

CHEMICAL HYGIENE PLAN

Laboratory Location (building and room): NR315
Department or Campus Unit: Department of Wildland Resources
Campus Unit Safety Coordinator: Rachel Curry at rachel.curry@usu.edu or at 797-7423
Principal Investigator: Andrew Kulmatiski
Laboratory Safety Coordinator: Andrew Kulmatiski
Date of plan completion: 1/10/2017
Person who completed the plan: Andrew Kulmatiski
Title of person completing the plan: Assistant Professor

Annual review (including any necessary updating) of the plan is required. Once reviewed and updated it must be sent to the USU Chemical Hygiene Committee for approval, UMC 8315.

References in this document are made to the following text:
Prudent Practices for Handling Hazardous Chemicals in Laboratories,
National Research Council, National Academy Press, 1981.

This manual along with other chemical safety and health references are available for loan from the USU Merrill Library or online at <http://www.ehs.usu.edu/>.

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A. GENERAL PRINCIPLES FOR WORK WITH LABORATORY CHEMICALS

- 1. It is prudent to minimize all chemical exposures.** Because few laboratory chemicals are without hazards, precautions for handling all laboratory chemicals should be adopted. Skin contact with chemicals should be avoided as a standard rule.
- 2. Avoid underestimation of risk.** Even for substances of no known hazard, exposure should be minimized; for work with substances which present hazards, special

precautions should be taken. One should assume that any mixture will be more toxic than its most toxic component and that all substances of unknown toxicity are toxic.

3. **Provide adequate ventilation.** The best way to prevent exposure to airborne substances is to prevent their escape into the working atmosphere by use of local exhaust hoods and closed chemical containers.
4. **Institute a chemical hygiene program.** OSHA 29 CFR 1910.1450 requires a chemical hygiene program be developed and implemented for all laboratories. It should be an ongoing program, not merely a one-time or short-term activity. Its procedures should be followed in academic teaching laboratories as well as research laboratories.
5. **Observe the PEL=s and TLV=s.** The OSHA Permissible Exposure Limits (PEL=s) and the American Conference of Governmental Industrial Hygienists Threshold Limit Values (TLV=s) should not be exceeded. Engineering controls should be implemented if action levels are exceeded. See appendices.
6. **Understand Routes of Exposure to Toxic Chemicals.** Toxic chemicals may enter your body through several routes.
 - a) By inhalation through the nose or mouth.
 - b) By absorption through the skin and eyes.
 - c) By ingestion, via unwashed hands.
 - d) By injection via broken glass, needles, knives or other sharp instruments.

Proper control methods reduce risk of chemical related injury or illness by eliminating these routes of entry. Chemical hygiene control methods are divided into three categories:

- 1) Engineering Controls
Local exhaust ventilation, glove boxes.
- 2) Administrative Controls
Standard Operating Procedures (SOP=s), changing process or protocol, substitution of a less toxic material in place of a more toxic material.
Safety glasses, goggles, face shields, respirators, protective clothing (gloves, lab coats, aprons etc.).

7. **Maintain readily available files of Material Safety Data Sheets.** Material Safety Data Sheets contain safety and health information on the hazardous properties and proper handling of chemicals. Chemical users should make an effort to be familiar with the MSDS=s for the chemicals with which they work. OSHA requires that workers have immediate access to MSDS=s for each chemical in the work area. See section E to find out how to obtain MSDS=s.

B. CHEMICAL HYGIENE RESPONSIBILITIES

Responsibility for chemical hygiene rests with various individuals and organizations including the:

1. Laboratory Worker who is responsible for:
 - (a) Knowing and following the chemical hygiene rules.
 - (b) Planning and conducting each operation in accordance with the laboratory chemical hygiene procedures.
 - (c) Developing good personal chemical hygiene habits.
2. Laboratory Supervisor and Principal Investigator who have primary responsibility for chemical hygiene in the laboratory including responsibility to:
 - (a) Ensure that workers know and follow the chemical hygiene procedures, that protective equipment is available and in working order, and that appropriate safety and health training has been provided.
 - (b) Provide routine, formal chemical hygiene and housekeeping inspections including inspections of emergency equipment.
 - (c) Know the current legal requirements concerning regulated, chemical substances
 - (d) Determine the required levels of protective apparel and equipment.
 - (e) Ensure that facilities are adequate and training is current for any material being used or ordered for the laboratory.
3. Campus Unit Safety Coordinator, as assigned by the department head or campus unit director who should:
 - (a) Serve as liaison between USU EH&S Office and his/her campus unit.
 - (b) Know the current legal requirements concerning regulated substances.
 - (c) See that laboratory personnel are informed and trained, as required by the standard.
4. The EH&S Office (ext. 7-2892) is a resource for improving chemical hygiene in the laboratories and for helping you comply with all safety and health regulations. Some of the services provided by the EH&S Office to help you comply with the OSHA Lab Standard include:
 - (a) Making model Chemical Hygiene Plans available.
 - (b) Review of Chemical Hygiene Plans.
 - (c) Training and information on lab safety and of Chemical Hygiene.
 - (d) Annual inspections of lab hoods.
 - (e) Environmental monitoring when high exposures to chemicals are
 - (f) Periodic safety audits of lab facilities.
 - (g) Quarterly newsletter to keep you informed on health and safety issues.

- (h) Consultation in developing Standard Operating Procedures.
- 5. The Campus Chemical Hygiene Officer will be from the Environmental Health and Safety Office staff as assigned by the director and will:
 - (a) Work with administrators and other employees to develop and implement appropriate chemical hygiene policies and practices.
 - (b) Provide information relating to procurement, use, and disposal of chemicals used in the lab.
 - (c) See that appropriate audits are performed.
 - (d) Help project directors identify appropriate equipment and adequate facilities.
 - (e) Know the current legal requirements concerning regulated substances.
 - (f) Seek ways to improve the chemical hygiene program.
- 6. Department Head or other Campus Unit Director, who is responsible for overall chemical hygiene in that unit.
- 7. President of Utah State University, the Vice-president for Research and other administrators who have ultimate responsibility for chemical hygiene within the institution and must, with other administrators, provide continuing support for institutional chemical hygiene.

C. THE LABORATORY FACILITY

1. **Design.** The laboratory facility should have:

- (a) An appropriate general ventilation system with air intakes and exhausts located so as to avoid intake of contaminated air.
- (b) Well-ventilated chemical storage rooms, or NFPA approved storage cabinets.
- (c) Properly functioning laboratory hoods and sinks.
- (d) Other readily accessible safety equipment including eyewash fountains and drench showers.
- (e) Arrangements for waste disposal.

2. **Maintenance.** Chemical hygiene related equipment (hoods, incinerator, etc.) should be evaluated routinely.

3. **Usage.** The work conducted and to what extent the work is conducted must be appropriate for the physical facilities available and, especially, to the availability and quality of ventilation.

4. **Ventilation.**

- (a) **General laboratory ventilation.** This system should:
 - i) provide a source of air for breathing and for input to local ventilation
 - ii) not be relied on for protection from toxic substances released
 - iii) ensure that laboratory air is continually replaced with acceptable level of exterior of the building.
- (b) **Hoods.** A laboratory hood with 2.5 linear feet of hood space per person should be provided for every 2 workers if they spend most of their time working with chemicals. Each hood should have a continuous monitoring device to allow convenient confirmation of adequate hood performance before use. If this is not

- possible, at a minimum, ensure the hood has a hood evaluation sticker placed on it within the last year indicating acceptable hood performance. Information pertaining to this can be found at the Environmental Health & Safety Office.
- (c) **Other local ventilation devices.** All local ventilation devices, when feasible, will have a separate exhaust duct.
 - (d) **Special ventilation areas.** Exhaust air from glove boxes and isolation rooms should be passed through scrubbers or other treatment devices before release into the regular exhaust system. Cold rooms and warm rooms should have provisions for rapid escape and for escape in the event of electrical failure.
 - (e) **Modifications.** Alterations of the ventilation system should be made only if thorough testing indicates that worker protection from airborne toxic substances will continue to be adequate.
 - (f) **Performance.** Rate: 12 room air changes/hour is adequate general ventilation for laboratories, if local exhaust systems such as hoods are used as the primary method of control.
 - (g) **Quality.** General air flow should not be turbulent and should be relatively uniform throughout the laboratory, with no high velocity or static areas; airflow into and within the hood should not be excessively turbulent. Ideally the hood face velocities should be 100 fpm (feet per minute) $\sqrt{25}$ fpm at the working sash height (generally 16" above table).
 - (h) **Evaluation.** Quality and quantity of ventilation should be evaluated on installation, regularly monitored and reevaluated whenever a change in the local ventilation devices is made. EH&S Office personnel monitor hood flow rates annually and are available for other ventilation monitoring and advice.

