

**Standard Operating Procedure for Using Aqua Regia**

Print a copy and keep with your Safety Data Sheets and training documents.

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| Department |  |
| Principal Investigator (PI) |  |
| PI Phone Number |  |
| Lab Manager |  |
| Lab Manager Phone Number |  |
| Emergency Contact |  |
| Emergency Contact Phone Number |  |

1. **Purpose**

The purpose of this document is to provide the information necessary to safely use aqua regia in the \_\_\_\_\_\_\_\_\_\_\_ laboratory.

1. **Hazard Identification:**

Aqua regia is a corrosive, fuming yellow solution that is a 1:3 mixture of concentrated nitric and hydrochloric acids. It is commonly used to remove noble metals such as gold, platinum and palladium from substrates, particularly in microfabrication and microelectronics labs. It may also be used to wash glassware in order to remove trace amounts of organic compounds. Its fumes and yellow color are caused by reaction of nitric acid, HNO3, with hydrogen chloride, HCl, to form nitrosyl chloride (NOCl), chlorine (Cl2), and water; both chlorine and nitrosyl chloride are yellow colored and volatile.

Aqua regia solutions are extremely corrosive and may result in explosion or skin burns if not handled with extreme caution. It causes destruction of living tissue at site of contact. Corrosive effects can occur not only on the skin and eyes, but also in the respiratory tract.

* ***Explosion Hazard*** *--* As a strong oxidizing agent, aqua regia can cause violent explosions when combined with reducing agents such as organic solvents and reagents. Therefore great care must be taken to store it separately from organic acids, flammable and combustible liquids (such as organic solvents), and organic reagents in general. All nitric acid containing waste must also be segregated from all other organic waste. Combination of nitric acid waste with other non-compatible waste streams is a major cause of laboratory explosions.
* ***Health Hazard*** -- Aqua regia is an extremely corrosive acid solution and strong oxidizing agent. It may be harmful if ingested, inhaled, or absorbed through the skin. It can cause severe skin and eye burns resulting in irreversible damage. It is extremely destructive to the tissue of the mucous membranes and the upper respiratory tract.

1. **Engineering & Administrative Controls**

Aqua regia must only be handled/used within the chemical fume hood, which is designed to pull air and fumes up and away from the user (Engineering Control).

All lab personnel who use aqua regia must be trained on the hazards of aqua regia, including being familiar with this SOP (Administrative Control).

The door to the \_\_\_\_\_\_\_\_\_\_ lab is posted with signage indicating the presence and hazards associated with aqua regia (Administrative Control).

1. **Personal Protective Equipment (PPE)**

* *Hand Protection*: Neoprene gloves are acceptable for incidental exposure. Butyl rubber or Viton gloves are preferable if the loss of manual dexterity they cause is acceptable.
* *Eye Protection*: Safety glasses or splash goggles must be worn when handling aqua regia.
* *Skin and Body Protection*: A lab coat must be worn when handling aqua regia.
* *Respiratory Protection*: Aqua regia must only be used in the chemical fume hood. Do not open, pour, etc. Aqua regia anywhere other than the chemical fume hood.

1. **Standard Operating Procedures for Handling Aqua Regia:**

Aqua regia can be only used in areas properly equipped with a certified eye wash/safety shower that can be reached within ten seconds. It is essential that all strong oxidizers be stored separately from other laboratory chemicals with which they may react. For oxidizing acids such as nitric acid this includes all organic materials. Ensure secondary containment and segregation of incompatible chemicals. Also, follow any substance-specific storage guidance provided in Safety Data Sheet (SDS) documentation. Some additional requirements for handling are:

* 1. Mix the solution in a fume hood with the sash between you and the solution. Wear gloves and eye protection.
  2. **Do not store aqua regia in a closed container**. Room temperature, uncontaminated aqua regia can be stored for short periods of time in a container with a **vented cap**. However, it is strongly suggested that aqua regia solution be prepared in as-needed quantities, and the waste disposed of promptly. If aqua regia is to be stored for any length of time, only use a vented cap to close the container.
  3. As they deem necessary, the PI/supervisor should insert here any information about whether a special use-area is designated for this material/process.
  4. Add appropriate lab-specific information here describing how this material(s) is generally used. E.g., name of protocol, typical frequency done, quantities used, temperature and any additional safety measures, etc.

1. **Chemical Disposal**

**It is crucial to avoid mixing nitric acid waste with organic waste of any kind. Nitric acid waste containers should be clearly marked as such to avoid accidental addition of any reducible materials. Failure to do this will cause a violent explosion.** Keep container un-capped or loosely capped until immediately before waste pickup. **Waste pickup should be requested only after the aqua regia waste has cooled and all reaction has stopped.** Upon scheduled waste pickup, seal aqua regia waste with a vented cap.

All chemical waste must be disposed of in accordance with Federal and State regulations and UNM's Chemical Hygiene Plan. Aqua regia and aqua regia-containing wastes should be collected in suitable containers and properly labeled as soon as waste is added to the containers. Aqua regia waste should be labeled as such:  
  
**HAZARDOUS WASTE**

**Aqua regia solution (1:3 nitric:hydrochloric acids)**

**Corrosive, Reactive**

Call EHS at 277-2753 to schedule a pickup of waste aqua regia and/or other waste chemicals.

1. **Spill Procedures:**

For small/minor spills (<1L), use the materials in the spill kit to clean up the spill. Minimum PPE for cleaning up a aqua regia spill is safety glasses/goggles, gloves and lab coat. The spill clean-up materials must be double-bagged, tightly closed, labeled and picked up by EH&S for disposal.

Spills in excess of 1L of aqua regia should not be cleaned up by lab personnel. In the event of a large/major spill of aqua regia, evacuate the area and call:

* Campus Police -- 911 on a landline or 505-277-2241 on a mobile phone, and
* Environmental Health & Safety (EH&S) – 505-277-2753 during business hours, or
* EH&S Duty Officer Pager -- 505-951-0194 (enter your phone number after the message)

1. **First Aid Procedures**

In the event of an aqua regia exposure, seek immediate medical attention.

* Skin Contact and Eye Contact should be washed immediately in safety shower or eyewash respectively for 15 minutes.
* If the exposure is severe, seek medical attention at the emergency room. If heading to UNMH, a non-injured person should contact the UNMH charge nurse in advance at 505-604-9349 with information on the chemical and nature of exposure.
* UNM employees should contact Employee Occupational Health Services (EOHS) at 505-272-8034.
* UNM students should contact Student Health Services at 505-277-7810.
* If the exposure occurs after hours, employees and students should seek medical treatment at a hospital emergency room.
* The supervisor of the injured person and EH&S must be notified as soon as possible after the exposure.
* The notice of Accident, Incident, or Spill form should be filled out on the EH&S website.

1. **Other Emergencies**

**Fire or Medical Emergency -- Dial 911**

**Life-Threatening Emergency, After Hours, Weekends and Holidays** – **Dial 911**

**Non-Life Threatening Emergency** – Call EH&S at 505-277-2753 to seek assistance and report the incident.

1. **Training Requirements**

All lab personnel who use aqua regia must review the lab specific aqua regia SOP before beginning work.

**Principal Investigator SOP Approval**

By signing and dating here, the Principal Investigator certifies that this Standard Operating Procedure (SOP) for Using Aqua Regia is accurate and provides information sufficient to safely use aqua regia in the \_\_\_\_\_\_\_\_\_\_\_ laboratory.

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Signature Printed Name/Title Date

I have read and understand the content of this SOP:

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| **Name** | **Signature** | **Date** |
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