Clark Hall

Safety, Health, and Environmental

Procedures Manual

Cornell University
Ithaca, NY
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1.0 INTRODUCTION

At Cornell University, compliance with safety procedures and environmental regulations is everyone's responsibility. All members of the university community should be thoroughly familiar with their safety and environmental responsibilities, strive to follow safety and environmental practices at all times, act proactively to prevent accidents, injuries, and releases to the environment, communicate hazards to supervisors, and be prepared for emergencies that may occur in the workplace or on campus.

1.1 Responsibilities

Cornell University Policies 2.4 and 2.9 identify the responsibilities of various members of the Clark Hall community for safety and environmental compliance.

1.1.1 Directors and Department Heads

Communicate and implement University Policy 2.4, Health and Safety and its requirements to faculty, students, and staff.

Communicate “Appendix G: What Everyone Should Know About This Policy – Frequently Asked Questions” from the Environmental Compliance and Voluntary Environmental Initiatives Policy 2.9. (See the Appendices Section of this Manual for a copy of Appendix G.)

Create a safety committee(s) or group as necessary to address and coordinate safety and environmental efforts and work with representatives of the Department of Environmental Health and Safety (EHS) and the Environmental Compliance Office (ECO) staff to address safety and environmental problems and issues within Departments and units.

Designate and empower a safety/environmental representative(s) for departments, units or sections to ensure compliance with University Policies 2.4 and 2.9 program requirements. This representative will work with the EHS and ECO staff to develop and maintain safety and environmental programs.

Direct individuals under your supervision, including but not limited to principal investigators, supervisors, regular and temporary employees, visiting professors, post doctoral associates, and students, to obtain any required safety training before they work with hazardous chemicals, biohazardous agents, radiation, lasers or other physical/mechanical hazards in their working or learning environments.

Report all incidents, accidents, laboratory-acquired illnesses, and work site injuries to the Clark Hall Safety Committee via the building safety coordinator. A copy of this form is in the Appendices of this manual.

Develop and maintain adequate accident/illness prevention and health and safety programs within colleges or units.

Determine that safety needs for units/departments are met (e.g., training, protective equipment, and corrective measures including noncompliance items identified in safety audits).

Incorporate workplace safety requirements and responsibilities into each appropriate job description and ensure that workplace safety requirements expectations are communicated to each employee.

Conduct periodic safety self-audits of work areas and/or facilities (e.g., laboratories, work shops, and offices).
Develop and maintain emergency action and disaster preparedness plans, for Ithaca and off-site facilities that provide clear roles and responsibilities for all personnel in order to ensure familiarity and coordination between facility personnel and emergency responders.

1.1.2 Faculty, Principal Investigators, and Supervisors

Implement University Policies 2.4, Health and Safety, and 2.9, Environmental Compliance and Voluntary Environmental Initiatives, and all other university safety practices and programs under your supervision or control.

Require all staff members and students under your direction to obtain and maintain required safety and environmental program training.

Ensure that laboratory personnel do not work alone when work involves hazardous materials or procedures.

Maintain workplaces and equipment under your direction that are safe, well-kept, and in compliance with University Policies 2.4 and 2.9.

Meet all safety and environmental needs for units/departments (e.g., engineering controls, training, personal protective equipment, corrective measures including non-compliance items identified in safety self-audits).

Appoint group safety representatives for your research laboratories or facilities.

1.1.3. Employees, Students, and Research Personnel

Comply with the Cornell University Policy 2.4, Health and Safety, and Policy 2.9, Environmental Compliance and Voluntary Environmental Initiatives, and all other university health, safety, and environmental practices and programs by maintaining class, work, and laboratory areas safe and free from hazards.

Attend required health, safety, and environmental training.

Do not work alone when work involves hazardous materials or procedures.

Participate in prevention of accident, injury, and noncompliance to this policy as it relates to operations under your control.

Inform a supervisor or instructor of any safety hazards in the workplace, classroom, or laboratory.

1.1.4 Group Safety Representatives (GSRs)

Advise and assist laboratory supervisors in training new personnel.

Disseminate safety and environmental compliance information.

Conduct inspections of your group's laboratories and facilities.

Inspect and ensure the maintenance of the group safety equipment such as spill containment kits.

Attend GSR meetings.
### 2.0 TRAINING AND INFORMATION

All members of the Clark Hall community must receive training in evacuation procedures and the Clark Hall Safety Orientation. Additional safety and operational training may be required. (See the list of training programs below). Information on signing up for courses and blackboard availability can be found at http://dataworks.fcs.cornell.edu/sb. Members who use, ship, or dispose hazardous chemicals must review the Cornell University Lab Safety Manual and Chemical Hygiene Plan.

**Clark Hall Safety Training**  
\(X = \text{Required, } 0 = \text{Recommended}\)

<table>
<thead>
<tr>
<th>Training Programs</th>
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<tbody>
<tr>
<td><strong>If you work with:</strong></td>
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<tr>
<td>In a lab area</td>
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<tr>
<td>Hazardous Chemical</td>
</tr>
<tr>
<td>In a lab area</td>
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<tr>
<td>Hazardous chemicals</td>
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<tr>
<td>In a non-lab area</td>
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<tr>
<td>Hazardous waste</td>
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<tr>
<td>Radioactive materials</td>
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<tr>
<td>Potential Bloodborne Pathogens</td>
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<tr>
<td>Hydrofluoric Acid</td>
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**Equipment related training:**  
If an extinguisher is in your Lab or shop or hallway  
\(X\)

<table>
<thead>
<tr>
<th>Training Programs</th>
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<tbody>
<tr>
<td>Respiratory Protection</td>
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<tr>
<td><strong>Equipment related training:</strong></td>
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<tr>
<td>If you use a single or dual Cartridge respirator</td>
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<tr>
<td>Class IIIb/IV Laser</td>
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<tr>
<td>Electrical equipment where exposure to hazard is likely</td>
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<tr>
<td>If you must enter a pit</td>
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<tr>
<td>If you use/drive a forklift</td>
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3.0 EMERGENCIES

3.1 Medical Emergency Procedure

1. Protect the victim from further injury by removing any persistent threat to the victim. Do not move the victim unnecessarily. Do not delay in obtaining trained medical assistance.

2. Notify Cornell Police of the location, nature and extent of the injury by calling 911 or using a Blue Light or Emergency Telephone. Always call from a safe location. If calling from a cell phone, dial 255-1111.

3. Provide first aid until help arrives if you have appropriate training and equipment and it is safe to do so.

4. Send someone outside to escort emergency responders to the appropriate location, if possible.

3.2 Fire or Explosion Emergency Procedure

1. Alert people in the immediate area of the fire or explosion and evacuate the room.

2. Confine the fire by closing doors as you leave the room.

3. Activate the building fire alarm system by pulling the handle on a local fire alarm box.

4. Notify Cornell Police of the location and size of the fire by calling 911 or using a Blue Light or Emergency Telephone. Always call from a safe location. If calling from a cell phone, dial 255-1111.

5. Evacuate the building using the established Emergency Evacuation Procedure (see Appendix). Once outside, notify emergency responders of the location, nature and size of the fire.

6. If you have been trained and it is safe to do so, you may attempt to extinguish the fire with a portable fire extinguisher. If you have not been trained to use a fire extinguisher you must evacuate the area. If you use an extinguisher, call EH&S at 255-8200 to report it so that extinguisher can be checked.

3.3 Hazardous Materials Emergency Procedure for Chemical Spills

A Hazardous Materials Emergency exists when:
- cleanup of a spill of a hazardous material is beyond the level of knowledge, training or ability of the staff in the immediate spill area or
- the spill creates a situation that is immediately dangerous to the life and health of persons in the spill area or facility.

Environmental Heath and Safety is equipped to respond to and cleanup Hazardous Material Spills.

1. Alert people in the immediate area of the spill and evacuate the room. If an explosion hazard is present, take care not to create sparks by turning on or off electrical equipment.

2. Confine the hazard by closing doors as you leave the room.

3. Use eyewashes or safety showers as needed to rinse spilled chemicals off people. Spare clothing is available in the men’s and ladies restrooms (basement level).
4. Evacuate any nearby rooms that may be affected. If the hazard will affect the entire building evacuate the entire building. Take care not to turn electrical equipment on or off or otherwise causes sparks. Activate the building fire alarm system by pulling the handle on a local fire alarm box.

5. Notify Cornell Police of the chemical, location and size of the spill by calling 911 or using a Blue Light or Emergency Telephone. Always call from a safe location. Be prepared to spell chemical names. If calling from a cell phone, dial 255-1111.

6. If a building evacuation is required, evacuate the building using the Emergency Evacuation Procedure presented in this guide. Once outside, notify emergency responders of the location, nature and size of the spill.

7. Isolate contaminated persons. Avoid contamination or chemical exposure.

3.4 First Aid / Emergency Response

3.4.1 General Procedures

1. Protect the victim from further injury (extinguish burning clothing, wash contaminated skin and eyes, or shut off the current shocking a victim). However, do not move an injured person unless the individual's life is in further danger.

