

An Acutely Toxic Material is a chemical falling within any of the following categories:

- A. A chemical with a median lethal dose (LD50) of 50 mg or less per kg of body weight when administered orally to albino rats weighing between 200 and 300 gm each.
- B. A chemical with a median lethal dose (LD50) of 200 mg or less per kg of body weight when administered by continuous contact for 24 hours (or less if death occurs within 24 hours) with the bare skin of albino rabbits weighing between 2 and 3 kg each.
- C. A chemical that has a median lethal concentration (LC50) in air of 200 ppm by volume or less of gas or vapor, or 2 mg per liter or less of mist, fume, or dust, when administered by continuous inhalation for 1 hour (or less if death occurs within 1 hour) to albino rats weighing between 200 and 300 gm each.

Acutely Toxic Materials can be identified using the Globally Harmonized System Hazard Codes H300 (Fatal if swallowed), H310 (Fatal in contact with skin) and H330 (Fatal if inhaled). A few examples of common Acutely Toxic Materials used at the UC Davis campus include, but are not limited to, the following:

1. Sodium Azide
2. Mercaptoethanol
3. Cyanide salts
4. Mercury compounds
5. Isocyanates

Sodium Azide

Sodium azide is an odorless, colorless crystal that is commonly used in research laboratories as a preservative. As a preservative, sodium azide usually exists in a solution at 0.1 to 2.0%. However, of greater concern is the use and storage of pure sodium azide or a solution of 10% or greater. In these forms or concentrations, the material and waste shall be considered highly acutely toxic and can be dangerously reactive when heated near its decomposition temperature. Sodium azide can also react with heavy metals to form dangerous metal halides that can be explosive; therefore, even dilute solutions (equal to or greater than 0.01%) of sodium azide must not be poured down the drain.

Sodium azide rapidly hydrolyzes in water, when mixed with water or an acid, to form hydrazoic acid, a highly toxic and explosive gas. It is thermally unstable and if heated to 275°C, sodium azide may undergo violent decomposition.

Sodium azide also forms explosive compounds when it comes in contact with or dries on metal surfaces. It can also react with metal pipes in laboratory sinks, traps and drains, so do not dispose of down the sink! If introduced to the waste water treatment system in large volume or in high concentrations, the desirable anti-bacterial characteristics of this chemical can damage the water treatment process of your city and county.

It will also react with metal spatulas and metal lab equipment to form shock sensitive salts. It reacts with lead, copper, silver, gold and metal halides to form heavy metal azides which are explosive.

Eye: Redness, pain, irritation. Contact with dust or vapor may cause systemic toxicity.

Skin: Irritation, redness, blisters. May be fatal if absorbed through the skin.

Ingestion: Irritation of the digestive tract, abdominal pain, nausea, sweating, vomiting, diarrhea. May cause low blood pressure, rapid heartbeat, skin discoloration, and possible coma. May be fatal if swallowed.

Inhalation: Severe irritation of the respiratory tract with sore throat, coughing, nasal stuffiness, blurred vision, shortness of breath and delayed lung edema. The vapor of hydrazoic acid may be present where sodium azide is handled. Symptoms of acute exposure to hydrazoic acid include eye irritation, headache, dramatic decrease in blood pressure, weakness, pulmonary edema and collapse.

Sodium azide can cause hypotension, hypothermia, headache, shortness of breath, faintness, convulsions and death. It is toxic by all routes of exposure. The oral LD50 (rat) for sodium azide is 27 mg/kg and the skin (rabbit) LD50 is 20 mg/kg. The LC50 (rat) is 37 mg/m³. In addition, it is a mutagen, and should be treated as a possible carcinogen.

Mercaptoethanol

2-Mercaptoethanol is extremely toxic if swallowed or inhaled and can be fatal if absorbed through the skin. It is corrosive and can cause severe burns to the skin and eyes. It is also a combustible liquid. This compound is extremely toxic to aquatic life and has long-lasting effects in the environment. Additionally, it has an extremely unpleasant odor that can be detected at very low concentrations (stench chemical).

3. ENGINEERING/VENTILATION CONTROLS

The following is a general plan for all Acutely Toxic Materials:

- A. Use containment devices (*e.g.*, chemical fume hoods, glove boxes, etc.) when:
 - i. Using volatile and/or semi-volatile substances;
 - ii. Manipulating substances that may generate aerosols; and
 - iii. Performing laboratory procedures that may result in an uncontrolled release.
- B. Use high-efficiency particulate air (HEPA) filters, carbon filters, or scrubber systems with containment devices to protect effluent and vacuum lines, pumps, and the environment whenever feasible.
- C. Ventilated containment should be used to weigh out solid chemicals (*e.g.*, certified laboratory chemical fume hood). Alternatively, the tare method can be used to prevent inhalation of the chemical. While working in a fume hood, the chemical is added to a pre-weighed container. The container is then sealed and can be re-weighed outside of the fume hood. If a chemical needs to be added or removed, this manipulation is carried out in the fume hood. In this manner, all open chemical handling is conducted in the fume hood.

