

University of Pittsburgh Safety Manual	EH&S Guideline Number: 04-034	
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GUIDELINES FOR THE SAFE USE OF PIRANHA SOLUTION

Piranha solution is often used to remove unwanted residues from laboratory materials and devices requiring high-purity surfaces. Piranha solutions typically contain a 3:1 mixture of concentrated sulfuric acid and 30% hydrogen peroxide. This mixture results in an energetic, exothermic reaction, and it is both highly corrosive and a strong oxidizer. Due to its reactivity and heat generation, extreme caution must be used when preparing and handling Piranha solution.

1. Health Hazards

- 1.1 Piranha solution is corrosive to the eyes, skin, and mucous membranes. Contact can cause severe burns and permanent damage.
- 1.2 Inhalation of Piranha solution vapors can lead to respiratory irritation causing coughing and shortness of breath.
- 1.3 Ingestion of Piranha solution will result in burning and corrosion of the mouth, throat, and stomach.

2. Safety Precautions

- 2.1 Laboratory staff/students who work with Piranha solution should receive laboratory-specific training on the associated hazards and what to do in the event of an exposure or a spill. Safety Data Sheets (SDSs) from the specific chemical manufacturer for hydrogen peroxide (30%) and sulfuric acid should be maintained in the immediate work area where Piranha solution is used. This Guideline, along with SDSs and additional laboratory-specific procedures, should be used for training laboratory staff/students on the hazards of Piranha solution. All training should be documented by the Principal Investigator or Laboratory Director.
- 2.2 Work with Piranha solution should always be performed inside a certified chemical fume hood. Care should be taken to clear the hood of incompatible materials such as combustibles, organics, and bases.
- 2.3 Chemical goggles along with a face shield are recommended when handling Piranha solution. Due to Piranha solution's corrosive properties, safety glasses with side shields do not provide adequate eye protection.
- 2.4 A lab coat and an acid-resistant apron are required when handling Piranha solution. Strict adherence to the University's Lab Attire Guidelines ([EH&S Guideline # 03-001](#)) is necessary when handling Piranha solution. Never wear shorts, skirts above the knee, or open-toed shoes when handling Piranha solution or other corrosive chemicals.
- 2.5 Neoprene or butyl rubber gloves should be worn when working with Piranha solution. If gloves become contaminated with Piranha solution, remove them immediately, thoroughly wash your hands, and check your hands for any signs of contamination.

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- 2.6 An eyewash and safety shower must be available and accessible when handling Piranha solution. The eyewash must be tested weekly to ensure proper operation. If exposure to Piranha solution occurs, immediately rinse the exposed area for at least 15 minutes. A follow-up medical evaluation is required immediately after the water rinse. Call Pitt Police at 412-624-2121 for emergency medical attention.
- 2.7 Piranha solution usage is not permitted in a laboratory when personnel are working alone per University Guidelines ([EH&S Guideline # 03-020](#)).
- 2.8 Glass containers (preferably Pyrex®) should be used for Piranha solution. THE USE OF PLASTIC CONTAINERS FOR PIRANHA SOLUTION IS PROHIBITED.
- 2.9 When preparing Piranha solution, the hydrogen peroxide should be added to the sulfuric acid VERY SLOWLY while stirring to avoid intense boiling. Concentrations of hydrogen peroxide should not exceed 30%.
- 2.10 Containers of Piranha solution must be clearly labeled and handled with extreme care due to the heat of the reaction. Reaction temperatures $\geq 100^{\circ}\text{C}$ should be expected.
- 2.11 Only prepare fresh Piranha solutions in small quantities for immediate use. Piranha solution should not be stored for future use.
- 2.12 Do not mix Piranha solution with incompatible materials such as combustibles, organics, and bases. Mixing Piranha solution with incompatible chemicals such as acetone, isopropanol, Photoresist, and nylon will result in an explosion.
- 2.13 DO NOT STORE FRESHLY PREPARED PIRANHA SOLUTION IN A CLOSED/SEALED CONTAINER. This will result in violent container failure and explosion.
- 2.14 Piranha solution must be left in an open container within a certified chemical fume hood until the solution is cool. Ensure that the reaction has ceased and that the solution has cooled to room temperature prior to initiating the disposal procedures provided below.

3. Waste Disposal

Piranha solution must be FULLY REACTED AND COOLED prior to disposal. Allow for the solution to cool overnight in a properly labeled open container within a fume hood. Once confirmed that the reaction has completed and the solution is cool, the solution must be placed in a compatible sealable container and disposed of via the University's Chemical Waste Program. Glass bottles (such as empty sulfuric acid bottles) are recommended for the containment and disposal of fully reacted piranha solution. Do not dispose of piranha solutions in container volumes greater than 500ml.

Contact EH&S at 412-624-9505 with any questions regarding the disposal of Piranha solution wastes.

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4. Spill Response and Storage

- 4.1 Small spills of Piranha solution (<100 ml) should be cleaned using an acid neutralizer. **DO NOT USE COMBUSTIBLE ABSORBENTS SUCH AS PAPER TOWELS OR ABSORBENT PADS.** Following application of the neutralizer and the verification of a neutral pH, the neutralized material can then be cleaned with a paper towel or absorbent pad. Spill cleanup materials should be placed into a sealable container or thick-mil bag for disposal through the University's Chemical Waste Program.
- 4.2 If a large spill occurs, evacuate the area, close the doors, and contact Pitt Police at 412-624-2121 for emergency assistance.
- 4.3 Piranha solution should not be stored for future use. Prepare small batches of fresh solution for each application. Freshly prepared Piranha solutions for immediate use should be kept away from incompatible materials such as combustibles, organics, and bases.

EMERGENCY PROCEDURES FOR PIRANHA SOLUTION EXPOSURES

Individuals that are exposed to Piranha solution must receive immediate first aid and a medical evaluation.

Skin contact

1. Immediately proceed to the nearest sink/drench hose/safety shower and wash the affected area for a minimum of 15 minutes.
2. While washing the affected area, have someone call for emergency medical assistance – **PITT POLICE 412-624-2121.**
3. Remove all contaminated clothing.
4. After 15-minute rinse, immediately obtain emergency medical attention.

Eye contact

1. Immediately proceed to the nearest eyewash station.
2. Wash eyes with water for at least 15 minutes while holding eyelids open.
3. While washing eyes, have someone call for emergency medical assistance – **PITT POLICE 412-624-2121.**
4. After 15-minute rinse, immediately obtain emergency medical attention.