2. Call Cornell Police (dial 911 or use an Emergency Telephone) for immediate assistance.

3. Protect yourself and others from harm.

4. If you have appropriate training and equipment, restore or maintain breathing and heartbeat.

5. If the victim is bleeding severely, elevate the wound above the level of the heart and apply firm pressure directly over the wound with a clean cloth or your gloved hand.

7. Keep the victim warm to prevent shock.

8. Do not give an unconscious person anything to drink.

9. Do not leave an injured person unattended.

10. If an injured person is transported to the hospital emergency room, an appropriate faculty or staff member should accompany that person or follow that person to the emergency room.

3.4.2 Thermal Burns

Burning clothing

A person with burning clothing should be inundated with water under the safety shower or should roll on the floor until the fire is out. A fire blanket should be used as a last resort because it tends to hold in heat. Remove loose clothing, but do not remove any clothing adhering to the skin. Loosely cover the burned area with the cleanest available cloth material. Keep the victim warm by wrapping in a blanket or clean clothing because shock is a very serious complication of burns.

Call Cornell Police (dial 911 or use an Emergency Telephone) for immediate transport of the victim to medical assistance.
Other thermal burns

Burns are rated according to their depth. **First- and second-degree burns** are the least severe and are characterized by reddening of pale skin, with few or no small blisters that do not cover the entire burn. Swelling and blistering are sometimes delayed. Small first- and second-degree burns that are not open wounds should be immersed immediately in plain cold water. Cool the burn until the pain is reduced and then pat dry with sterile gauze.

**Third-degree burns** go all the way through the skin and may involve bone, muscle, and other tissue beneath the skin. The wound may be red and raw with ashy white or black charred areas. Since the nerve endings in the skin are burned away in a third degree burn there may be no sensation of pain. For deep burns where the skin is broken, do not put the burned area directly in water since this can cause an infection to spread. Instead, cover the burn loosely with thick, dry sterile gauze. Do not attempt to remove clothing that is sticking to the wound. The burn victim **MUST** be seen by a physician immediately.

3.4.3 Chemical Accidents

**Chemicals splashed in the eye**

Flush the eyes immediately at a sink and then at the eyewash in the hall or lab and remove any contact lenses if it is easy to do so. A few seconds can be the difference between saving and losing an eye. Flush the injured eyes for at least 15 minutes; hold the eyes open while washing them. Be sure to rinse the area under and around the eyelids. Get medical attention as soon as possible. Identify the chemical agent to assist in medical treatment.

**Chemicals spilled on the skin**

Flush the area immediately with profuse amounts of water for at least 15 minutes and remove contaminated clothing, shoes, or jewelry on any part of the body affected by chemical spills. Take care not to spread the chemical on the skin or eyes. Do not apply chemical neutralizing agents or ointments. **The one exception is hydrofluoric acid (HF) splashes.** Each lab that uses HF must have calcium gluconate available for first aid. After skin has contacted HF, wash the area in cold running water for **15 minutes** and then apply the calcium gluconate gel to the affected area. Seek medical attention after completing the first aid procedures.

Do not remove safety goggles until the face and head have been washed thoroughly. Obtain medical care immediately for all but the smallest chemical burns.

3.4.4 Inhalation of chemicals

Remove the person as quickly as possible to an uncontaminated location, but do not risk your life. If the victim is not breathing, begin mouth-to-mouth resuscitation if you are properly trained. Keep the victim warm. Immediately call Cornell Police (911 or Emergency Telephone) for assistance.

If there is risk involved in the rescue of an inhalation victim, call Cornell Police (911 or Emergency Telephone) without delay. An emergency rescue team wearing self-contained breathing apparatus will carry out the rescue operations.

3.4.5 Ingestion of chemicals

Call Cornell Police (911 or Emergency Telephone) immediately to summon help and to give information about the type of poison ingested.

A conscious person who has ingested a toxic chemical should drink copious amounts of
lukewarm water. Do not induce vomiting unless instructed to do so by a physician. Never give an unconscious person anything to drink, including milk. Do not give antidotes except for cyanide poisoning.

3.4.6 Electric Shock

Do not touch a person in contact with a live electrical source. Disconnect the source of power. If this cannot be done, use a non-conducting object to separate the victim from the live circuit. Immediately call Cornell Police (911 or Emergency Telephone). If the victim is not breathing, administer mouth-to-mouth resuscitation. If the heart has stopped, administer cardiopulmonary resuscitation (CPR) if you have been trained to do so.

3.4.7 Cuts and Bleeding

While wearing gloves place a clean cloth or pad over the wound and apply firm pressure. Keep the injured area elevated, and keep the victim warm to avoid shock. Call Cornell Police (911 or Emergency Telephone) for immediate transport to medical assistance of anyone with serious bleeding. Do not attempt to use a tourniquet.

3.4.8 Other Eye Injuries

Do not attempt to remove any particle that may be embedded in the eye; seek immediate medical attention.

3.5 Power Outage

Assess the extent of the outage in the unit's area.

1. Report the outage to Cornell Customer Service Center at 255-5322 or call 911 if someone is trapped in an elevator.

2. Assist other building occupants to move to safe locations. Loss of power to fume hoods may require the evacuation of laboratories and surrounding areas.

3. Implement the unit's power outage plan. Evaluate the unit's work areas for hazards created by the power outage. Secure hazardous materials. Take actions to preserve human and animal safety and health. Take actions to preserve research.

4. Turn off and/or unplug non-essential electrical equipment, computer equipment and appliances. Keep refrigerators and freezers closed throughout the outage to help keep them cold.

5. If needed, open windows (in mild weather) for additional light and ventilation.

3.6 Criminal Activity or Violence Emergency Procedure

1. Attempt to remove yourself from any danger.

2. Notify Cornell Police by calling 911 or using a Blue Light or Emergency Telephone. Try to call from a safe location if possible. If calling from a cell phone, dial 255-1111.

3. If possible, provide the police with the following information:
   - Location of crime
   - Nature of crime and specifics (number of people involved, any weapons, etc.)
   - Any injuries
• Description of suspect(s) (height, weight, sex, race, clothing, hair color etc.)
• Direction of travel of suspects
• Description of any vehicles involved in the crime

4. DO NOT pursue or attempt to detain suspects.

3.7 Bomb Threat

1. Remain calm and obtain as much information as possible from the caller. Try to write down the caller's exact words. Ask for and try to obtain the following information:
   • When is the bomb going to explode?
   • Where is the bomb located right now?
   • What does the bomb look like?
   • What kind of bomb is it?
   • What will cause the bomb to explode?
   • Did you place the bomb? Why?
   • What is your address?
   • What is your name?

2. Also record the following information:
   • Exact time the call is received
   • Information about caller including:
     - Sex
     - Education
     - Age
     - Background noise
     - Location of caller
     - Accent
     - Speech impediments or traits
     - Caller's attitude

3. Immediately notify Cornell Police by calling 911 or using an Emergency Telephone. Always call from a safe location. Provide the police with the context of the threat, telephone number on which it was received, your name, room number and a telephone number where you can be reached.

4. Take no other action unless directed to by Cornell Police.

3.8 Suspicious Package Procedure

If you receive or observe a suspicious letter or package that is unexpected or unknown with the following characteristics:
• Excessive postage
• Misspellings of common words
• Excessive weight
• Rigid envelope
• Foreign mail, air mail or special delivery
• Hand written or poorly typed address
• Restrictive markings such as confidential, personal, etc.
• An excessive amount of securing material used, such as masking tape, string, etc.
• Incorrect titles
• Oily stains or discoloration
• Visual distractions
• Lopsided or uneven
• Titles but no names
• No return address
• Protruding wires or tinfoil
• Contains a powder or residue
Immediately:
1. Notify Cornell Police by calling 911 or using an Emergency Telephone. Always call from a safe location. If calling from a cell phone, dial 255-1111.

2. Move people away from the package.

3. DO NOT move or open the package. If you find powder or a residue upon opening a package or letter, move away from it, wash your hands immediately, call 911, and save all packaging.

4. DO NOT investigate too closely.

5. DO NOT cover, insulate or place the package into a cabinet or drawer.
4.0 ELECTRICAL SAFETY

Many electrical hazards can be easily identified before a serious problem exists. Common scenarios that may indicate an electrical problem include flickering lights, warm switches or receptacles, burning odors, loose connections, frayed, cracked, or broken wires. Do not ignore electrical problems.

4.1 General Guidelines

1. Do not attempt electrical repairs unless you are an authorized electrical technician. Authorized individuals must receive training in safety related work practices and procedures, be able to recognize specific hazards associated with electrical energy, and be trained to understand the relationship between electrical hazards and possible injury. Fixed wiring may only be repaired or modified by Cornell Facilities Services.

2. Do not use extension cords or power taps (plug adapters) as a substitute for permanent wiring. Extension cords may be used for experimental purposes for no longer than three months, or for portable tools or appliances that must be moved frequently. Power strips must have built-in overload protection (circuit breaker), a power switch, and must not be connected to another power strip or extension cord. Extension cords and other purchased electrical equipment must be UL listed. Extension cords should not be draped over utility fixtures such as lights, water sprinklers, or steam lines. Cords should not clutter the floor in places where they could be stepped on or tripped over. Keep all junctions away from liquids.

3. Do not use equipment having worn or damaged power cords, plugs, switches, receptacles or cracked casings. Running electrical cords under doors or rugs, through windows, or through holes in walls is a common cause of frayed or damaged cords and plugs.