D. CHEMICAL HYGIENE IN THE LABORATORY

Laboratory workers will know and follow the rules, procedures and recommendations in this Chemical Hygiene Plan.

1. Basic Chemical Hygiene Rules

The following will be used for essentially all laboratory work with chemicals:

(a) Accidents and spills:

- Eye Contact: Promptly flush eyes with water for a prolonged period (15 minutes) and seek medical attention.
- Ingestion: Encourage the victim to drink large amounts of water. Refer to the Material Safety Data Sheet.
- Skin Contact: Promptly flush the affected area with water and remove any contaminated clothing. If symptoms persist after washing, seek medical attention.
- Clean-up: Promptly clean up spills, using appropriate protective apparel and equipment and proper disposal.

(b) Avoidance of "routine" exposure:

- Develop and encourage safe habits; avoid unnecessary exposure to chemicals by any route.
 - i) Do not smell or taste chemicals.
 - ii) Vent any apparatus which may discharge toxic chemicals (vacuum

- pumps, distillation columns, etc.) into local exhaust devices.
- (iii) Inspect gloves and other personal protective equipment before use.
 - (iv) Do not allow release of toxic substances in cold rooms and warm rooms, since these have contained re-circulated atmospheres.
- (c) **Choice of chemicals:** Use only those chemicals for which the quality of the available ventilation system is appropriate.
 - (d) **Eating, smoking, etc.:** Do not eat, drink, smoke, chew gum, or apply cosmetics in areas where laboratory chemicals are present; wash hands before conducting these activities. Do not allow storage, handling, or consumption of food and beverages in areas, which are used for laboratory operations.
 - (e) **Equipment and glassware:** Handle and store laboratory glassware with care to avoid damage; do not use damaged glassware. Use extra care with Dewar flasks and other evacuated glass apparatus; shield or wrap them to contain chemicals and fragments should implosion occur. Use equipment only for its designed purpose.
 - (f) **Exiting:** Wash areas of exposed skin well before leaving the laboratory.
 - (g) **Horseplay:** Avoid practical jokes or other behavior which might confuse, startle or distract another worker.
 - (h) **Mouth suction:** Do not use mouth suction for pipetting or starting a siphon.
 - (i) **Personal apparel:** Confine long hair and loose clothing. Wear shoes at all times in the laboratory. Sandals, perforated or open-toed shoes should not be worn. Always wear long pants, not skirts or short pants. Wear a lab coat.
 - (j) **Personal housekeeping:** Keep the work area clean and uncluttered, with chemicals and equipment being properly labeled and stored; clean up the work area on completion of an operation or at the end of each day.
 - (k) **Personal protection:** Assure that appropriate eye protection is worn by all persons, including visitors, where chemicals are stored or handled. Wear appropriate gloves when the potential for contact with toxic materials exists; inspect the gloves before each use, wash them before removal, and replace them periodically. Use appropriate respiratory equipment when air contaminant concentrations are not sufficiently restricted by engineering controls, inspecting the respirator before use. Use any other protective and emergency apparel and equipment as appropriate. Avoid use of contact lenses in the laboratory unless necessary; if they are used, inform supervisor so special precautions can be taken. Remove laboratory coats immediately on significant contamination.
 - (l) **Planning:** Seek information and advice about hazards, plan appropriate protective procedures, and plan positioning of equipment before beginning any new operation.
 - (m) **Unattended operations:** Leave lights on, place an appropriate sign on the door, and provide for containment of toxic substances in the event of failure of a utility service (such as cooling water) to an unattended operation.
 - (n) **Use of hood:** Use the hood for operations which might result in release of toxic chemical vapors or dust. In general, use the hood whenever feasible to limit exposure to laboratory workers. Confirm adequate hood performance before use; keep hood closed at all times except when adjustments within the hood are being made; keep materials stored in hoods to a minimum and do not allow them to block vents or air flow. Leave the hood "on" when it is not in active use, if toxic

substances are stored in it or if it is uncertain whether adequate general laboratory ventilation will be maintained when it is "off".

- (o) **Vigilance:** Be alert to unsafe conditions and see that they are corrected when detected.
- (p) **Waste disposal:** Deposit chemical waste in appropriately labeled chemically compatible receptacles and follow USU Hazardous Waste Guidelines. The following chemicals will not be discharged to the sewer: concentrated acids or bases, toxic, malodorous, lachrymatory explosives, re-actives, or flammable substances; or any substances which might interfere with the biological activity of waste water treatment plants, cause structural damage or obstruct flow. Consult the EH&S Office if you have disposal questions on a particular chemical waste.
- (q) **Working alone:** Avoid working alone in a building; do not work alone in a laboratory if the procedures being conducted are hazardous.
- (r) **Chemicals with unknown hazards:** Chemicals whose hazardous properties have not been evaluated (no MSDS available) will be considered highly toxic and handled as such. (See sections 3.4 and 3.5 of this CHP)

2. Additional Rules specific to this laboratory

none

3. Chemicals posing significantly high hazards

3.1 Work with Allergens

- (a) **Allergens or sensitizers** are chemicals that cause manifestations of allergies. At least one previous exposure to the substance is required (examples: diazomethane, isocyanates, bichromates, formaldehyde). Wear suitable gloves to prevent hand contact with allergens or substances of unknown allergenic activity.

Review each use of these materials with the research supervisor and review continuing uses annually or whenever a procedural change is made.

Store these substances, properly labeled, in an adequately ventilated area in an unbreakable secondary container.

Notify supervisors of all incidents of exposure or spills; consult a qualified physician when appropriate.

- (b) **List of allergens (sensitizers) used in this lab:**

Chemical Name	CAS number (if known)	Manufacturer

3.2 Work with Chemicals of High Acute Toxicity

See Chemical Hygiene Appendix for a definition and a partial listing of acutely toxic chemicals.

- (a) **Aim:** To minimize exposure to these toxic substances by any route using all reasonable precautions.
- (b) **Applicability:** These precautions are appropriate for substances with moderate chronic or high acute toxicity used in significant quantities.

system. This category includes embryo toxins (teratogens) and mutagens. See Chemical Hygiene Appendix for examples of reproductive toxins.

- (b) **Embryotoxins** or teratogens are chemicals that are harmful to a developing fetus at a concentration that may have no effect on the mother (examples: organomercurials, lead compounds, formamide). If you are a woman of childbearing age, handle these substances only in a hood whose satisfactory performance has been confirmed, using appropriate protective apparel (especially gloves) to prevent skin contact.

Review each use of these materials with the research supervisor and review continuing uses annually or whenever a procedural change is made.

Store these substances, properly labeled, in an adequately ventilated area in an unbreakable secondary container.

Notify supervisors of all incidents of exposure or spills; consult a qualified physician when appropriate.

- (c) **Listing of chemicals in this lab considered to be Reproductive toxins:**

Chemical Name	CAS number (if known)	Manufacturer

3.4 Work with Chemicals of High Chronic Toxicity (Carcinogens)

Examples: dimethyl mercury, nickel carbonyl, benzo-a-pyrene, N-nitrosodiethylamine, and other human carcinogens or substances with high carcinogenic potency in animals. A listing of "select carcinogens" (which are considered to be of high chronic toxicity) is included in the Chemical Hygiene appendices.

Further supplemental rules to be followed, in addition to all these mentioned above, for work with substances of known high chronic toxicity (in quantities above a few milligrams to a few grams, depending on the substance) are located in Procedure A of "Prudent Practices" pp. 47-50.