If you must use Acutely Toxic Materials without engineering or ventilation controls, you must contact the Chemical Hygiene Officer or healthandsafety@ucdavis.edu for an exposure assessment.

- Work in a properly operating and certified chemical fume hood.
- Work at least 6" inside the hood, never place your head in the hood, set the sash at the lowest position possible (if using the horizontal sliding sashes do not open past the labeled positions).
- Safety shower and eye wash stations should be easily accessible .

4. ADMINISTRATIVE CONTROLS

The following elements are required:

1. Complete the [UC Laboratory Safety Fundamentals](#) (or approved equivalent) training prior to working in the laboratory;
2. Complete laboratory-specific safety orientation and training on laboratory-specific safety equipment, procedures, and techniques to be used, including any applicable laboratory-specific Laboratory Safety Plan(s), prior to receiving unescorted access to the laboratory;
3. Demonstrate competency to perform the procedures to the Principal Investigator (PI), Laboratory Supervisor, laboratory-specific Safety Officer, and/or trainer;
4. Be familiar with the location and content of any applicable Safety Data Sheets (SDSs) for the chemicals to be used (online SDSs can be accessed from [UC SDS](#));
5. Implement good laboratory practices, including good workspace hygiene;
6. Inspect all equipment and experimental setups prior to use;
7. Follow best practices for the movement, handling, and storage of hazardous chemicals (see Chapters 5 and 6 of [Prudent Practices in the Laboratory](#) for more detail). An appropriate spill cleanup kit must be located in the laboratory. Chemical and hazardous waste storage must follow an appropriate segregation scheme and include appropriate labeling. Hazardous chemical waste must be properly labelled, stored in closed containers, in secondary containment, and in a designated location;
8. Do not deviate from the instructions described in this SOP without prior discussion and approval from the PI and/or Laboratory Supervisor.
9. Notify the PI and/or Laboratory Supervisor of any accidents, incidents, near-misses, or upset condition (*e.g.*, unexpected rise or drop in temperature, color or phase change, evolution of gas) involving Acutely Toxic Materials described in this SOP; and
10. Abide by the laboratory-specific working alone SOP, if applicable.

For Acutely Toxic Materials, the following are also required:

11. Work surfaces should be protected (*e.g.*, disposable absorbent bench paper, aluminum foil, etc.) and must be decontaminated after each use.

Sodium Azide

Sodium azide powder should be purchased in the smallest practical amount. Make stock solutions of 10%, if possible to minimize potential accidents.

2 Mercaptoethanol

Do not over purchase; only purchase what can be safely stored in the laboratory.

2 Mercaptoethanol

Special handling or storage requirements: Keep container upright and tightly closed in a dry and well-ventilated place. Keep away from incompatible materials: oxidizing agents and metals, such as aluminum, stainless steel, iron and copper.

Sodium Azide

Special handling or storage requirements: Do not store on metal shelves or use metal items (spatulas) to handle sodium azide. Store in tightly closed containers in a cool, well-ventilated area away from heat, air, light and moisture. Store away from metals, acids, carbon disulfide, bromine, chromyl chloride, sulfuric acid, nitric acid, hydrazine and dimethyl sulfate.

5. PERSONAL PROTECTIVE EQUIPMENT (PPE)

At a minimum, long pants (covered legs) and closed toe/closed heel shoes (covered feet) are required to enter a laboratory or technical area where hazardous chemicals are used or stored.

In addition to the minimum attire required upon entering a laboratory, the following PPE is required for work with Acutely Toxic Materials:

- A. Eye Protection: Eye protection is required for all work with Acutely Toxic Materials.
 - i. At a minimum ANSI Z87.1-compliant safety glasses are necessary.
 - ii. Splash goggles may be substituted for safety glasses, and are required for processes where splashes are foreseeable or when generating aerosols.
 - iii. Ordinary prescription glasses will NOT provide adequate protection unless they also meet the Z87.1 standard and have compliant side shields.
- B. Body Protection: At a minimum a chemically-compatible laboratory coat that fully extends to the wrist is necessary.
 - i. If a risk of fire exists, a flame-resistant laboratory coat that is NFPA 2112-compliant should be worn.
 - ii. For chemicals that are corrosive and/or toxic by skin contact/absorption additional protective clothing (*e.g.*, face shield, chemically-resistant apron, disposable sleeves, etc.) are required where splashes or skin contact is foreseeable.
- C. Hand Protection: When hand protection is needed for the activities described in this SOP define the type of glove to be used based on: A) the chemical(s) being used, B) the anticipated chemical contact (*e.g.*, incidental, immersion, etc.), C) the manufacturers' permeation/compatibility data, and D) whether a combination of different gloves is needed for any specific procedural step or task.

Nitrile disposable gloves should be used for these chemicals. Double-gloving is recommended when working with pure sodium azide or sodium azide solutions greater than 5%. Change gloves frequently and when contaminated, punctured, or torn. Wash hands immediately after removing gloves. Safety glasses with side shields or chemical splash goggles shall be worn when dealing with >5% concentration of sodium azide. A laboratory coat should be worn when working with these chemicals.