4. Whenever possible, use only one hand when working on circuits or control devices. When you must touch electrical equipment (for example, when checking for overheated motors), use the back of the hand. Thus, if accidental shock were to cause muscular contraction, you would not "freeze" to the conductor.

5. Provide overhead runways for power cords and other plug-in receptacles to keep all electrical leads above floor level and out of walkways.

6. Keep work areas clean and dry. Do not operate electrical equipment if your hands are wet or if you are standing in water. Do not operate electrical equipment where it may come in contact with water.

7. Remove all jewelry before working with electricity. This includes rings, watches, bracelets, and necklaces.

8. Turn off all power and pull the plug when repairing electrical equipment under your immediate control.

9. Do not use alligator clips in permanent electrical circuits.

10. Do not use 2-prong non-double insulated electrical devices.

11. Entrances to rooms and other guarded locations containing energized exposed parts must be marked with conspicuous warning signs forbidding unauthorized persons to enter.

12. Use insulated tools and test with properly rated equipment when working on electrical equipment.
13. Use power tools that are double-insulated or that have ground-fault circuit interrupters protecting the circuit.

14. Do not use aluminum ladders while working with electricity; choose either wood or fiberglass.

15. Live parts of electrical equipment operating at 50 volts or more must be guarded against accidental contact.

16. Authorized individuals may work or test energized equipment. Always wear safety glasses and appropriately rated electrically insulated gloves when working on live circuits. Before using, inspect glasses and gloves for signs or wear and tear and other damage. Replace defective safety items prior to use.

17. If electrical equipment repeatedly blows a fuse or trips a circuit breaker, or has given you a shock, unplug it and have it repaired or replaced.

18. Check to see that fuses are the correct size for a circuit. Replacing a correct size fuse with a larger size can present a serious fire hazard.

4.2 Equipment

1. Read and follow all equipment operating instructions for proper use.

2. All 110-volt outlets should be of the type that accepts three-pronged electrical plugs. Laboratory equipment should be fitted with fuses and with three-wire power cords, which provide an independent ground to the chassis of the apparatus.

3. Outlets for equipment used in fume hoods should be located outside of the hood.

4. Any electric equipment that is operated in areas containing volatile and flammable material must have non-sparking induction motors. Refrigerators used to store flammable chemicals must be certified by the manufacturer for this application.

5. The accidental or unexpected starting of electrical equipment can cause severe injury or death. Before any inspections or repairs are made, the current must be turned off at the switch box and the switch padlocked or tagged out in the off position. At the same time, the switch or controls of the machine or the other equipment being locked out of service should be securely tagged to show which equipment or circuits are being worked on. Test the equipment to make sure there is no residual energy before attempting to work on the circuit. Employees must follow the Cornell University lock-out/tag-out procedures.

6. Some variable autotransformers (Variacs) are not grounded. Make sure that any equipment regulated by such a Variac is independently grounded. Variacs should be fitted with the appropriately sized fuse.

7. High- or low-voltage power supplies should be enclosed to prevent accidental contact and MUST be grounded. The power supply enclosure should have an interlock that disconnects the power and dumps capacitors when the enclosure is opened. Direct-wired equipment should have a readily accessible power disconnect switch. A warning sign should be posted in an appropriate location.

8. Heating elements MUST be enclosed in glass, ceramic, or other temperature-resistant housing. Check the underside of hot plates for any exposed wires.
9. All electrical splices should be secured within a junction box. Use wire nuts. Wrap with insulating tape only in very low-voltage circuits.

10. Isolated (earth) grounds, used for some equipment, should be tested for continuity on a regular basis.

4.3 Static Grounding

The proper way to set up a static ground is to connect the ground wire to the table using a crimped connector. You should connect the other end via a ground clamp intended for that purpose to a grounded metal pipe in the room such as a water line. You can assure a continuous path to a ground by scraping a bit of the paint off the water line. You should not connect your static ground wire to the building electrical system. The selected pipe should be verified as a viable ground. If your grounding wire runs on the floor, please assure that it does not create a tripping hazard.

4.4 Emergency Actions

In the event of an accident involving electricity, if the individual is down or unconscious or not breathing call Cornell University Police immediately. If an individual must be physically removed from an electrical source, it is always best to eliminate the power source first (ie: switch off the circuit breaker) but time, or circumstance may not allow this option – be sure to use a nonconductive item such as a dry board. Failure to think and react properly could make you an additional victim. If the individual is not breathing and you have been trained in CPR, have someone call the CU Police (911) while you begin CPR IMMEDIATELY!
5.0 CHEMICAL SAFETY

5.1 General Guidelines – Safe Handling of Chemicals

Be aware that all chemicals are hazardous to some degree, and protect yourself from accidental skin, eye, and respiratory contact.

Know the hazards of the materials you are working with. If you are using an unfamiliar procedure or chemical, conduct a literature search for reports of known or suspected hazards. Material Safety Data Sheets (MSDSs), provided by manufacturers of commercially available chemicals, are an important primary source of information on physical properties, health hazards, reactivity, and spill cleanup procedures. The Cornell University Environmental Health and Safety Web site (http://www.ehs.cornell.edu) contains an extensive collection of MSDSs for most chemicals found in the building. Another important reference work, also available for consultation in the Safety Library (205 Baker Lab), is Bretherick’s Handbook of Reactive Chemical Hazards.

1. Whenever possible, perform hazardous reactions in a properly functioning hood using appropriate shielding.

2. Never taste a laboratory chemical.

3. Take special precautions when scaling up a reaction. A reaction that is safe under published conditions may be violent when multiplied in scale.

4. Read labels carefully, and keep labels clean so that they are legible. Replace deteriorating labels before a chemical becomes unidentifiable.

5. Clearly label ampoules, product vials, reaction vessels, and all other containers. Labels should include chemical names whenever possible, structures when appropriate, and identity of owner. Laboratories that contain synthesized materials, which are labeled without chemical names, must have an explanation of the research group's labeling system posted in a conspicuous place in the lab. This system must include a lab notebook number, notebook page number, and the name or initials of the researcher. Containers labeled using abbreviations of chemical names must have an explanation key posted in the lab. Unidentified materials cannot be disposed of and can cause serious accidents.

6. If it is necessary to smell a chemical, do so by wafting the vapors toward your nose with your hand so that the minimum amount is inhaled.

7. Be aware of chemical incompatibilities before mixing to avoid explosive or uncontrollable reactions, generation of toxic gases, etc.

8. Prior to leaving* the building, all laboratory personnel will ensure that any of their chemicals are either disposed of properly as waste or remain a part of continuing work. Sharps (needles or syringes) must also be properly disposed or transferred to another group member. Sharps use and/or disposal logs must reflect the transfer or disposal.

Remaining chemicals made in the building must be in containers labeled with the name of the chemicals (not only a code name or number or a formula) and the name of the "new" owner. Principal investigators are responsible for enforcing this policy for graduate students, visiting scientists, post doctoral personnel, undergraduate students, or others leaving their groups.

*Leaving is defined as graduating, taking a leave of absence, retiring, quitting, or halting research for an extended period of time.
9. The wearing of properly fitting prescription or non-prescription safety spectacles with side shields is required whenever hazardous chemicals are used or transported. Any safety spectacles MUST comply with the ANSI Z87.1 standard. ANSI approved safety goggles or face shields may also be used and are recommended when material may present a splash hazard.

10. Wear gloves when you are working with hazardous chemicals; many toxic chemicals are readily absorbed through the skin. Many chemicals and laboratory detergents that are not toxic may nevertheless cause dermatitis and other allergic reactions. Before each use, check gloves for rips, pinholes, and defects. After working with toxic materials, rinse gloves before taking them off. Check Manufacturer’s recommendations for glove material for use with chemicals. Information can be found in safety supply catalogs or the Cornell Lab Safety Manual and Chemical Hygiene Plan.

11. Wear a laboratory coat to protect your clothes and body. When working with corrosive substances, it is desirable to wear a rubber apron. Shoes should cover the entire foot.

12. Use a safety shield when you are doing an experiment under reduced or elevated pressure or when you work with explosive compounds. A safety shield is a portable, unbreakable plastic or glass barrier that is placed between a hazard and a laboratory worker.

13. Use of Cyanides
   - Hydrogen cyanide and cyanides are among the most rapid-acting poisons known.
   - If you care planning to work with inorganic cyanides, contact Clark Hall Safety Manager prior to the work for training.

14. Use of Hydrofluoric Acid
   - Contact Clark Hall Safety Manager for training and administrative requirements for HF use.

5.2 Clark Hall Chemical Inventory

1. Commercial chemicals must be barcoded. Please contact Clark Hall Safety Manager for current requirements.

2. For a report of your group’s current inventory, contact Clark Hall Safety Manager.

5.3 Storage of Chemicals

   General Guidelines

1. Do not store excessive quantities of chemicals in a research laboratory. Purchase the minimum amount required and dispose of unneeded chemicals in a timely fashion.

2. Date bottles of chemicals when they are opened. Peroxidizable chemicals such as isopropyl ether should be tested periodically (see Cornell Lab Safety Manual and Chemical Hygiene Plan, appendix I for testing frequency) or discarded according to the label expiration date. Discard any chemical of dubious purity (by the usual waste disposal procedures) if it cannot be purified safely.