- (a) **Access:** Conduct all transfers and work with these substances in a "designated and controlled area" such as a restricted access hood, glove box, or portion of a lab designated for use of highly toxic substances. These restricted areas will be posted with warning signs, to ensure that people with access to the lab are aware of the substances being used and necessary precautions. These substances will be stored separately with access restricted.
- (b) **Signs and labels:** Assure that the designated and controlled area is conspicuously marked with warning and restricted access signs and that all containers of these

- substances are appropriately labeled with identity and warning labels.
- (c) **Approvals:** Prepare a plan for use and disposal of these materials and obtain the approval of the laboratory supervisor.
 - (d) **Non-contamination/Decontamination:** Protect vacuum pumps against contamination by scrubbers or HEPA filters and vent them into the hood. Decontaminate vacuum pumps or other contaminated equipment, including glassware, in the hood before removing them from the controlled area.
Decontaminate the controlled area before normal work is resumed there.
 - (e) **Exiting:** On leaving a controlled area, remove any protective apparel (placing it in an appropriate, labeled container) and thoroughly wash hands, forearms, face, and neck.
 - (f) **Housekeeping:** Use a wet mop or a vacuum cleaner equipped with a HEPA filter instead of dry sweeping if the toxic substance was a dry powder.
 - (g) **Medical surveillance:** If using toxicologically significant quantities of such a substance on a regular basis (e.g., 3 times per week), consult a qualified physician concerning desirability of regular medical surveillance.
 - (h) **Records:** Keep accurate records of the amounts of these substances stored and used, the dates of use, and names of users.
 - (i) **Spills:** Assure that contingency plans, equipment, and materials to minimize exposures of people and property in case of accident are available.
 - (j) **Storage:** Store containers of these chemicals only in a ventilated, limited access area in appropriately labeled, unbreakable, chemically resistant, secondary containers.
 - (k) **Glove boxes:** For a negative pressure glove box, ventilation rate must be at least 4 volume changes/hour and pressure at least 0.5 inches of water. For a positive pressure glove box, thoroughly check for leaks before each use. In either case, trap the exit gases or filter them through a HEPA filter and then release them into the hood.
 - (l) **Waste:** Use chemical decontamination whenever possible; ensure that containers of contaminated waste (including washings from contaminated flasks) are transferred from the controlled area in a secondary container under the supervision of authorized personnel. Dispose of waste in accordance with USU Hazardous Waste guidelines listed in the Chemical Hygiene Appendix.
 - (p) **List of chemicals in this lab considered to be of high chronic toxicity (Carcinogens):**

Chemical Name	CAS Number (if known)	Manufacturer

3.5 Animal Work with Chemicals of High Chronic Toxicity (Carcinogens)

- (a) **Access:** For large scale studies, special facilities with restricted access are preferable.
- (b) **Administration of the toxic substance:** When possible, administer the substance

by injection or gavage instead of in the diet. If administration is in the diet, use a caging system under negative pressure or under laminar air flow directed toward HEPA filters.

- (c) **Aerosol suppression:** Devise procedures which minimize formation and dispersal of contaminated aerosols, including those from food, urine, and feces (e.g., use HEPA filtered vacuum equipment for cleaning, moisten contaminated bedding before removal from the cage, mix diets in closed containers in a hood).
- (d) **Personal protection:** When working in the animal room, wear plastic or rubber gloves, a fully buttoned laboratory coat or jumpsuit. Other apparel and equipment may be necessary such as, shoe and head coverings or a respirator, if suppression of aerosols is incomplete.
- (e) **Waste disposal:** Dispose of contaminated animal tissues and excreta by incineration if the available incinerator can convert the contaminant to non-toxic products; otherwise, package the waste appropriately for burial in an EPA-approved site.
- (f) **List of chemicals of high chronic toxicity (carcinogens) involved with animal work in this lab:**

Chemical Name	CAS number (if known)	Manufacturer

Chemicals commonly used in the laboratory:

Ethyl Alcohol	64-17-5
Deuterium oxide	7789-2-0
Potassium Chloride	7447-40-7
Oxygen	7782-44-7
Propane	74-98-6
Liquid Nitrogen	7727-37-9
Hydrochloric acid	7647-01-0

MSDS sheets available in folder.

4. Standard Operating Procedures (SOP=s) specific to this laboratory

- (a) **Aim:** to assure that hazardous operations specific to the lab are conducted in a prudently safe manner.
- (b) **Content:** Chemical Hygiene SOP=s may be incorporated into general lab procedural protocols or may be written up separately. SOP=s contain 1) the major hazards associated with a task and/or chemicals and 2) controls to avoid exposure. Examples of SOP=s can be found in Prudent Practices, chapters 1B,

1C and 1D. A Guide to preparing Chemical Hygiene SOP=s is available from the Campus EH&S Office.

Examples of procedures or tasks, that support implementation of SOP=s.

- 1) Use of perchloric acid.
- 2) End of day clean-up procedures.
- 3) Mixing of acrylamide gels-will be conducted in a "controlled area", with local exhaust (i.e. a lab hood) and measures taken to limit exposure including preventing skin contact.
- 4) Use of Ethidium Bromide - similar to number 3 above.

(c) Insert any SOP=s specific to the lab after this page.

Standard Operating Procedures
Laboratory Specific
Chemical: **Hydrochloric Acid**

Department: Wildland Resources Date when SOP was written: 08/15/13
Date when SOP was approved by the lab supervisor: 8/15/2013
Principal Investigator: Andrew Kulmatiski
Internal Laboratory Safety Coordinator/Lab Manager: Andrew Kulmatiski
Laboratory Phone: Office Phone: 435-797-8220
Emergency Contact: Andrew Kulmatiski 435-797-8220
Location(s) covered by this SOP: NR 317
Type of SOP: Process Hazardous Chemical Hazardous Class

Purpose

Hydrochloric acid is a **highly corrosive, strong inorganic/mineral acid**. If not stored and handled properly, this can pose a serious threat to the health and safety of laboratory personnel, emergency responders and chemical waste handlers. Hence, it is important to follow safety protocols to handle this chemical. Hydrochloric acid is used in the chemical industry as a chemical reagent in the large-scale production of vinyl chloride for PVC plastic, and MDI/TDI for polyurethane. It has numerous smaller-scale applications, including household cleaning, production of gelatin and other food additives, descaling, and leather processing. We use it primarily to clean glassware.

Physical & Chemical Properties/Definition of Chemical Group

CAS#	7647-01-0
Class:	<u>Corrosive</u>
Molecular Formula:	HCl
Form (Physical State):	Colorless liquid.
Boiling Point:	> 100 °C (> 212 °F) - lit.
Melting point:	-30 °C (-22 °F)
Density:	1.2 g/cm ³ at 25 °C (77 °F)
Odor:	Pungent
Synonym:	Muriatic acid

Potential Hazards/Toxicity

Pictogram



Potential Health Effects

Inhalation May be harmful if inhaled. Material is extremely destructive to the tissue of the mucous membranes and upper respiratory tract.

Skin May be harmful if absorbed through skin. Causes skin burns.

Eyes Causes eye burns.

Ingestion May be harmful if swallowed.

Signs and Symptoms of Exposure

Burning sensation, cough, wheezing, laryngitis, shortness of breath, spasm, inflammation and edema of the larynx, spasm, inflammation and edema of the bronchi, pneumonitis & pulmonary edema. Material is extremely destructive to tissue of the mucous membranes and upper respiratory tract, eyes, and skin.

Engineering Controls

NOTE: Lab-specific information on engineering controls may be included in the Protocol/Procedure section.

- ✓ All operations involving Hydrochloric acid must be carried out in a certified chemical fume hood unless other controls are designated in the Protocol/Procedures section. Sash height should be kept low to avoid escaping fumes and to provide a physical barrier.
- ✓ Laboratory rooms must be at negative pressure with respect to the corridors and external environment. To achieve this, the laboratory/room door must be kept closed at all times.

Personal Protective Equipment (PPE)

Respiratory protection

NOTE: Lab personnel intending to use/wear a respirator mask must be trained and fit-tested by EH&S. This is a regulatory requirement.

Refer to 8 CCR 5144 for selection of respirators. A respiratory protection program that meets 8 CCR 5144 must be followed whenever workplace conditions warrant use of a respirator.

Respirators should be used only under any of the following circumstances:

- As a last line of defense (i.e., after engineering and administrative controls have been exhausted).
- When Permissible Exposure Limit (PEL) has exceeded or when there is a possibility that PEL will be exceeded, and the material has adequate warning properties (e.g., odor or taste).
- Regulations require the use of a respirator.
- An employer requires the use of a respirator.
- There is potential for harmful exposure due to an atmospheric contaminant (in the absence of PEL)
- As PPE in the event of a chemical spill clean-up process

Hand protection

Type of gloves recommended for Hydrochloric acid: Neoprene for large volumes or long exposures; Nitrile acceptable for small quantities and dilute solutions.

