to ensure the proper use of Piranha solutions.
- b. Departments will be responsible for:
 - i. Understanding and complying with the requirements of this Guideline;
 - ii. Contacting EHS at safety@andrew.cmu.edu if assistance is needed.
- c. Users will be responsible for:

- i. Completing both [Laboratory Safety training and Hazardous Waste generator training](#) prior to initial use;
- ii. Complying with the procedures outlined in this Guideline;
- iii. Purchasing chemicals used to prepare Piranha solutions in accordance with the EHS "[Hazardous Materials Purchasing Guideline](#)";
- iv. Submitting "Permission to Work Alone Forms" when activities conducted are covered under the EHS "[Working Alone in Research Laboratories, Shops, Studios and Work Areas Guideline](#)";
- v. Maintaining a clean and hygienic work area in rooms where Piranha solutions are prepared or used, and;
- vi. Informing the supervisor of concerns relating to preparation and use of Piranha solutions.

5. Exposure Controls

- a. Engineering Controls
 - i. All work with Piranha solutions with the potential to create exposure via inhalation must be done in a properly functioning chemical fume hood, glove box, or ventilated enclosure.
 - ii. Piranha solutions may not be handled or stored outside of the laboratory
- b. Administrative Controls
 - i. Particularly Hazardous Substance (PHS) Forms must be completed when preparing and using Piranha solutions. PHS forms can be found at: <https://www.cmu.edu/ehs/Laboratory-Safety/chemical-safety/documents/ehs---particularly-hazardous-substances-procedure-protocol-form.pdf>. Additional information on PHS use may be found in the Carnegie Mellon [Chemical Hygiene Plan](#).
 - ii. Consult Safety Data Sheets (SDS) for hazard and exposure information for all components used to create Piranha solutions.
 - iii. Glass containers (preferably Pyrex) must be used for preparation and use of Piranha solutions.
 - iv. Open containers of Piranha solutions must be placed in a leak-proof secondary container during use.
 - v. When preparing the Piranha solution, always add the peroxide to the acid.
 - vi. Never store Piranha solutions. Piranha solutions stored in a closed container will likely explode. Mix fresh solutions for each use, preparing only the amount expected for current use.
 - vii. Never add any acids or bases to Piranha solutions or spray it with water since it will accelerate the reaction. Spraying with water could also cause violent reaction or explosion. This includes bulk Photoresist in solution, which is a strong base.
 - viii. Never mix hot Piranha solutions with organic compounds since it may cause an explosion. This includes acetone, isopropyl alcohol, and nylon.
 - ix. Leave hot Piranha solution in an open container until cool.

- x. Wash hands thoroughly with soap and water after handling any chemical and prior to leaving the lab.
- xi. Never prepare or use Piranha solutions alone. Always use a Buddy system (knowledgeable person accompanying you), should an emergency situation occur.
- c. Training
 - i. Laboratory Safety training and Hazardous Waste Generator training must be completed by all lab personnel using Piranha solutions prior to initial use and every two years thereafter.
 - ii. For additional information on training, please visit [the CMU EHS Training Directory](#).
- d. Personal Protective Equipment (PPE)
 - i. Eye Protection
 - 1. Safety goggles and/or full face shields must be worn when working with Piranha solutions.
 - ii. Gloves
 - 1. Gloves compatible with each material that is used must be worn when working with Piranha solutions. Please refer to Section 8 of Safety Data Sheet or Glove selection charts.
 - iii. Other
 - 1. Lab coats, closed toed shoes, and clothing that covers entire legs and arms must be worn when working with Piranha solutions. Chemical aprons may also be required.

6. Disposal

- a. Do not collect Piranha solutions for hazardous waste disposal. After the material has cooled, aspirate excess Piranha and dispose via the drain, flushing the drain with copious amounts of water. Solutions must be at room temperature prior to disposal. Solutions should be poured into water for dilution, not the other way around. Note that not all lab drains are suitable for disposing of such a corrosive solution, and repeated disposal of Piranha solutions could lead to failure of the drain piping, ultimately leading to a release of Piranha solutions. Please contact EHS if you have concerns about your lab drain.

7. Emergency Procedures

- a. Personal Injury or Contamination
 - i. For eye contamination, flush with an eyewash for 15 minutes. Contact University Police at (412) 268-2323 and EHS at (412) 268-8182.
 - ii. For localized skin contamination, wash the impacted area with soap and water. Contact University Police at (412) 268-2323 and EHS at (412) 268-8182
 - iii. For widespread contamination, remove contaminated clothing and shoes and flush body with an emergency safety shower. Contact EHS at (412) 268-8182 and University Police at (412) 268-2323.
- b. Small Chemical Spills
 - i. Stop work and turn off equipment.

- ii. Alert people in the immediate area of the spill.
 - iii. Avoid breathing vapors from the spill.
 - iv. Wear protective clothing and gloves when addressing spills.
 - v. Confine spills to a small area.
 - vi. Use the chemical spill kit to clean the area.
 - vii. Collect the residue, place in labeled container and contact [EHS](#) for disposal as hazardous waste.
- c. Large Chemical Spills
- i. Stop work and turn off equipment.
 - ii. Alert people in the immediate area of the spill.
 - iii. Attend to your own needs first and then assist injured or contaminated people.
 - iv. Control the spread of contamination if safe to do so.
 - v. Keep people away from the location.
 - vi. Close door as you exit and evacuate to a safe location.
 - vii. Contact University Police at (412) 268-2323 and EHS at (412) 268-8182.
 - viii. Remain safely in the area to inform emergency responders of:
 1. Number and extent of injured people;
 2. Name(s) and volume(s) of material(s) involved; and
 3. Hazards associated with the material(s).

8. Revisions

Date	Documented Changes	Initials

For additional questions or concerns please contact EHS at safety@andrew.cmu.edu.