3. Store reagents on shelves or in cabinets. Store large bottles of chemicals on the lowest shelves of any chemical storage area. Do not allow bottles to extend over the edge of a shelf.
4. Do not store chemicals on benchtops. They are more readily knocked over and are unprotected from potential exposure to fire. Storage of hazardous materials on the raised shelf in the middle of benches should be minimized.

5. Hoods should not be used for chemical storage. Hood storage interferes with air flow in the hood, causes clutter, and increases the fuel load in the event of a hood fire. If small quantities of chemicals are stored in the hood, they should be placed on an elevated shelf made of noncombustible material such as perforated sheet metal.

6. No chemicals (either reagents or waste chemicals) should be stored on the floor. Floor storage presents a major safety hazard because bottles can break if knocked over or struck together.

7. Chemicals requiring refrigerated storage should be properly labeled and sealed to prevent escape of any vapors. Use only refrigerators designated for chemical storage. Flammable liquids MUST be stored only in explosion-safe refrigerators. Do not refrigerate chemicals unnecessarily.

8. Seal the caps of opened bottles of volatile chemicals using Parafilm. This will help prevent odor problems and deterioration of air- or moisture-sensitive reagents.

9. Inspect storage areas periodically for damaged containers such as cracked bottles or caps or rusted cans. Replace loose or deteriorating labels.

10. Evacuated glass vessels used for chemical storage should be cylindrical or spherical, should be as small as possible, and should be shielded. They should be protected from thermal and mechanical shocks, which might cause an implosion. Round flasks over one liter in volume must be shielded.

5.3.1 Storage of Specific Classes of Chemicals

1. Provide separate storage areas for acids, bases, solvents, oxidizing agents, pyrophoric materials, and air- or water-reactive materials. See the list of incompatible chemicals in the Clark Hall stockroom or check the EHS website (http://www.ehs.cornell.edu).

2. Store acids separate from bases. Store ammonium hydroxide in a separate cabinet, preferably ventilated.

3. Store oxidizers, including oxidizing acids such as nitric and perchloric acid, separate from oxidizable compounds such as acetic acid. Perchloric acid MUST be stored where it cannot contact organic materials.

4. Store highly toxic chemicals in unbreakable secondary containers labeled with a description of the contents. Cyanides and sulfides MUST be kept safe from any contact with acids. Store cyanides in a closed cabinet, not in a location visible to passersby. Dispose cyanides for which you have no current use.

5. Store pyrophoric materials separate from flammable materials, in a dry, inert atmosphere such as a nitrogen-filled desiccator or a glove box.

6. Do not store flammable materials in cabinets under sinks.
5.4 Transport of Chemicals

General Rules for Safe Transport of Chemicals

1. Use a hand-held rubber safety bottle carrier for liquids and hazardous solids in glass containers. **These carriers are mandatory for 1.0-L or larger bottles of liquids.** Carriers are recommended for smaller containers of liquids if a small spill would present a significant hazard. Carriers may be purchased from the Chemistry stockroom.

2. Use a cart with side panels if transporting several chemicals at once, to prevent bottles falling off the cart platform. Do not allow containers to collide with each other during transport. Use shipping boxes with Styrofoam inserts for the transport of more than two bottles of liquid chemicals. Seal the box with tape.

3. Use a hand truck for cylinders of compressed gases. Remove regulators before transport. Do not drag cylinders. Chain the cylinder to the hand truck at a point high enough on the cylinder so that it will not tip during transport. Be sure the cylinder cap is screwed on tightly.

4. Never pick up a bottle by the cap or lid.

5. Wear eye protection while transporting chemicals.

5.4.1 Materials Shipping

DOT regulations require that all aspects of package preparation and shipping be done by properly trained individuals. A list of approved shipping facilities that have trained people and can properly prepare hazardous material for shipment is provided below. A charge code is required to pay for the shipping. Hazardous Materials Shipping assistance can be obtained by contacting EH&S at 5-8200.

Radioactive Materials
Environmental Health & Safety – 125 Humphreys Service Building (5-8200)

Biohazards/Medical Waste
Vet Med Center, Diagnostic Lab Mailroom -

The university Environmental Health & Safety web-page is a resource to use to determine if the material to ship is a hazardous material.

If it is hazardous:
1. Obtain Material Safety Data Sheets (MSDS) for chemicals to ship including solvents.

2. Fill out the Cornell shipping paperwork. Blank forms are available from the shipping sites and can be downloaded from the EH&S website.

3. Take the Cornell shipping paperwork, MSDS and container/material to be shipped to the shipping site.
6.0 GRADUATE RESEARCH MACHINE SHOP
STANDARD OPERATING PROCEDURES

6.1 Responsibilities & Training

6.1.1 Shop Supervisors

Supervisors must recognize those factors within their shop with accident potential. The supervisor shall provide frequent inspections of work methods and materials/equipment used. Any unsafe equipment/material shall be tagged and rendered inoperative or physically removed from its place of operation. The supervisor shall permit only qualified personnel to operate equipment and machinery.

6.1.2 Supervisors Are Responsible For:

- Ensuring safe working conditions
- Providing necessary protective equipment
- Ensuring that required guards and protective equipment are provided, used, and properly maintained.
- Ensuring that tools and equipment are properly maintained and used.
- Ensuring that the shop users understand the task to be performed, the hazards that may be encountered, and the proper procedure for doing the task safely.
- Taking immediate action to correct any violation of safety rules observed or reported to them.

6.1.3 Training & Use of the Machine Shop

1. All shop users shall be thoroughly trained in the use of protective equipment, guards, and the safe operation of equipment, machines, and tools they use or operate. Only shop users who have been trained shall be allowed to use shop equipment, machines, and tools.

2. Keep the shop doors closed after hours or when the supervisor is not present. Do not let unauthorized or untrained people into the shop. If someone does not have their access card, do not admit them to the facility.

3. Never work alone. All shop users must be accompanied by an authorized person at all times or wear an approved personal emergency call unit (located in the machine shop).

6.2 Injury Reporting, Emergencies, and Housekeeping

6.2.1 Injury Reporting & Emergencies

1. ALL injuries, no matter how small, shall be reported to the shop supervisor and your group supervisor. An incident report shall be completed and sent to the Clark Safety Manager within 24 hours.

2. The shop supervisor or group supervisor will assist personnel in completing this form.

3. In the event of an emergency, call “911” for immediate assistance.

6.2.2 Housekeeping

1. Work areas must be kept clear of unnecessary clutter and scrap materials at all times. Clean your work area frequently.
2. All materials and equipment shall be returned to their proper storage location when not in use.

3. Aisles & exit ways will be kept in good repair and free of chips, dust, metal scraps, and other slipping and tripping hazards.

4. Storage of materials and equipment shall not impede access to fire extinguishers, emergency stop buttons, electrical panels, exits, alarm actuators, or eyewash stations.

5. Waste containers will be emptied daily or more often, if necessary, to prevent excessive waste accumulations.

6. All materials, including usable scrap, will be stored so that they will not present a hazard.

6.3 Graduate Research Shop Machinery

6.3.1 General Safe Work Practices

1. If you are not sure how to operate a machine or perform a specific task, **STOP** and ask for assistance.

2. If you find a machine or equipment to be damaged, report the condition to the supervisor immediately. Never use damaged or faulty equipment.

3. If you observe an unsafe work practice within the shop, notify the shop supervisor immediately.

6.3.2 Personal Protective Equipment & Clothing

1. Eye protection shall be worn by all personnel within areas where machines are operated. Safety glasses must have side shields and comply with the ANSI 287.1 standard.

2. Loose fitting clothing, neckties, rings, bracelets, or other apparel that may become entangled in moving machinery will not be worn by machine operators or their helpers.

3. All long hair must be secured back to prevent entanglement in moving machinery.

4. Absolutely no bare feet, sandals, or open-toed shoes are permitted within the shop area.

5. Earplugs or muffs will be used when required for worker protection.

6. Gloves will not be worn where there is a chance of them being caught in machinery.

6.3.3 Standard Operating Procedures

1. Machines will never be left unattended while running.

2. No attempt will be made to clean any part of a machine until the moving parts have come to a complete stop. Chips will not be removed from machinery by hand. Chip pullers and hand brushes should be used but compressed air may be used when reduced to less than 30 psi and then only with effective chip guarding and personal protective equipment.

3. Machines will be completely stopped before attempting to clear jammed work or debris.

4. Secure or clamp all materials to be machined in a vice whenever possible, particularly when operating a drill press. Secure round bar stock and small pieces when using a band saw.
5. Never leave chuck keys or wrenches unattended in machines.

6. Do not touch rotating machine parts when the machine is operating.

7. Machinery and equipment shall be kept clean of excess grease and oil, and free of excessive dust. Pressure gauges and visual displays shall be kept clean and visible at all times. Drip pans shall be cleaned and emptied regularly.

8. Always use specially modified drills when working with brass, sheet metal, and some plastics. Check with the shop supervisor to ensure proper drill selection.

9. Always ensure that bits, cutters, and blades are of the correct rating (RPMs and material) for the stock to be machined.