Note: Consult with your preferred glove manufacturer to ensure that the gloves you plan on using are compatible with Hydrochloric acid.

Eye protection

Type of eye protection used to handle the chemical: *Splash goggles. If used in large quantities, please use appropriate face shield.*

Skin and body protection

Long pants, closed-toed and closed-heeled shoes, cotton-based clothing/attire (no skin exposed below waist), and flame resistant lab coat must be worn for protecting against chemical hazards.

Hygiene measures

Handle in accordance with good industrial hygiene and safety practices. Avoid contact with skin, eyes and clothing. Wash hands before breaks, at the end of the workday, and immediately after handling Hydrochloric acid.

First Aid Procedures

Notify supervisor and EH&S immediately after first aid is administered.

General advice

Move out of dangerous area. Consult a physician. Show a safety data sheet and this SOP to the doctor in attendance

If inhaled

If breathed in, move person into fresh air. If not breathing, give artificial respiration, then call **911**. Consult a physician.

In case of skin contact

Take off contaminated clothing and shoes immediately. Wash off with soap and plenty of water for at least 15 minutes. Consult a physician.

In case of eye contact

Rinse thoroughly with plenty of water for at least 15 minutes and consult a physician. Continue rinsing eyes during transport to hospital.

If swallowed

Do NOT induce vomiting. Never give anything by mouth to an unconscious person. Rinse mouth with water. Consult a physician.

Special Handling and Storage Requirements

NOTE: Lab-specific information on handling and storage may be included in the Protocol/Procedure section.

Working alone: Certain extremely hazardous operations should not be performed if the PI or Lab Safety Contact(s) are not present. Never work alone with extremely hazardous materials/operations. See the Protocol/Procedure section for specific prohibitions (if any) on

working alone with this material.

Precautions for safe handling

Avoid contact with skin and eyes.

Avoid inhalation of vapor or mist.

Always use inside a chemical fume hood.

Note: In case you need to dilute the concentration of HCl, always add acid to water.

Always transfer from container to the receptacle by using an appropriate funnel.

DO NOT mouth-pipette HCl.

Conditions for safe storage

Do not store in/with combustible packing material; such as cardboard, Styrofoam, plastic and paper.

Keep container upright & tightly closed in a dry and well-ventilated place.

Containers which are opened must be carefully resealed and kept upright to prevent leakage.

Always store HCl in a secondary container. Note: Nalgene/polypropylene tray or a tub is the best suited secondary containment.

Materials to avoid: Store segregated from – Organic Acids, Bases, Amines, Alkali metals, Metals, permanganates, e.g. potassium permanganate, sodium hypochlorite (bleach), Fluorine, metal acetylides, hexalithium disilicide.

Spill and Accident Procedure

Personal precautions

Use Personal Protective Equipment (PPE).

Avoid breathing vapors, mist or gas.

Ensure adequate ventilation.

Evacuate personnel to safe areas.

Environmental precautions

Do not let product enter drains.

NOTE: Always have a chemical spill kit fully stocked and easily accessible at all times.

Chemical Spill Dial 911 and EH&S ext. 7-2892.

Spill – Assess the extent of danger. Help contaminated or injured persons. Evacuate the spill area. Avoid breathing vapors. Eliminate sources of ignition if the chemical is flammable. If possible, confine the spill to a small area using a spill kit or absorbent material. Keep others from entering contaminated area (e.g., use caution tape, barriers, etc.).

Small (<1 L) – If you have training, you may assist in the clean-up effort. Use appropriate personal protective equipment and clean-up material for chemical spilled. Double bag spill waste in clear plastic bags, label and take to the next chemical waste pick-up.

Large (>1 L) – Dial **911 and EH&S ext. 7-2892** for assistance.

Chemical Spill on Body or Clothes – Remove clothing and rinse body thoroughly in emergency

shower for at least 15 minutes. Seek medical attention. *Notify supervisor and EH&S immediately. Follow up with a call to **and EH&S** ext. 7-2892 to report the incident.*

Chemical Splash Into Eyes – Immediately rinse eyeball and inner surface of eyelid with water from the emergency eyewash station for 15 minutes by forcibly holding the eye open. Seek medical attention. *Notify supervisor and EH&S immediately. Follow up with a call to **and EH&S** ext. 7-2892 to report the incident.*

Medical Emergency Dial **911**

Life Threatening Emergency, After Hours, Weekends And Holidays – Dial **911** or go to the nearest emergency room. *Note: All serious injuries must be reported to EH&S within 8 hours. Follow up with a call to **and EH&S** ext. 7-2892 to report the incident.*

Non-Life Threatening Emergency– Go to the Occupational Health Facility. After hours go to the nearest emergency room. *Note: All serious injuries must be reported to EH&S within 8 hours. Follow up with a call to **and EH&S** ext. 7-2892 to report the incident.*

Needle stick/puncture exposure (as applicable to chemical handling procedure)– Wash the affected area with antiseptic soap and warm water for 15 minutes. For mucous membrane exposure, flush the affected area for 15 minutes using an eyewash station. Go to the Occupational Health Facility. After hours go to the nearest emergency room. *Note: All needle stick/puncture exposures must be reported to EH&S within 8 hours. Follow up with a call to **and EH&S** ext. 7-2892.*

Decontamination/Waste Disposal Procedure

NOTE: Lab-specific information on decontamination/waste disposal may be included in the Protocol/Procedure section.

Wearing proper PPE, please decontaminate equipment and bench tops using soap and water. Please dispose of the spent hydrochloric acid and disposables contaminated with hydrochloric acid as hazardous waste.

General hazardous waste disposal guidelines:

NOTE: Segregate acid waste containers from base waste containers.

Label Waste

- Label all waste containers.

Store Waste

- Store hazardous waste in closed containers, in secondary containment and in a designated location.
- Double-bag dry waste using transparent bags.
- Waste must be under the control of the person generating & disposing of it

Dispose of Waste

- Dispose of regularly generated chemical waste within six months.
- Call EH&S for questions (**ext. 7-2892**)

Safety Data Sheet (SDS) Location

Hardcopies of SDS are located in the back of this manual.

Protocol/Procedure

Hydrochloric acid is a reagent used in organic reactions, and is a strong, corrosive acid.

Researchers should wear lab coats, gloves, and safety goggles or safety glasses with side shields when handling hydrochloric acid. All work with concentrated hydrochloric acid should be done inside a fume hood. As a reagent, hydrochloric acid may be used in quantities of <1mL up to 1L, and across a wide range of temperatures. When working with concentrated hydrochloric acid, it is important to make sure the work area is free of any bases as these may react violently with the acid. It is also common to prepare dilute solutions of hydrochloric acid for use as reagents, or for working up organic reactions. When diluting hydrochloric acid with water, the concentrated hydrochloric acid should be added slowly to water to minimize the exothermic nature of the reaction and any dangers from splashing. Any solutions which contain hydrochloric acid should be disposed of as hazardous waste after reactions are complete. Hydrochloric acid should be stored in a secondary container inside a designated corrosive-resistant cabinet. Additionally, hydrochloric acid should be stored in a separate area from any bases due to the danger of an exothermic reaction if allowed to mix. Also, hydrochloric acid should be stored away from oxidizers since mixing can lead to the generation of chlorine gas.

Protocol/Procedure

Chemical Storage

- Do not store near combustible materials.
- Keep container closed when not in use.
- Store in a cool, dry, well-ventilated area away from incompatible substances.
- Do not store near alkaline substances.
- Store protected from moisture.
- Ideally, hydrochloric acid should be stored in isolation from all other chemicals in an approved acid or corrosives safety cabinet.
- Hydrochloric acid is incompatible with metals, oxidizing agents, reducing agents, bases, acrylonitrile, chlorates, finely powdered metals, nitrates, perchlorates, permanganates, epichlorohydrin, aniline, carbides, fulminates, picrates, organic materials, flammable liquids.

Chemical Disposal

- Collect hydrochloric acid liquid waste in labeled 1 gal. plastic containers.
- Do not mix strongly acidic and strongly basic aqueous waste streams.
- Do not mix with other waste or incompatibles

- Store hazardous waste in closed containers, in secondary containment and in a designated location.
- Double-bag dry waste using transparent bags.
- Call EH&S for questions (ext. 7-2892)

Procedure/Use: 1. Preparation of dilute solutions for acid wash baths (typically 0.3 M)

Scale: Up to 1000 ml concentrated hydrochloric acid added to 20 L water bath.