6. SPILL AND EMERGENCY PROCEDURES

Follow the guidance for chemical spill cleanup from [SafetyNet #13](#) and/or the [UC Davis Laboratory Safety Manual](#), unless specialized cleanup procedures are described below. Emergency procedure instructions for the UC Davis campus and UCD Medical Center are contained in the [UC Davis Laboratory Safety Manual](#), [campus Emergency Response Guide \(ERG\)](#), and [UCD Health System ERG](#). The applicable ERG must be posted in the laboratory. All other locations must describe detailed emergency procedure instructions below.

For spills of solid materials, DO NOT dry sweep.

Sodium Azide: Vacuum or sweep up material and place into a suitable disposal container (non-metal). Avoid generating dusty conditions. Do not flush down the drain. Sodium azide may react with copper, lead, brass, or solder in plumbing systems to form an accumulation of the highly explosive compounds of lead azide and copper azide. Do not let this chemical enter the environment. Cover spills of sodium azide solution with absorbent material, and clean surfaces with pH-adjusted water.

7. WASTE MANAGEMENT AND DECONTAMINATION

Hazardous waste must be managed according to [Safety Net #8](#) using the appropriate [label](#). In general, hazardous waste must be removed from your laboratory within 9 months of the accumulation start date; refer to the [accumulation time for waste disposal](#). Hazardous waste pick up requests must be [completed online](#).

Sodium azide is a water-reactive poison. After working with sodium azide, decontaminate work space with 70-75% ethanol. Contaminated pipet tips, eppendorf tubes, and gloves should be discarded as hazardous waste according to EH&S waste disposal procedures. Store liquid wastes in designated waste containers. Dispose of according to the EH&S hazardous waste guidelines. Drain disposal of sodium azide solutions is not permitted.

2-Mercaptoethanol: Store hazardous waste in closed containers that are properly labeled, and in a designated area (flammable cabinet is recommended) away from incompatible chemicals such as aqueous solutions. 2-Mercaptoethanol waste has a very unpleasant odor; care should be taken when handling waste solutions as well. Do not mix 2-mercaptoethanol waste with other organic waste, collect separately if possible. Contaminated debris (e.g., gloves, Kim wipes, etc.) generated while working with 2-mercaptoethanol must also be collected as hazardous waste (due to odor).

Decontamination procedures vary depending on the material being handled. The toxicity of some materials can be neutralized with other reagents. All surfaces and equipment should be wiped with the appropriate cleaning agent following dispensing or handling to prevent accumulation of Acutely

Toxic chemical residue. Decontaminate vacuum pumps or other contaminated equipment before removing them from the designated area or before resuming normal laboratory work in the area.

Carefully inspect work areas to make sure no hazardous materials remain. Clean contaminated work areas with an appropriate cleaning agent, and dispose of cleaning materials properly. Be sure all ignition sources are secured before beginning clean up with flammable liquids.

Lab coats must be decontaminated before they are removed for laundering. This may be accomplished by washing the affected area in small container of soap and water. Dispose of the soap and water as hazardous waste.

Upon completion of work with Acutely Toxic Materials and/or decontamination of equipment, remove gloves and/or PPE to wash hands and arms with soap and water. Additionally, upon leaving a designated Acutely Toxic Materials work area remove all PPE worn and wash hands, forearms, face and neck as needed. Contaminated clothing or PPE should not be worn outside the lab. Soiled lab coats should be sent for professional laundering. Grossly contaminated clothing/PPE and disposable gloves must not be reused.

8. DESIGNATED AREA

Designated area(s) are required for the use and storage of Acutely Toxic Materials. Such areas must be clearly marked with signs that identify the chemical hazard and include an appropriate warning; for example: DANGER! ACUTELY TOXIC MATERIAL WORK AREA!

Room 3337, especially fume hood and balances area.

9. DETAILED PROTOCOL

For Sodium Azide please follow everything above and:

Dilute solutions of sodium azide are used in research laboratories as a preservative. This use generally presents no extraordinary dangers to the user, but it should be noted that weak solutions of sodium azide (0.1 to 1.0%) are eye and skin irritants. Of greater concern is the use and storage of pure sodium azide and solutions of 5% or greater sodium azide. Use of these materials presents both physical hazards, in the form of explosions, and health hazards, as sodium azide is highly acutely toxic. To make a 10% stock solution of sodium azide, dissolve 10 g of sodium azide in 100 ml of distilled H₂O. Store at 4 degrees. * Add Sodium Azide to a final concentration of 0.05% to prevent contamination: 5ul of 10% stock per 1 ml).

For 2-mercaptoethanol please follow everything above and:

SDS-PAGE sample buffer 2-mercaptoethanol:

Sample buffer 5X = make up 100 mls and store away 5-10 mls aliquots.

1M Tris/HCl pH = 6.8 31.25 mls

SDS powder 10 g

Glycerol 25 mls

Bromophenol Blue (2% in ethanol) 750 uls

2-mercaptoethanol 5 mls

Water to 100 mls