6.4 Compressed Air

6.4.1 Safe Use of Compressed Air

1. Turn valve off and vent pressure from a line before connecting or disconnecting it. Never work on a pressurized line.
2. Never apply compressed air to any part of a person's body. Compressed air is not to be used to blow dirt, chips, or dust from clothing or skin.
3. Do not use compressed air to clean machinery or parts unless absolutely necessary. Where possible, use a brush. If necessary, use a minimum pressure and provide barriers. Wear goggles to protect your eyes.
4. Do not blow debris or fluids toward yourself or in the direction of other shop users.

6.5 Hand & Power Tools

6.5.1 Hand Tools

1. Supervisors and equipment users shall frequently inspect all hand tools used for damage and defects. Defective tools shall be immediately removed from service.
2. All tools shall be kept in good repair and maintained by qualified personnel.
3. Use the right tool for the job.
4. Damaged hammer handles shall be immediately replaced. Replacement handles shall be well fitted and securely fastened by wedges or other acceptable means.
5. Cold chisels, punches, hammers, drift pins, and other similar tools mushroom from repeated poundings. When this happens the mushroomed material shall be removed to prevent it from fragmenting off as dangerous projectiles.
6. Never use a hand file, without a handle, in a machine tool operation.
6.5.2 Power Tools

1. Disconnect tools when not in use, during servicing, or while changing accessories such as blades, bits or cutters.

2. All power tools shall be inspected for damage before use. Damaged or defective tools shall be tagged and removed from service.

3. All electric power tools must be three-wire with a grounding prong, or be double insulated.

4. All electric power tools must be UL listed.

6.6 Abrasive Wheel Equipment

1. All abrasive wheels shall be closely inspected and ring-tested by the supervisor before mounting to ensure that they are free from cracks or defects.

2. All individuals using abrasive grinding wheels shall be protected by eye equipment.

3. Work rests shall be used to support the work. They shall be of rigid construction and designed to be adjustable to compensate for wheel wear. Work rests shall be kept adjusted closely to the wheel with a maximum opening of 1/8-inch to prevent the work from being jammed between the wheel and the rest, which may cause wheel breakage. The work rest shall be securely clamped after each adjustment. The adjustment shall not be made with the wheel in motion.

4. An adjustable tongue guard shall be located on the top side of the grinder and kept to within 1/4-inch of the wheel to prevent broken wheel fragments from striking the operator.

5. Care shall be taken to ensure the maximum RPM rating of each abrasive wheel is compatible with the RPM rating of the grinder motor.

6. Safety guards shall be in place so that the spindle end, nut, and outer flange are not exposed.
7.0 CONFINED SPACE

7.1 Definition

A confined space is one that is:

a. Large enough to bodily enter, and
b. A location with a limited means for entry and/or exit, and
c. Not designed for continuous human occupancy.

Examples of confined spaces in Clark Hall are the pit areas in the basement and sub-basement areas of the building.

If no hazards, potential or real, exist in this space it is a confined space that does not require a permit. All individuals who enter confined spaces must be trained prior to entry. The following two conditions are also required prior to entry:

1. Pre-entry air monitoring is required. The results must show that the oxygen level is greater than 19.4% and that the LEL (lower explosive limit) is not exceeded prior to entry. If either of these conditions is unmet, entry cannot be permitted until the air quality meets these conditions.

An air quality meter can be found in the Research Services Shop. Contact the Facility Manager for training in the use of this instrument.

2. You must complete the confined space entry log. This log is to be maintained in a binder at the room or area of the confined space. A copy of the log is found at the end of this document.

It is recommended that a second person be advised of an individual’s planned entry.

7.2 Permit-Required Confined Space

A permit-required confined space is one that meets the definition of a confined space and also contains or has the potential to contain hazards such as

- A contaminated atmosphere
- Entrapment (the inability to exit the space once it’s been entered)
- Engulfment (a condition where materials collapse in on the entrant i.e: sand, water),
- Any other recognized safety or health hazard that cannot be eliminated prior to entry.

This type of entry is highly hazardous. The university EH&S group (5-8200) should be contacted if this type of entry is to be made. You must complete the confined space entry log and permit, have trained attendants & entrants, have rescue devices in place, etc. EHS will provide assistance with an entry into this type of confined space.
7.3 Confined Space Entry Permit

* Complete this permit, in addition to the entry log, when the confined space to be entered contains recognized hazards that cannot be eliminated prior to entry.

Hazards identified: (check all that apply)
- Atmospheric
- Engulfment
- Entrapment by configuration
- Other, describe ________________________________

Entrant(s):
________________________________
________________________________

Attendant(s):
________________________________
________________________________

Entry Supervisor:
________________________________

Communication method: (check all that apply)
- Visual
- Radio
- Other

Additional safety equipment: (check all that apply)
- Mechanical forced air ventilation
- Respirator – type ________________________________
- Tripod & hoist (vertical entries)
- Lifeline (horizontal entries)
- Chemical protective clothing – type: _______________

- Fire extinguisher
- Other, describe ________________________________

Additional air monitoring results:
Time __ __ __ __ __ __ __ __ %
O₂ __ __ __ __ __ __ __ __ %
LEL __ __ __ __ __ __ __ __ %
CO __ __ __ __ __ __ __ __ ppm
H₂S __ __ __ __ __ __ __ __ ppm
Other __ __ __ __ __ __ __ __

Rescue and emergency procedures: (check all that apply)
- non-entry rescue (lifeline & safety harness)
- entry rescue (must have prior EH&S approval)

Permit canceled by: ____________________________
Cancel Time: __________________

In case of emergency:
Dial 911 or 255-1111

For more information on Cornell University’s Confined Space Entry Program dial: 255-8200
7.4 Confined Space Entry Log
(for all confined space entries)

* A confined space is:
1. Large enough to bodily enter
2. Has limited means for entry and/or exit
3. Not designed for continuous human occupancy

Form completed by: ____________________
Date: ____________________
Department/Shop: ____________________
Location of entry: ____________________
Reason for entry: ____________________
Ticket/Job #: ____________________

Opening protected by barricades: Y NA
Lockout/tagout/verify: Y NA
If yes, describe _______________________________________________________________________
Tag #: ____________________

Safety Equipment: (check all that apply)
____ Harness   ____ Hardhat   ____ Communication
____ Eye Protection   ____ Gloves   ____ Light
____ Hearing Protection   ____ Ladder   ____ GFI
Other _______________________________________________________________________

Atmospheric Testing:
Date meter last calibrated: _______________ (min. every 3 months)
Initials of individual performing atmospheric tests: ____________________

Initial air monitoring results:
O₂ _________ % (19.5-23.5%)
LEL _________% (<10%)
CO _________ppm (<35ppm)
H₂S _________ppm (<10ppm)

7.5 Alternate Entry Procedures

This section should be completed, in addition to the entry log, if the confined space to be entered contains or has the potential to contain a hazardous atmosphere. Air monitoring results must demonstrate that continuous forced air ventilation will maintain safe atmospheric levels for the duration of the entry.

Continuous forced air ventilation: Y
Hot work permit completed: Y NA
Fire extinguisher present: Y NA

Additional air monitoring results:
Time _______ _______ _______ _______ _______ _______%
O₂ _______ _______ _______ _______ _______ _______%
LEL _______ _______ _______ _______ _______%
CO _______ _______ _______ _______ _______ _______ ppm
H₂S _______ _______ _______ _______ _______ _______ ppm
Other _______ _______ _______ _______ _______ _______ _______ _______

In case of emergency:
Dial 911 or 255-1111

For more information on Cornell University’s Confined Space Entry Program dial: 255-8200
Reclassifying Permit-Required Confined Spaces

Alternate Entry Procedures

This is used when the only hazard of a confined space is a contaminated atmosphere, and the atmosphere can be controlled (made safe) through continuous forced air ventilation. Typically this is used when welding in confined spaces. Continuous forced air ventilation and continuous air monitoring must be provided during the entire entry, as well as completing the entry log and documenting additional air monitoring results.

Permit-required confined spaces that have been deemed “permit-required” due to live electrical lines or moving mechanical parts can be reclassified to a plain confined space if those hazards are eliminated prior to entry into the space. This is usually accomplished through locking & tagging out energy sources. Complete the entry log and document the lock out/tag out procedures employed for these entries.
8.0 LASER SAFETY

8.1 Introduction

New York State has adopted the American National Standard for Safe Use of Lasers (ANSI Z136.1) as the standard for the safe use of lasers and laser systems. Users of lasers and their supervisors must adhere to the practices and procedures described in the ANSI Standard. Additional information and recommendations concerning the use of lasers can be obtained through consultation with the Clark Safety Manager (5-8773) or the University Office of Environmental Health and Safety (5-8200). All Class 3b and Class 4 lasers used in the building must be inventoried. Complete the registration form and send a copy to the Clark Safety Manager and EHS department.

8.2 Electrical Safety. The following specific guidelines for electrical safety of lasers was largely taken from Winburn's *Practical Laser Safety*.