Engineering Controls/Equipment: All work using concentrated hydrochloric acid must be performed in a ventilated fume hood.

PPE (eye, face, gloves, clothing)

- **Eye protection:** Wear tight-fitting safety goggles or safety glasses with side shields.
- **Face protection:** Wear a face shield when not protected by a lab hood sash.
- **Gloves:** Wear Butyl or Butyl/Viton gloves when handling hydrochloric acid. Remove gloves as soon as contaminated.
- **Clothing:** Wear lab coat, full length pants or equivalent; and close-toed closed heeled shoes. Wear acid resistant apron when pouring concentrated hydrochloric acid
- **Hydrochloric acid is corrosive and hazardous by inhalation. Wear gloves and use in a well-ventilated hood.**

Procedure Steps and Precautions

- The dilution of hydrochloric acid is exothermic.
- Always add acid slowly to the bulk water component. Do not add the water to the acid.

STANDARD OPERATING PROCEDURES FOR STORING & HANDLING OF ETHYL ALCOHOL SAFELY

Standard Operating Procedure

Ethyl Alcohol

Department:	Wildland Resources Department
Date SOP was written:	20 Aug. 2013
Date SOP was approved by PI/lab supervisor:	
Principal Investigator:	Andrew Kulmatiski
Internal Lab Safety Coordinator/Lab Manager:	Andrew Kulmatiski
Lab Phone:	
Office Phone:	
Emergency Contact:	Andrew Kulmatiski, 881-5496
Location(s) covered by this SOP:	NR 317

Type of SOP: Process Hazardous Chemical Hazardous Class

Purpose

Ethanol is a common lab disinfectant used in glassware clean up and arthropod storage. Limit use while torches are in use in the lab.

Physical & Chemical Properties/Definition of Chemical Group

CAS#: 64-17-5

Class: Flammable

Molecular Formula: C₂H₅OH

Form (physical state): Liquid

Color: Clear

Boiling point: 78 deg C

Potential Hazards/Toxicity

WARNING!!: Ethanol is extremely flammable and poses a serious risk of fire, and thus burns to persons, when used in conjunction with alcohol burners at laminar flow benches.

Inhalation:

High vapor concentrations may cause a burning sensation in the throat and nose, stinging and watering in the eyes. At concentrations which cause irritation; dizziness, faintness, drowsiness, nausea and vomiting may occur.

Ingestion:

May cause dizziness, faintness, drowsiness, decreased awareness and responsiveness, euphoria, abdominal discomfort, nausea, vomiting, staggering gait, lack of coordination and coma.

Eye Contact:

Severe eye irritant. Vapors can irritate eyes. Eye damage from contact with liquid is reversible and proper treatment will result in healing within a few days. Damage is usually mild to moderate conjunctivitis, seen mainly as redness of the conjunctiva.

Chronic Exposure:

Long term repeated oral exposure to ethanol may result in the development of progressive liver injury with fibrosis.

Aggravation of Pre-existing Conditions:

Repeated exposure to ethanol may exacerbate liver injury produced from other causes.

Other effects of overexposure:

Repeated ingestion of ethanol by pregnant mothers has been shown to adversely affect the central nervous system of the fetus, producing a collection of effects which together constitute the fetal alcohol syndrome.

Personal Protective Equipment (PPE)

Eyes: Wear appropriate protective eyeglasses or chemical safety goggles as described by OSHA's eye and face protection regulations in 29 CFR 1910.133.

Skin: Wear appropriate protective gloves to prevent skin exposure.

Clothing: Wear appropriate protective clothing to prevent skin exposure.

Respirators: A respiratory protection program that meets OSHA's 29 CFR 1910.134 and ANSI Z88.2 requirements or European Standard EN 149 must be followed whenever workplace conditions warrant a respirator's use.

Engineering Controls

Use explosion-proof ventilation equipment. Facilities storing or utilizing this material should be equipped with an eyewash facility and a safety shower. Use adequate general or local exhaust ventilation to keep airborne concentrations below the permissible exposure limits.

First Aid Procedures

Eyes: Immediately flush eyes with plenty of water for at least 15 minutes, occasionally lifting the upper and lower eyelids. Get medical aid. Gently lift eyelids and flush continuously with water.

Skin: Get medical aid. Flush skin with plenty of water for at least 15 minutes while removing contaminated clothing and shoes. Wash clothing before reuse. Flush skin with plenty of soap and water.

Ingestion: Do NOT induce vomiting. If victim is conscious and alert, give 2-4 cupfuls of milk or water. Never give anything by mouth to an unconscious person. Get medical aid.

Inhalation: Remove from exposure and move to fresh air immediately. If not breathing, give artificial respiration. If breathing is difficult, give oxygen. Get medical aid. Do NOT use mouth-to-mouth resuscitation. If breathing is difficult, give oxygen. Get medical aid. Do NOT use mouth-to-mouth resuscitation.

Notes to Physician: Treat symptomatically and supportively. Persons with skin or eye disorders or liver, kidney, chronic respiratory diseases, or central and peripheral nervous system diseases may be at increased risk from exposure to this substance.

Antidote: Replace fluid and electrolytes.

Special Handling and Storage Requirements

1. All persons shall consult the Material Safety and Data Sheet and SOP on ethanol before working with the chemical. It is the responsibility of the employer to make sure inexperienced persons have read and understood the MSDS and SOP on ethanol usage before they do any work.
2. All persons shall wear personal protective equipment such as lab coat and gloves when working with ethanol.
3. Persons using ethanol in conjunction with ignition sources shall make themselves aware of the location of fire extinguishers, fire blankets, safety showers, safety kits and any other safety/firefighting equipment. If unsure of the location, all persons are to ask their supervisor of location before doing any work.
4. Ethanol is to be transported in appropriate containers. These may be 4L plastic jugs with sealed lid or other containers with sealed lids.
5. Equipment requiring ethanol as a fuel (e.g. alcohol lamps) shall be filled in a well-ventilated area away from ignition sources.
6. ETHANOL VAPOR CAN REACT WITH IGNITION SOURCES CAUSING A "FLASH BACK" BACK TO THE CONTAINER CAUSING AN EXPLOSION. NEVER ATTEMPT TO RE-FILL ANYTHING WITH ETHANOL IF THE ALCOHOL IS BURNING. EXTINGUISH THE FIRE AND REMOVE ANY OTHER SOURCES OF IGNITION BEFORE RE-FILLING CONTAINERS.

Large quantities of ethanol are to be stored in approved flammable solvent cabinet, away from heat, sparks and flames. Smaller quantities of ethanol are to be stored in containers outlined above in the description of procedures section. Keep containers closed when not in use. Use with adequate ventilation. Avoid contact with eyes and skin. Avoid breathing vapors and wash exposed skin thoroughly after handling. Take precautions to prevent static electricity buildup when transferring contents.

Spill and Accident Procedure

Chemical Spill Dial 911 and EH&S ext. 7-2892.

Spill – Assess the extent of danger. Help contaminated or injured persons. Evacuate the spill area. Avoid breathing vapors. If possible, confine the spill to a small area using a spill kit or absorbent material. Keep others from entering contaminated area (e.g., use caution tape, barriers, etc.).

Small (<1 L) – If you have training, you may assist in the clean-up effort. Use appropriate

personal protective equipment and clean-up material for chemical spilled. Double bag spill waste in clear plastic bags, label and take to the next chemical waste pick-up.

Large (>1 L) – Dial **911** and EH&S at 228-7864 for assistance.

