





## LABORATORY SAFETY GUIDELINE

### Aqua Regia [Nitrohydrochloric acid] [CAS#: 8007-56-5]

Aqua Regia is a corrosive, fuming yellow liquid prepared by slow mixing of one volume of concentrated nitric acid with three volumes of concentrated hydrochloric acid. It is used to dissolve metals such as gold, platinum, silver, etc. Its fumes and yellow color are caused by reaction of nitric acid (HNO<sub>3</sub>) with hydrogen chloride (HCl) to form nitrosyl chloride (NOCl), chlorine (Cl<sub>2</sub>), and water; both chlorine and nitrosyl chloride are yellow-colored and volatile. It is commonly used as a cleaning agent to remove trace amounts of organic compounds, and due to its highly corrosive nature, should be handled with extreme caution.

#### HAZARDS

	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 respiratory tract, causing respiratory tract irritation.
	A very strong oxidizer. It may ignite flammable/combustible materials. DO NOT mix it with ORGANIC solvents (e.g. ethanol).
	Toxic if inhaled, and causes severe burns and eye damage.
	Very toxic to aquatic life.

#### PRECAUTIONS

##### Before starting work:

- Review manufacturer's [Safety Data Sheet](#) and additional chemical information.
- Ensure that a written experimental protocol including safety information is available.
- Be familiar with general University emergency procedures in the [EHS Lab Emergency Response Guide](#). Create the most dilute solutions available that will meet experimental needs. Create only what you need.
- Identify the location of the nearest eyewash and shower and verify that they are accessible.
- Locate and verify that appropriate Aqua Regia spill cleanup materials are available.
- Perform all work in a secondary container that is clean and free of organic matter.
  - *Warning:* NEVER add any organics to Aqua Regia solution, it could react violently. This includes any chemical containing a C-H bond, e.g., acetone, isopropanol, ethanol, photoresist, or detergents. Even small amounts of organics could make the Aqua Regia solution unstable.
  - When preparing Aqua Regia, always add nitric acid to hydrochloric acid, never vice versa.
- DO NOT STORE AQUA REGIA. Apart from its hazardous byproducts and reactions, Aqua Regia quickly loses its effectiveness due to oxidation of its reactive components. Mix a fresh solution for each use.

##### During work:

- AVOID INHALATION! Perform all operations in a certified chemical fume hood or other approved ventilated enclosure. All handling of Aqua Regia **MUST** be done with glassware inside a fume hood. Never remove a container with Aqua Regia from the fume hood. Keep the sash as low as possible. Never raise it above the indicated position (18 inches).
  - If you leave something to soak overnight, close the fume hood sash, and clearly label the container as "Aqua Regia: Extremely Corrosive"

- AVOID CONTACT! Wear appropriate PPE including:
  - Lab coat and closed toed shoes.
  - Safety glasses
- Consult the [Harvard EHS Glove Selection Guide](#) to help you choose the appropriate chemically protective gloves that are rated for use with the specific concentration of both Nitric Acid and Hydrochloric Acid that you will be using. Not all gloves are rated for use with both materials. It's important that you choose the appropriate glove for the specific concentrations you will be using. If you need help choosing a glove, please contact your [EHS Lab Safety Advisor](#).
- When handling large amounts (>500mL), or when splashing is more likely, in addition to working in a fume hood, wear acid resistant gloves with extended cuffs, acid-resistant apron, and face shield.
- Wash hands thoroughly each time gloves are removed.
- Use materials and containers appropriate for Aqua Regia use and remain aware of potential incompatibilities.
- Always use glass (preferably Pyrex) containers. Aqua Regia solution is very energetic and potentially explosive. It is also very likely to become hot - more than 100°C. Handle with care.
- Aqua Regia will melt some plastics and corrode most metals.
- Never put Aqua Regia in a closed vessel; evolved gases will cause a pressure build-up and possible over-pressurization of your container. Allow the aqua regia cool completely before transferring to a container with a vented cap.

### **After completing the work**

- Dispose of Aqua Regia waste following Harvard University Hazardous Waste Procedures:
  - Hazardous Waste Classification: Corrosive/Toxic
  - Use a glass bottle and a vented cap. You can request vented caps from the [Chemical Waste Pickup and Services Tool](#). In absence of a vented cap, screw a regular cap on *very lightly* – a tightly screwed on cap can cause pressure to build-up inside the bottle.
  - Ensure that the waste container you are using is clean, dry, and does not have residual solvent or other organic materials in it. Aqua Regia should be the sole waste constituent in the waste bottle. Aqua Regia is a strong oxidizing agent and will react with organic chemicals.
  - Wash hands before leaving lab.

## **EMERGENCY PROCEDURES**

### **First Aid**

#### **SKIN CONTACT**

- Flush skin with tepid water for 15 minutes using the closest available sink, portable drench hose or safety shower. Remove any exposed clothing as well as any jewelry that may be trapping Aqua Regia.
- Call 911 on a landline phone for medical assistance (or provide location if calling on a mobile phone).

#### **EYE CONTACT**

- Using eyewash, flush eyes while hold eyelid open and away from exposed eye.
- Call 911 on land line phone for medical assistance.
- Continue flushing with water until emergency medical personnel arrive.

#### **INHALATION**

- If Aqua Regia mist or vapors are inhaled, immediately move to get fresh air.
- Call 911 on land line phone for medical assistance.

#### **INGESTION**

- Do not induce vomiting.
- Call 911 on land line phone for medical assistance.

### **Spill Response**

#### **OUTSIDE FUME HOOD OR VENTILATED ENCLOSURE**

- Alert others and evacuate to a safe distance and prevent entry.
- Contact the University Operations Center at (617) 495-5560 [HMS/HSDM (617) 432-1901]
- Remain in a safe location until EH&S or other response personnel arrive.

#### **INSIDE FUME HOOD OR VENTILATED ENCLOSURE (< 500 ml)**

- Contact the University Operations Center at (617) 495-5560 [HMS/HSDM (617) 432-1901]
- If trained and confident, don the PPE described above and apply acid neutralizer.
- Otherwise close fume hood and await support.