8.2.1 Power Distribution Lines

1. Do not touch anything except operating handles.

2. Use only one hand.

3. Wear protective eye gear.

4. Stand to the side of the breaker box and turn face away from breaker.

5. Push (or pull) with a fast motion.

6. Notify all persons concerned that the circuit will be activated.

7. Do not close breaker until equipment is ready for energizing.

8.2.2 Capacitors

Capacitors or capacitor banks having an impulse capability of 0.25 Joules or more constitute an electrical shock hazard. Those having 25 Joules or more carry a potential lethal shock hazard.

8.2.3 Types of Hazards

1. Even after having been disconnected and discharged, capacitors may again build up an electrical charge. Passing atmospheric electrical disturbances can leave an electrical charge on a capacitor.

2. Shorting discharge can cause electrical arcs and the resultant energy release can cause burning by radiation, heat, or flying molten material.

3. Internal faults within capacitors often result in ruptured containers.

4. If an internal fault occurs, causing rupture of the case, or if leakage is ignited by an electrical arc or other source of ignition, a liquid dielectric capacitor can create a serious fire hazard.

5. Fuses are frequently used to protect individual capacitors from the total energy of the capacitor bank. If not adequate, such fuses and capacitors could explode, throwing dangerous projectiles.

6. In relation to all above hazards, capacitors used in inductive circuits can, during transient conditions, develop a charge or overvoltage.
8.2.4 Safety Considerations for Capacitors

1. Provide fault-current-limiting devices, such as fuses or resistors, capable of clearing or dissipating the total energy.

2. Provide protection against projectiles that may be produced during faults by the use of suitable enclosures and barriers.

3. Provide enclosures designed to prevent accidental contact with terminals, cables, or exposed electrical contacts.

4. Provide a locked or interlocked grounded metal enclosure.

5. Prevent or contain fires by reducing combustible material in the vicinity of the capacitors.

6. Automatically dump (crowbar action) capacitors before opening any access door.

7. **Use a grounding system with an appropriate discharge time constant (seconds).**

8. Using an appropriate meter, check that each capacitor is discharged, shorted, and grounded prior to allowing general access to a capacitor area.

9. Provide reliable grounding, shorting, and interlocking devices.

10. Install "crowbars", grounding switches, cables, and other safety devices to withstand the mechanical forces that can occur when faults or crowbar currents flow.

11. Provide suitable warning devices, such as signs and lights.

12. **Place shorting straps on each capacitor during maintenance period and while capacitors are in storage.**

13. Provide manual grounding equipment that has the connecting cable visible for its entire length.

14. Supply safety devices, such as safety glasses, rubber gloves rated for the potential voltage, and insulating poles.

15. Provide metering, control, and auxiliary circuits that are suitably protected from possible high potentials, even during fault conditions.

16. **Perform routine inspection for deformed or leaky capacitors and, if found, discard appropriately.**

17. Provide a grounding stick that has a discharge resistor at its contact point, an insulated ground cable (transparent insulation preferred), and the grounding cable permanently attached to ground. Such a grounding stick should not be used to ground an entire large-capacity capacitor bank. Large-capacity shorting bars (with resistors) should be part of the stationary equipment.

18. Manual grounding of capacitors (25 joules or more) should proceed as follows:

a. check grounding stick resistance

b. calculate discharge time
c. ground for appropriate time with properly gloved hand
d. measure voltage
e. install ground bar where practical.

8.2.5 **Electronic Equipment (Including Power Supplies)**

The instrumentation discussed in this section includes circuits and equipment used in measuring, monitoring, observing, and recording mechanical, electrical, and chemical phenomena. The instrumentation and controls to be considered are limited to those used with systems that are either operated at more than 300 V above ground or where stored energy exceeds 15 J.

The power supplies being considered are limited to those having either ac or dc outputs exceeding 600 V terminal-to-terminal, or the capability of operating at a potential in excess of 300 V above ground.

8.2.6 **Instrumentation and Controls**

The following types of hazards can occur with the electronic gear described above.

1. If controls or interlocks fail, personnel can gain uncontrolled access to hazardous areas. These failures can result either when interlocks and associated relays are damaged electrically or mechanically, or when such interlocks and relays are bypassed by operating personnel.

2. False signals or erroneous instrumentation readings can result in hazardous conditions.

3. Excessive voltage on instrumentation or controls due to induced voltages or contact with high-voltage components can be hazardous to operating personnel.

4. Improper coordination of protective fuses or circuit breakers can result in overheating of electrical conductors because of electrical faults or overload.

5. Hazards can be created by the introduction of instrumentation equipment into a system that does not necessarily require the instrumentation for its operation.

**Examples**

a. A high-intensity stroboscopic light used for photography may adversely affect eyes, ignite flammable materials, and may require high voltages.

b. Voltage-dividing networks may, under normal fault conditions, cause the investigator's measurement device to operate at high-voltage levels between input terminals to ground, or to other equipment.

c. "Floating" chassis and/or ground loop circuits can result in potentials or current levels far in excess of those anticipated.

d. Under normal and/or fault conditions, the instrumentation system may introduce, or be the subject of, energy levels in excess of the ratings of either or both circuits or of personnel safeguards.

6. Protective relay coils and their electrical contacts, if not sufficiently rated for the circuit, can burn open or weld closed on a momentary short circuit and thus leave the protective circuit inoperative for future operations.
8.2.7 Safety precautions to control these hazards are:

1. Provide the electrical control and instrumentation circuitry with adequate isolation at its interface with the main power equipment being controlled and monitored, considering both the normal and the fault conditions that may exist during operation of the main equipment.

2. Provide isolation where any hazardous situation exists, by using isolation devices such as transformers, high-impedance components, or telemetering equipment such as radio, light, or sound.

3. Provide relays and interlocks on instrumentation and protective circuits with contacts rated at least as high as the voltage of the circuit and with current ratings as high as the protective fuse or circuit breaker used in the circuit. Observe carefully the inductance of the circuit in the proper application of relays and interlocks.

4. Design the circuit in a failsafe manner so that the loss of power does not result in a hazardous condition.

5. Develop a written standard operating procedure (SOP) for only authorized personnel to obtain permission to bypass interlocks when necessary. This documentation must state why interlocks are bypassed, why the system cannot be isolated to conduct the necessary work, and how personnel safeguarding is established. All personnel that may need to bypass interlocks must be trained on the SOP.

6. Provide systematic operating procedures to inform affected personnel of interlock bypass conditions. The system must not remain in the bypassed condition longer than necessary.

7. Set up procedures that allow only qualified personnel to make connections to high-voltage systems.

8. Provide redundant control, indication, or instrumentation on sections of a system where an operating error or faulty instrumentation could otherwise result in a hazard.

9. Provide a clear indication of the status of remote controlled equipment, with positive feedback for each specific command.

10. Provide shorting devices for use on current transformers when connecting or disconnecting instruments or controls.

11. Provide sufficient isolation devices and barriers between high-voltage and low-voltage equipment.

12. Provide proper overload protection on control circuits; and prevent low-current rated conductors from contacting circuits that have only large overcurrent protection.

13. Wire control circuits to prevent "sneak" circuits and accidental grounding of one line from causing safety devices to become inoperative.

14. Provide a consistent labeling procedure for control buttons, knobs, etc., and encourage the use of mimic control diagrams.

15. Route control wires so that no large looped (ground or otherwise) circuits are formed.

16. Arrange controls for large systems so that unit control circuits are electrically isolated.
from, but subordinate to, an overall system control.

17. Test controls by simulating failures or maximum-limit feature before placing system into operation.

18. Provide visible indicators showing the bypassed interlocks, which should set automatically after one cycle.


8.2.8 Power supplies

1. Make input connections to power circuits through either manual or automatic switching devices. Consider providing overcurrent, undervoltage, or other protection, depending on type of load supplied.

2. Provide proper isolation devices or physical barriers to prevent high-voltage stored energy from being dissipated in the low-voltage supply and/or control circuits. Consider two means of isolation so that the failure of one does not result in injury or excessive damage.

3. Install all high-voltage components in separate, isolated enclosures. In addition, interlocking may be required to render the high-voltage areas inaccessible unless the input power is de-energized, and access should be limited to qualified personnel only.

4. Provide automatic switches or contacts in output circuits, as well as manual devices, for grounding and shorting the power supply when the power has been turned off and when personnel are allowed access to an area containing high voltage.

5. The power supply system should contain a minimum amount of flammable liquid. Construction features should provide for self-containment of the liquid.

6. Make input and output connections at terminals that are covered or inaccessible during normal operations.

7. The main input supply switch should be located within sight of the power supply, and clearly identified.

8. Use alarms, such as signs or lights, to warn personnel and to indicate an energized power supply, especially on remote loads or power supplies.

9. Limit the number of startup stations or controls and provide shut-down stations or emergency stop controls at all remote locations.

10. Construct the enclosure or protective barriers of noncombustible conducting material and ground it to the adjacent building steel with a conductor suitable for fault conditions.

11. Use overload and short-circuit protection for the power supply output. These should operate the disconnect switches in the input circuit, as per item 1, and output grounding and shorting facilities, as per item 4.

12. To prevent overheating and fires, remote control and monitoring circuits would have overload or short-circuit protection.

13. Remote control and monitoring circuits subject to high voltage or high energy should be suitably isolated, or a provision should be made to prevent personnel injury or
14. For inductive loads, use "freewheeling" diodes or thyrite elements connected across the power supply dc terminals to ensure satisfactory discharge of stored energy.