Chemical Spill on Body or Clothes – Remove clothing and rinse body thoroughly in emergency shower for at least 15 minutes. Seek medical attention. *Notify supervisor and EH&S at ext. 7-2892 immediately.*

Chemical Splash Into Eyes – Immediately rinse eyeball and inner surface of eyelid with water from the emergency eyewash station for 15 minutes by forcibly holding the eye open. Seek medical attention. *Notify supervisor and EH&S at ext. 7-2892 immediately.*

Medical Emergency Dial 9-911 or EH&S ext. 7-2892

Life Threatening Emergency, After Hours, Weekends And Holidays – Dial **911** *Note: All serious injuries must be reported to EH&S at ext. 7-2892 within 8 hours.*

Non-Life Threatening Emergency – Go to Logan Regional Hospital: 500 East 1400 North Logan. *Note: All serious injuries must be reported to EH&S at ext. 7-2892 within 8 hours.*

Needle stick/puncture exposure (as applicable to chemical handling procedure) – Wash the affected area with antiseptic soap and warm water for 15 minutes. For mucous membrane exposure, flush the affected area for 15 minutes using an eyewash station. *Note: All needle stick/puncture exposures must be reported to EH&S ext. 7-2892 within 8 hours.*

Decontamination/Waste Disposal Procedure

General hazardous waste disposal guidelines:

Label Waste

- Affix a hazardous waste tag on all waste containers as soon as the first drop of waste is added to the container

Store Waste

- Store hazardous waste in closed containers, in secondary containment and in a designated location
- Double-bag dry waste using transparent bags
- Waste must be under the control of the person generating & disposing of it

Dispose of Waste

- Dispose of regularly generated chemical waste within 90 days
- Call EH&S at ext. 7-2892 for questions
- Empty Containers
 - Dispose as hazardous waste if it once held extremely hazardous waste (irrespective of the container size)

Prepare for transport to pick-up location

- Check on-line waste tag
- Use secondary containment

Safety Data Sheet (SDS) Location

SDS can be found at the end of this folder.

Protocol/Procedure

Ethanol is primarily used in our lab to preserve arthropod samples. The source bottle of Ethanol should be moved from its flammable storage container to the fume hood to fill temporary use (i.e., 500 – 1000 mL) bottles using a funnel. Temporary use bottles must be labeled ‘Ethanol’. This transfer should be done wearing a lab coat, goggles, and nitrile gloves. Waste ethanol should be disposed of in a glass container labeled accordingly including what was washed off with the ethanol.

Documentation of Training (signature of all users is required)

- Prior to conducting any work with ethanol, designated personnel must provide training to his/her laboratory personnel specific to the hazards involved in working with this substance, work area decontamination, and emergency procedures.
- The Principal Investigator must provide his/her laboratory personnel with a copy of this SOP and a copy of the SDS provided by the manufacturer.
- The Principal Investigator must ensure that his/her laboratory personnel have attended appropriate laboratory safety training or refresher training within the last one year.

I have read and understand the content of this SOP:

Name	Signature	Identification	Date
[Click here to enter text.]	[]		[Click here to enter a date.]
[Click here to enter text.]	[]		[Click here to enter a date.]
[Click here to enter text.]	[]		[Click here to enter a date.]
[Click here to enter text.]	[]		[Click here to enter a date.]
[Click here to enter text.]	[]		[Click here to enter a date.]
[Click here to enter text.]	[]		[Click here to enter a date.]

STANDARD OPERATING PROCEDURES FOR STORING & HANDLING AND USING OF AN OXYGEN/PROPANE TORCH SAFELY

Standard Operating Procedure

1. Purpose:

To provide a procedure which outlines the responsibilities of employees in Storing Handling and using an oxygen/propane torch Safely.

2. Responsibility:

All employees are responsible for understanding and carrying out the responsibilities and duties outlined in the policy.

3. Procedure:

- Practices, procedures, equipment and appliances are required to be safe and compliant with federal, state and university standards.
- Propane and oxygen cylinders must be used, transported and stored in the upright position, valve capped and secured in position.
- Store cylinders in designated area(s), away from heat or sources of ignition, and in a secure, well-ventilated area.
- Never use, store, or transport your cylinder where it could be exposed to temperatures greater than 52° C (125° F).
- Never smoke while handling a propane cylinder.
- Do not transport or use propane containers that are damaged, show signs of corrosion, have been exposed to fire, or appear to be leaking.
- Always use proper fitting wrenches when making connections. Do not use vise grips or pipe wrenches.
- Check valves for leaks using a soapy liquid around the valve connection.
- Cylinders should be exchanged in a well-ventilated location.

4. Personal Protective Equipment:

- The following safety equipment will be worn at all times when exchanging cylinders and/or using propane torches:
 - a) Safety glasses
 - b) Gloves
 - c) Long sleeve shirt or jacket
 - d) Long pants (no shorts)
 - e) Shoes with high tops.
 - f) All loose hair should be bound and retained (e.g., under a shirt) so it cannot fall into a flame.

5. Torch Use:

A flame from an oxygen/propane torch can reach extremely high temperatures. Workers using a torch can receive serious burns from both the torch flame and the material they are applying heat to.

- Prior to use, ensure that torching equipment is in good working order and the cylinder valves are clean.

- DO NOT USE defective equipment.
- Check that fittings, hoses and heads are secure.
- Use soapy water to check connections for leaks.
- Only use a spark lighter or electronic starter to light torch.
- Protect the propane hose from damage by:
 - Keeping torch flame away from hose.
 - Keeping hose free of kinks.
 - Not running over hose with equipment.
 - Not using the hose to lift the cylinder.
- A torch flame is difficult to see in daylight, be aware of and keep away from the flame.
- NEVER LEAVE AN OPERATING TORCH UNATTENDED.
- Other than the operator, all workers should stay at least 1 meter away from the torch.
- Set torch units into support leg position when not in use.
- treat burns with ice or cold water and seek professional attention as needed
- notify all members in the lab that a flame is going to be used
- Do not have any open containers of flammable materials within 15 ft of flame.
- The flame must be extinguished immediately if flammable materials are spilled anywhere in the lab.
- Ignite pure gas first then adjust oxygen as need.
- Extinguish flame by turning oxygen off first then gas.
- Provide appropriate eye protection against intense light for anyone watching glassblowing
- Do not leave flame unattended.
- To shut off torch, close cylinder valve first, let gas burn out, close torch valve.
- At the end of the day, disconnect hoses and store properly.
- I have read and understand the content of this SOP:

Name	Signature	Identification	Date
[Click here to enter text.]	[]		[Click here to enter a date.]
[Click here to enter text.]	[]		[Click here to enter a date.]
[Click here to enter text.]	[]		[Click here to enter a date.]
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STANDARD OPERATING PROCEDURES FOR STORING & HANDLING AND USE OF LIQUID NITROGEN SAFELY

Standard Operating Procedure

We use liquid nitrogen to freeze samples and for cryogenic distillation (i.e., freeze-drying to remove water from plant and soil samples).

Liquid nitrogen is inert, colorless, odorless, non-corrosive, nonflammable and extremely cold. Nitrogen makes up the major portion of the atmosphere (78% by volume). Nitrogen is inert and will not support combustion; however, it is not life supporting. When nitrogen is converted to liquid form it becomes a cryogenic liquid.

Cryogenic liquids are liquefied gases that have a boiling point below -150°C (-238°F). Liquid nitrogen has a boiling point of -195.8°C (-320.5°F). All cryogenic liquids produce large amounts of gas when they vaporize.

Health Effects

Extensive tissue damage or burns can result from exposure to liquid nitrogen or cold nitrogen vapors.

Being odorless, colorless, tasteless and nonirritating, nitrogen has no warning properties. Humans possess no senses that can detect the presence of nitrogen. Although nitrogen is nontoxic and inert, it can act as a simple asphyxiant by displacing oxygen in air to levels below that required to support life. Inhalation of nitrogen in excessive amounts can cause dizziness, nausea, vomiting, loss of consciousness and death. Death may result from errors in judgment, confusion or loss of consciousness that prevents self-rescue. At low oxygen concentration, unconsciousness and death may occur in seconds and without warning.

Personnel including rescue workers should not enter areas where the oxygen concentration is below 19.5%, unless provided with a self-contained breathing apparatus or air-line respirator.

Containers

Liquid nitrogen is stored, shipped and handled in several types of containers, depending upon the quantity required by the user. The types of containers in use are the dewar, cryogenic liquid cylinder and cryogenic storage tank.

Dewars: This type of container is a non-pressurized container. The unit of measure for the capacity of a dewar is typically the liter. Five to 200 liter dewars are available. Product may be removed from small dewars by pouring, while larger sizes will require a transfer tube. Cryogenic liquid cylinders that are pressurized vessels are sometimes incorrectly referred to as dewars.

Cryogenic Liquid Cylinders: Cryogenic liquid cylinders are insulated, vacuum-jacketed pressure vessels. They come equipped with safety relief valves and rupture discs to protect the cylinders from pressure buildup. These containers operate at pressures up to 350 psig and have capacities between 80 and 450 liters of liquid.