15. Prior to initial operation and as a maintenance procedure, "megger" or "pot" the power supply; calibrate and check all protective devices.

8.3 Clark Hall Laser Safety Program

All new users of Clark Hall lasers must complete requirements listed on form prior to using a laser. A copy of the Clark Hall Laser Safety Program can be found in the appendix.

8.4 Medical Surveillance

All users of Class IIIb or Class IV lasers are required to have a baseline eye exam completed prior to using lasers and laser systems. Gannett Health Center is the repository of the eye examination results.

A Cornell University consultation/referral form is available in the Clark Hall stockroom. Use this form to schedule an eye exam with the physician indicated on the form. When scheduling the appointment advise the Doctor’s office that this appointment is for a laser baseline eye exam.

The consultation/referral form should be given to the Doctor when you have the exam. After you’ve completed the exam, advise the Doctor’s office to send the bill to your department’s Business Office.

8.5 Training

All users of Class IIIb or Class IV lasers are required to complete an approved Laser Safety Training class. Contact the Clark Hall Safety Officer (5-8773) or University EHS department (5-8200) to schedule training.

8.6 Laser Facilities

Rooms where Class IIIb and Class IV lasers are used must include the following controls if laser radiation exposure may be above the Maximum Permissible Exposure (MPE) level:

1. Access restrictions for rooms.

2. Eye protection available and used. It must be identified with the optical density and wavelength, cleaned, inspected, and replaced if damaged.

3. Skin protection for chemical and radiation exposure.

4. Area controls including lighted approved warning signs for Class 4 lasers. These signs are to be activated whenever Class 4 lasers are operational.

5. Entryway safety controls are required for Class IV laser systems.

6. Area postings to warn onlookers.

7. Barriers, screen or curtains for facility windows and entryways for Class IV laser systems.

8. Shrouds and beam path enclosures. Whenever possible, the entire beam path including
the target area should be enclosed.


10. Panic buttons (control disconnect switches) for Class IV laser systems.

11. Entryway safety devices for rapid egress.

12. Maintenance of adequate aisles for egress.

13. Viewing portals and collecting optics must maintain laser radiation to below the MPE.

14. All lasers must have key control (master switch or coded access) which disables the laser when not in use.

15. Administrative controls.

16. Standard operating procedures for alignment and other hazardous operations.

17. Computer stations and desks located in these laboratories must be shielded from exposure to laser beams above the MPE.

8.7 General Safety Rules

1. Remove all jewelry, watches, and any other items (belt buckles, etc.) that may have reflective surfaces when in a Class IIIb or Class IV laser area.

2. Laser protective eyewear is required for all users and visitors who may be potentially exposed to eye irradiation from Class IIIb and Class IV lasers. Particular care must be exercised when dealing with invisible radiation. The protective eyewear shall be used only at the wavelength and energy/power for which it is intended.

3. Never intentionally point a laser at anyone.

8.8 Responsibilities

8.8.1 Supervisor

1. Assure group members are trained and have baseline eye examinations prior to exposure and that laser hazard controls are in place and operating correctly. Assure that Clark Hall Laser Safety Program form is completed and returned to Clark Hall Safety Manager. Assure that class 3b and 4 lasers are registered with EH&S.

2. Report known or suspected incidents.

3. Assist in obtaining medical attention if there is an accident.

4. Provide standard operating procedures to users.

5. Approve the installation and operation of the lasers.

6. Provide any necessary control equipment and procedures.
8.8.2 Laser User

1. Only work under the authorization of the supervisor.
2. Comply with all safety rules and standard operating procedures.
3. Be familiar with the operation of the laser.
4. Attend required training and use required eye and skin protection.
5. Report all accidents and incidents immediately to supervisor.
6. Obtain baseline eye exam.

8.8.3 Laser Safety Officer (LSO)

1. Classify systems and establish the Nominal Hazard Zone.
2. Audit, recommend, or approve controls.
3. Approve standard operating procedures.
4. Approve signs and labels.
5. Prior to use approve laser installation facilities and equipment.
6. Periodically audit safety features.
7. Assure adequate education and training.
8. Determine personnel categories.
9. Establish system for medical surveillance.
10. Maintain records.
11. Investigate accidents and ensure corrective action.

The LSO has the authority to suspend, restrict, or terminate an operation if the hazard controls are inadequate.
9.0 HAZARDOUS WASTE

It is the responsibility of each Cornell laboratory worker to be sure that chemical waste generated from his/her activities is disposed of properly.

Below are the requirements for areas where Hazardous Waste is accumulated:

- EH&S prefers that generators limit themselves to 5 gallons when possible.
- Waste containers must be under the control of the operator. This can be a supervisor, principle investigator, or the person generating the waste.
- Waste containers must be in good condition.
- Wastes must be chemically compatible with the container.
- Containers must be closed except when adding or removing waste. (Don’t leave a funnel in the bottle.)
- Mark containers with the words "hazardous waste" or the identities of the chemical contents. (The EH&S chemical waste label has the required words.)
- Store waste chemicals in a designated area, preferably only one per room.
- Store waste chemicals in secondary containment; plastic bins are best.
- Deface original container labels on reused bottles, unless the waste matches the label.
- Segregate waste containers by chemical hazards.

9.1 Reduction of Waste

The level of hazardous waste can be reduced by limiting the purchase of chemicals to the quantities that will be used. Experiments in teaching and research labs should be done on as small a scale as is feasible.

9.2 Consolidation of Waste Solvents

When collecting waste chemicals, compatible solvents may be combined in a single container. When solvents are thus combined, the approximate volume percent of each solvent should be noted on the disposal tag. However, halogenated solvents should not be combined for disposal with solvents which do not contain halogens, because of differences in handling and ultimate disposal techniques. Solutions of halogenated and non-halogenated solvents will be considered as halogenated solvents and disposed of accordingly.

9.3 Materials Which are not Legally Disposable as Hazardous Waste

The identity of the material for disposal must be established. In the case of materials for which no information is available, EH&S will absorb the cost to have one or two samples characterized by a competent laboratory. The cost incurred to identify larger numbers of samples is the responsibility of the generating department.

A recurring problem is "orphan" waste. Orphan waste material is waste (with no information) left behind by students, staff and faculty who have left Cornell University. The best method of dealing with such "orphan" waste is to prevent its occurrence by having as much chemical waste removed as possible before a generator leaves.

Trade names or initials are insufficient identification. MSDSs have sufficient information to allow identification, and, thereby, disposal of such products.
9.3.1 Disposal of Explosive and Highly Reactive Chemicals

Chemicals that form peroxides must be tested prior to disposal. Diethyl ether, 1,4 dioxane and tetrahydrofuran are examples of chemicals susceptible to peroxide formation. They must be tested for peroxide formation per the table in the Cornell Lab Safety Manual and Chemical Hygiene Plan. Test strips for determining the amount of peroxides in solvents are available from the Chemistry Department stockroom. Containers with dark blue test results should be disposed of.

Another class of materials which cannot be disposed of without pre-treatment is those which evolve gases. Any waste material which requires vent-caps cannot be accepted by EH&S.

9.3.2 Disposal of Heavy Metals

Limited disposal methods are available for mercury and other heavy metal compounds, and these materials are currently picked up by EH&S. Metallic mercury will be recycled by EH&S. The mercury should be separated from the glassware apparatus, such as thermometers and manometer by the researcher, using proper precautions. All heavy metal compounds should be kept separate from other materials to facilitate disposal.

9.3.3 Non-Chemical Paraphernalia

Plasticware, disposable gloves, glassware, paper towels, tools, pumps, and the like, contaminated with chemical waste, cannot be disposed of by EH&S. Such items must be decontaminated and reused, or disposed of as ordinary trash. The method of decontamination is the responsibility of the laboratory. The resulting rinsate solution will be accepted for disposal as chemical waste.

For disposing of empty bottles, EPA regulations require that containers be rinsed three times with a 30-second drain time between rinses before being discarded or reused. The rinsate is collected as hazardous waste.

Hypodermic syringes and needles are considered regulated medical waste, and must be disposed of according to state and federal regulations. See the Biohazards section of this manual for procedures.

9.4 Disposal of Non-hazardous Laboratory Waste Chemicals as Trash

See the Cornell Lab Safety Manual and Chemical Hygiene plan for a list of solid materials that are not considered hazardous and are thus suitable for disposal with regular trash. However, neither the custodians nor the trash collectors can readily distinguish between hazardous and non-hazardous wastes. Therefore, the packaging of such waste for disposal must be secure, and its transfer to the dumpster carried out by laboratory personnel.

Instructions for Packaging:
1. Package securely for the dumpster by using at least two layers of packaging so that material cannot spill during collection.
2. Leave label on innermost container.
3. Label outer container "Non-hazardous" waste.
4. Place containers in the dumpster yourself, custodians do not handle nonhazardous lab chemicals.
9.5 Procedure for Disposal of Empty Glass Chemical Containers

1. Remove cap

2. Container must be cleaned inside and out (no visible chemical or odor remaining)
   • If contents are water soluble and not toxic, rinse with water several times
   • If contents are not water soluble, rinse with appropriate solvent. Evaporate residual solvent in hood. Process rinsings as hazardous waste.