Cryogenic Storage Tanks: Tanks may be spherical or cylindrical in shape. They are mounted in fixed locations as stationary vessels. Tanks are designed to ASME specifications for the pressures and temperatures involved.

Use only suitable vessels for the handling and/or transport of cryogenic liquids. Do not store liquid nitrogen in any container with a tight fitting lid; a loose fitting lid helps preventing air and moisture from entering the container and at the same time allows pressure to escape.

Safety Considerations

Cold contact burns: Liquid or low-temperature gas from any of the specified cryogenic substances will produce effects on the skin similar to a burn. The extremely low temperature of the liquid can cause severe frostbite or eye damage upon contact. Symptoms of frostbite include change in skin color to white or grayish yellow and the pain after contact with liquid nitrogen may quickly subside. Items in contact with liquid nitrogen become extremely cold. Touching these items may result in torn flesh.

Asphyxiation: Liquid nitrogen gas released in a confined space can displace sufficient oxygen to make the atmosphere incapable of sustaining life and cause asphyxiation without warning. Degrees of asphyxia will occur when the oxygen content of the working environment is less than 20.9% by volume. Effects from oxygen deficiency become noticeable at levels below ~ 18% and sudden death may occur at ~ 6% oxygen content by volume. This decrease in oxygen content can be caused by a failure/leak of the cryogenic vessel or transfer line and subsequent vaporization of the cryogen.

Explosion – Pressure: Heat flux into the cryogen from the environment will vaporize the liquid and potentially cause pressure buildup in cryogenic containment vessels and transfer lines. On vaporization liquid nitrogen expands by a factor of 696; one liter of liquid nitrogen becomes 24.6 cubic feet of nitrogen gas. Adequate pressure relief must be provided to all parts of a system to permit this routine out gassing and prevent explosion.

Explosions – Chemical: Cryogenic fluids with a boiling point below that of liquid oxygen are able to condense oxygen from the atmosphere. Repeated replenishment of the system can thereby cause oxygen to accumulate as an unwanted contaminant. Similar oxygen enrichment may occur where condensed air accumulates on the exterior of cryogenic piping. Violent reactions, e.g. rapid combustions or explosion, may occur if the materials which make contact with the oxygen are combustible.

Buildings

Because of the large expansion ratio of liquid to gas (1:696), it is important to provide adequate ventilation in areas using liquid nitrogen. A minimum of six air changes per hour is required in these areas.

Oxygen level monitoring should be provided for areas where oxygen displacement may occur.

OSHA has established 19.5% oxygen concentration as the minimum for working without supplied air.

Remember, nitrogen has no warning properties!

Storage and Handling

Store and use liquid nitrogen containers with adequate ventilation. Do not store containers in confined areas or in areas unprotected from the extremes of weather. Cryogenic containers are equipped with pressure relief devices designed to control the internal pressure. Under normal condition these containers will periodically vent product. Do not plug, remove or tamper with any pressure relief device.

Cryogenic containers must be stored, handled and transported in the upright position. When moving never tip, slide or roll containers on their side. Use a suitable hand truck for moving smaller containers. Move larger container by pushing, not pulling.

Use freight elevators whenever possible to transport liquid nitrogen. Do not ride in the elevator with the liquid nitrogen. Make arrangements for someone to send the elevator to a receiving person waiting on the desired floor.

Avoid mechanical and thermal shock.

Never leave the vessel unattended while transferring liquid nitrogen. Ensure that the delivery of the liquid nitrogen is directly below the mouth of the receiving vessel. Always fill warm dewars slowly to reduce temperature shock effects and to minimize splashing. Do not fill cylinders and dewars to more than 80% of capacity.

Never allow any unprotected part of the body to come in contact with uninsulated pipes or equipment containing cryogenic product. The extreme cold will cause flesh to stick fast and potentially tear on withdrawal.

If there is any difficulty in operating the container valve or container connections discontinue use and contact the vendor.

Do not remove or interchange connections. Use only the properly assigned connections. Do not use adapters.

Use only transfer lines and equipment designed for use with cryogenic liquids. Some elastomers and metals, such as carbon steel, may become brittle at extremely low temperatures and may easily fracture. These materials must be avoided in cryogenic service.

On gas withdrawal systems use check valves or other protective apparatus to prevent reverse flow in the containers. On liquid systems pressure relief devices must be used in lines where there is the potential to trap liquid between valves. It is recommended that all vents be piped to the exterior of the building.

Liquid containers should not be left open to the atmosphere for extended periods. Keep all valves closed and outlet caps in place when not in use. If restriction results from freezing moisture or foreign material present in openings and vents contact the vendor for instructions. Restrictions and blockages may result in dangerous over-pressurization. Do not attempt to remove the restriction without proper instructions. If possible move the cylinder to a remote location.

Personal Protective Equipment (PPE)

Personnel must be thoroughly familiar with properties and safety considerations before being allowed to handle liquid nitrogen and/or its associated equipment.

Eyes are most sensitive to the extreme cold of liquid nitrogen and its vapors. The recommended personal protective equipment when handling or using liquid nitrogen is a full face shield over safety glasses/goggles; loose-fitting thermal insulated gloves; and long-sleeved shirts and pants without cuffs. In addition, safety shoes are recommended for those involved with the handling of liquid nitrogen containers.

First Aid

In the event a person is injured by liquid nitrogen, the following first aid treatment should be given pending the care of a physician ONLY if there is no risk to you.

For skin contact with cryogenic liquid nitrogen, remove any clothing that may restrict circulation to the frozen area. Do not rub frozen parts, as tissue damage may result. People with frostbitten feet should not walk on them. As soon as practical place the affected area in a warm water bath that has a temperature not in excess of 105°F (40°C). Never use dry heat.

Frozen tissue is painless and appears waxy with a possible yellow color. It will become swollen, painful and prone to infection when thawed. If the frozen part of the body has been thawed, cover the area with a dry sterile dressing with a large bulky protective covering, pending medical care. In case of massive exposure, remove clothing while showering the victim with warm water. Do not use hot water. Call a physician immediately.

If the eyes are exposed to the extreme cold of the liquid nitrogen or its vapors, immediately warm the frostbite area with warm water not exceeding 105°F (40°C) and seek immediate medical attention.

Take a copy of the MSDS to the physician.

People suffering from lack of oxygen should be moved to fresh air. If the victim is not breathing, administer artificial respiration. If breathing is difficult, administer oxygen. Obtain immediate medical attention. Do not attempt to rescue an individual that has been overcome due to lack of oxygen. The rescuer then becomes the second victim.

5. Chemical Procurement, Distribution, and Storage

- (a) **Procurement:** Before a substance is received, information on proper handling, storage, and disposal will be known to those who will be involved. No container will be accepted without an adequate identifying label.
- (b) **Stockrooms/storerooms:** Incompatible substances will be segregated in a well-identified area with local exhaust ventilation. Chemicals which are highly toxic or other chemicals whose containers have been opened will be in unbreakable secondary containers. Stored chemicals will be examined periodically (at least annually) for replacement, deterioration, and container integrity. Chemicals with sensitive shelf lives, such as peroxide formers, will be dated and used or disposed of properly within suggested shelf life period.

Stockrooms/storerooms will not be used as preparation or repackaging areas, will be open during normal working hours, and will be controlled by one person.

- (c) **Distribution:** When chemicals are hand carried, the container will be placed in an outside container or bucket. Freight-only elevators will be used if possible.
- (d) **Laboratory storage:** Amounts permitted will be as small as practical. Storage on bench tops and in hoods is inadvisable. Exposure to heat or direct sunlight will be avoided. Periodic inventories will be conducted, with unneeded items being discarded, returned to the storeroom/stockroom, or made available to other users. Care will be taken to protect the integrity of chemicals, (prevent contamination etc.) so that the chemicals can be of use to others. Proper storage will ensure that incompatible chemicals are stored separately. Chemicals referred to in 3.1, 3.2, 3.3, 3.4, and 3.5 will be stored in areas of restricted access.

6. Environmental Monitoring

Area monitoring of airborne concentrations is typically not necessary in laboratories. Personal monitoring may be appropriate when testing or redesigning hoods or other ventilation devices, when a highly toxic substance is stored or used regularly (e.g., 3 times/week) or other situations of question. The EH&S Office Staff is available for consultation and chemical monitoring on a request basis.

7. Housekeeping and Maintenance

- (a) **Cleaning:** Floors will be cleaned regularly.
- (b) **Maintenance:** Eye wash fountains should be inspected by users at intervals of not less than 3 months. All labs will have ready emergency access to an eye wash station and drench shower, and the location will be communicated to all workers. Respirators for routine use will be inspected periodically. Other safety equipment will be inspected regularly (e.g., every 3-6 months) and prior to use. Procedures to prevent restarting of out-of-service equipment will be established.
- (c) **Passageways:** Stairways and hallways will not be used as storage areas. Access to exits, emergency equipment, and utility controls will never be blocked.

8. Laboratory Audits

- (a) **Frequency:** Formal housekeeping and chemical hygiene audits of the laboratory will be held at least quarterly. See Chemical Hygiene Appendix for "Laboratory Safety Audit Form".
- (b) **Documentation:** Dated copies of the completed quarterly audits will be filed at the end of this plan. A copy of the Safety Audit will be sent to the EH&S Office.

9. Medical Program

- (a) Compliance with regulations: Regular medical surveillance will be established to the extent required by regulations.
- (b) **Routine surveillance:** Anyone whose work involves regular and frequent handling of toxicologically significant quantities of a chemical will consult a qualified physician to determine on an individual basis whether a regular schedule of medical surveillance is desirable.
- (c) **First aid:** Personnel trained in first aid will be available during working hours. In case of a medical emergency call 911 on campus or 9-911 off campus. The campus dispatcher can then contact emergency response personnel. USU employees are to use the medical emergency services of Logan Regional Hospital. See pp 176-178 of "Prudent Practices" for description of some emergency first aid procedures.

10. Protective Apparel and Equipment

These will include for each laboratory:

- (a) Protective apparel compatible with the required degree of protection for substances being handled.
- (b) An easily accessible drench-type safety shower.
- (c) An eyewash fountain.
- (d) A fire extinguisher.
- (e) Respiratory Protection - Any worker issued a respirator must be trained in its appropriate use and undergo medical determination of fitness. This is a simple process, through which the Campus EH&S Office can guide you.
- (f) Fire alarm and telephone for emergency use will be available nearby.
- (g) Other items designated by the laboratory Safety Coordinator.

11. Records

- (a) Accident records will be written and retained.
- (b) Chemical Hygiene Plan records will document that the facilities and precautions are compatible with current knowledge and regulations.
- (c) Inventory and usage records for high-risk substances will be kept.
- (d) Medical records will be retained by the institution in accordance with the requirements of state and federal regulations.

12. Signs and Labels

Prominent signs and labels of the following types will be posted:

- (a) Chemical container labels showing contents of containers (including waste receptacles) and associated hazards.

- (b) Location signs for safety showers, eyewash stations, other safety and first aid equipment, exits and areas where food and beverage consumption and storage are permitted. Food and beverages will not be allowed in areas where chemicals are stored or handled.
- (c) Warnings at areas or equipment where special or unusual hazards exist. This includes controlled areas for use of chemicals described in 3.1, 3.2, 3.3, 3.4 and 3.5 above.

13. Spills and Accidents

- (a) Spill response plan will be established and communicated to all personnel; it will include procedures for ventilation failure, evacuation, medical care, reporting, prevention, containment, cleanup and drills.
- (b) There will be an alarm system to alert people in all parts of the facility including isolation areas such as cold rooms.
- (c) All accidents or near accidents will be carefully analyzed with the results distributed to all who might benefit.
- (d) For questions on spill clean-up procedures consult a MSDS or call the EH&S Office ext. 7-2892.
- (e) In the event of a chemical spill emergency, dial the USU Campus Emergency phone number (911).

14. Information and Training Program

- (a) **Aim:** To assure that all individuals at risk are adequately informed about the work in the laboratory, its risks, and what to do if an accident occurs. Laboratory Safety Training seminars are available through the EH&S Office.
- (b) **Emergency and Personal Protection Training:** Every laboratory worker will know the location and proper use of available protective apparel, emergency equipment and procedures.

Such training as well as first aid instruction will be available to and encouraged for everyone who might need it. First aid courses are offered quarterly through the local Red Cross Chapter.
- (c) **Handling:** Receiving and stockroom/storeroom personnel will know about hazards, handling equipment, protective apparel, and relevant regulations.
- (d) **Frequency of Training:** The training and education program will be a regular, continuing activity NOT simply an annual presentation. Various video tapes and training materials are available from the EH&S Office.
- (e) **Literature/Consultation:** Literature and consultation concerning chemical hygiene is readily available to laboratory personnel, through the EH&S Office (ext. 7-2892). Laboratory personnel are encouraged to use these information resources.

15. Waste Disposal Program

- (a) **Aim:** To assure that minimal harm to people, other organisms, and the environment will result from the disposal of waste laboratory chemicals.
- (b) **Content:** The USU waste disposal instructions included in the Chemical Hygiene Appendices specifies how waste is to be collected, labeled and prepared for pickup by the EH&S Office. Waste minimization methods are also included in

these guidelines. Chemical waste and radioactive waste disposal request forms can be made online at <http://www.ehs.usu.edu/hazwaste.html> and <http://www.ehs.usu.edu/radwaste.html>.

- (c) **Discarding Chemical Stocks:** Chemicals that are no longer needed will be either designated as waste or preferably given to another responsible user. Unlabeled containers must be identified prior to disposal or transfer (See guidelines). In the event the unknown may be potentially explosive (e.g. picric acid, ethers etc.) it must not be opened by laboratory personnel.

Before a worker's employment in the laboratory ends, chemicals for which that person was responsible will be discarded, returned to storage, or given to a fellow researcher. It is the responsibility of each employee to ensure that all chemicals in his/her work area are properly removed before leaving the University. This includes faculty, graduate students and lab technicians.

- (d) **Frequency of Disposal:** Waste must be stored in a secure place within the laboratory and removed at a regular interval.
- (e) **Method of Disposal:** Most waste chemicals shipped from USU are incinerated at an EPA regulated facility. Other wastes are recycled or burned as a fuel. The only acceptable disposal methods to be practiced in the lab are elementary neutralization and other chemical reactions that eliminate or reduce the hazardous characteristics of a chemical. Hoods will not be used as a means of disposal for volatile chemicals. Indiscriminate disposal by pouring waste chemicals down the drain is unacceptable.

I have read and understand the content of this SOP:

Name	Signature	Identification	Date
[Click here to enter text.]	[]		[Click here to enter a date.]
[Click here to enter text.]	[]		[Click here to enter a date.]
[Click here to enter text.]	[]		[Click here to enter a date.]
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[Click here to enter text.]	[]		[Click here to enter a date.]

E. Chemical Inventory

Ethanol – 20 L, plastic jug in flammables case purchased 8/2012

D₂O – 2, 1L plastic bottles purchased 3/2013

F. Material Safety Data Sheets

Material Safety Data Sheets contain information on the hazardous properties and proper handling of chemicals. OSHA requires chemical handlers be familiar with the chemicals with which they work. OSHA also requires that workers have ready access to an MSDS for each chemical in the work area. You will receive a MSDS with or shortly after the arrival of an ordered chemical product. On purchase orders or requisitions for chemicals or any other product requiring Material Safety Data Sheets please include 1) Product Name 2) Catalog Number or Product Number. Request a copy of the MSDS for each product and specify that the order number or (PO #) be included on the copy. The Environmental Coordinator (ext. 7-2888) can provide you with information regarding MSDS web sites as well as hard copies of MSDS=s for chemicals in your laboratories. MSDS=s should be maintained in a notebook or file that is easily accessible to employees in the lab.

G. Physical Hazards

The above recommendations do not include those which are directed primarily toward prevention of physical injury rather than toxic exposure. However, failure of precautions against injury will often have the secondary effect of causing toxic exposures. Therefore, we list below the major categories of physical hazards which also have implications for chemical hygiene:

1. Electrically powered laboratory equipment.
2. Fires, explosions.
3. Low temperature procedures.
4. Pressurized and vacuum operations (including use of compressed gas cylinders).
5. Slippery surfaces or tripping hazards.

Information on these laboratory hazards and their control is available in the listed laboratory safety references included in the USU Chemical Hygiene Appendix of Useful Information, the USU Fire Marshal's Office and the USU EH&S Office. The Fire Marshal's Office offers advice on fire and electrical safety, and sponsor a hands on extinguisher training session. The USU Lab Safety Audit Form includes sections on basic control methods for both physical and health hazards in laboratories.

H. Lab Safety Training Certificates