3. If the container was from a chemical in the Clark Hall Chemical Inventory System, remove barcode label and place on your lab’s Disposal Sheet.

4. Place glass in sturdy cardboard box, tape box closed, label as glass, and take to brown dumpster across the dock.

5. Other clean glass can be disposed of as in the previous step.

9.6 Preparation of Hazardous Waste Chemicals for Disposal by EH&S

1. Call EH&S at 255-8200 to request the two-part stick-on 4” x 6” disposal forms. There are also disposal forms available in the Clark Hall stockroom.

2. Complete the two-part stick-on label with all of the spaces filled in (i.e., bldg. and room number, name of requester, telephone number, chemical type, chemical name and weight or volume of all ingredients in each container). No trade names please. (Some ingredients may take more room than can be written on the numbered label. If this is the case, please tape one (1) additional copy of the ingredients on a small piece of paper to the container and send a second copy to EH&S, along with the tear off portion of the label.) After receiving copies of the labels EH&S will respond on a first come first served basis. Please make sure that the date on the label is the date that you send the labels to EH&S via campus mail.

3. Use only screw top chemical glassware or plasticware for disposal. Soda pop, glass or plastic milk bottles, Clorox bleach bottles or rubber/glass stoppered containers will not be allowed for waste disposal. Any waste bottle/container that emits a noxious smell or is cracked or damaged in any way must be placed in an overpack container or transferred to a new bottle/container.

4. Place all containers in a Department of Transportation (DOT) approved box which has markings located on one side of the box. (i.e., UN/4G/X,Y or Z/S/DATE OF MANUFACTURE/USA, etc.). The DOT boxes have a styrofoam insert for four 4-liter bottles. If the waste containers/bottles are smaller than the insert space, please place as many smaller containers/bottles in the space as you can. Cardboard pieces must be placed between the small bottles to prevent breakage during transportation to the chemical waste facility. These boxes are available in the Clark Hall stockroom.

9.6.1 Tear-off Strip

The newest version of the two-part stick-on label has a tear-off strip along the bottom edge of the self-adhesive portion (second page) of the label. This tear-off strip is designed to facilitate the management of waste containers by making it easier to enter information on the waste label. The small tear-off strip has the same red inventory control number as is on the main label, along with Cornell's EPA registration number, the words "hazardous waste" and a line on which the name of the waste or the class of the waste can be written ("phenol/chloroform" 50:50° or "chlorinated solvents").
The small tear-off strip can be removed from the main label and placed on the waste bottle. The label itself can then be placed on a clipboard near the waste bottle or on the side of the fume hood using a magnet or other attachment. The label is then filled out with initial information (name, address, etc.). As the waste container is filled, specific waste chemical information is added (names, amounts, etc.). The completed label is then attached to the waste bottle when it is ready to be collected by EH&S.

9.6.2 Used Oil containing PCBs

Waste oils containing PCBs must indicate the parts per million (ppm) of PCBs and the source of the oil. If this is unknown, the material can be tested by calling 255-3761 and obtaining a computerized sample number and sampling bottle to analyze the oil.

9.7 Disposal of Laboratory Waste to Sanitary Sewer

1. Send down the drain only those materials found on the safe list. The safe list is found in the Cornell Lab Safety Manual and Chemical Hygiene Plan (web address is: http://ehs.cornell.edu). Compounds not listed are not suitable for drain disposal.

2. Drain disposal must only be used when the drain flows to a sanitary sewer system* which eventually goes to the waste water treatment plant. Storm drain systems flow directly into surface water (Fall or Cascadilla Creeks, for example) and should NEVER be used for chemical disposal. Floor drains may flow to storm sewers and should never be used for disposal. Laboratory sinks should be used for disposal of chemicals on the safe list.

3. Quantities of chemical waste for drain disposal should be limited generally to a few hundred grams or milliliters or less per day. Larger amounts should have prior approval from EH&S. Only materials listed as safe for drain disposal are approved for drain disposal in quantities up to 100 grams or 100 milliliter per discharge. Disposal should be followed by flushing with at least 100-fold excess of water at the sink. (That means for 100 ml of chemical run the water for about two minutes at maximum flow.)

4. Chemicals that are not appropriate for drain disposal are collected by EH&S. Check with EH&S at 255-8200 if you are not certain about drain disposal for a particular material.

9.8 Used Oil (Including Vacuum Pump Oils) Collection and Disposal

Oil should be collected locally and stored temporarily in approved and properly marked containers (30 or 55 gallon drums) provided by EHS. The containers must be stored inside the building. The containers must be clearly marked "Used Oil Only: No Solvents." Contact Bob Kenyon for used oil disposal. Provide Bob with information regarding the source of the oil (ex. Vacuum pump name, manufacturer, and serial number, pump location, and group name).

9.9 Assistance for Cleanouts of Unwanted Chemicals

EH&S funds knowledgeable individuals to help research groups and departments conduct chemical cleanouts, be it, for example, an annual departmental spring cleaning. This individual is John Terry (Chemistry & Chemical Biology department). You can e-mail him directly or request his aid through EH&S.
10.0 BIOHAZARDS

10.1 Sharps

10.1.1 Definition

Sharps include but are not limited to:
Discarded, unused, or used items utilized in animal or human patient care or employed in research laboratories including hypodermic, intravenous, or other medical needles, hypodermic syringes with attached needles, pasteur pipettes, scalpel blades, or blood vials with plastic micropipette tips, broken or unbroken glass including slides and cover slips that have been in contact with infectious agents glass or rigid plastic culture tubes, flasks, beakers, etc. that have come in contact with infectious agents.

When only the barrel of the syringe has been used without contacting infectious agents (e.g., with infusion pumps, buffers, columns), it can be disposed of as solid waste. Other materials that have not come in contact with infectious agents such as broken glass, glass pipettes, plastics, etc., can be collected in a rigid container (i.e., other than a red biohazard container), taped up and disposed of carefully as solid waste.

10.1.2. Dangers of using sharps

The ability of sharps materials to generate puncture wounds or lacerations, which then create a portal of entry for infectious agents, is a very real hazard. Therefore, all laboratories should minimize the handling of syringes and needles and restrict their use to procedures for which there are no other alternatives. Needle locking syringes or disposable syringe-needle units in which the needle is an integral part of the syringe should be used for injection or aspiration of infectious materials. Additionally, aerosol droplets containing biohazardous agents or materials can be produced when withdrawing a needle from a vial sealed under pressure, when forcing material though a needle, or when cutting a needle. When working with potentially infectious or other biohazardous agents you should:
• wear gloves
• a lab coat and
• work in a biosafety cabinet whenever possible
(remembering, however, that gloves will not protect against needlesticks, so exercise extreme caution). The syringe should be carefully filled so as to avoid or minimize the production of air bubbles, and all air, liquid, and bubbles should be expelled into a towel or cotton pad moistened with disinfectant.

10.1.3 Syringe and Needle Storage

Hypodermic syringes and needles must be stored in a locked secure place. The lock employed cannot be a spring or combination dial lock. Hypodermic syringes and needles not in use must be kept under suitable locked protection.

10.1.4 Sharps containers

Sharps containers are generally red, or labeled with the universal biohazard symbol or the word "BIOHAZARD", rigid, leakproof, and puncture-proof with a lid. They should be readily available in all areas where syringe and needle waste may be generated. Sharps containers are available from the Chemistry Stockroom or from various scientific supply companies (e.g., Fisher, VWR). Other types of containers such as old coffee cans or empty media bottles are not acceptable.
10.1.5 Disposal of sharps

Contaminated needles shall not be recapped, bent, sheared or removed from the syringe following their use. The total unit should be placed in a sharps container and disposed of as regulated medical waste. Thus, the use of needle clippers should be discontinued, and the needle boxes should be disposed of appropriately. However, if recapping and/or needle removal is necessary because of a specific procedure or lack of a readily available sharps container, the cap should be replaced with one of the following methods:

- a one-handed scoop method whereby the syringe barrel is held in one hand and used to "scoop" the cap, lying horizontally on a surface, onto the needle; or
- through the use of a mechanical device such as forceps or a clamp.

When sharps containers are approximately 3/4 full, they should be disposed of through the Veterinary School RMW Management system. Sharps containers are accumulated in room UC-6 East in the basement of Clark Hall, and then packaged and shipped offsite, by a licensed hauler, for subsequent treatment and disposal. Each generator must complete a Biohazard Identification Form. Do not dispose of these containers in the regular solid waste stream.

10.1.6 Accidents involving sharps

Broken glassware, Pasteur pipettes, etc. contaminated with infectious agents should not be handled directly with bare or gloved hands, but with tongs and/or a dustpan and broom. This glassware should be discarded into a sharps container. The area contaminated with biohazardous material should be covered with paper towels and soaked with a 1:10 dilution of bleach (or other appropriate disinfectant) starting from the periphery and working towards the center, allowing for a contact time of at least 10 min. Place this refuse into a red biohazard bag and dispose of as regulated medical waste. The tongs, dustpan, or broom can be decontaminated and reused or discarded. Whenever possible substitute plasticware for glassware in the laboratory.

10.2 Biohazardous agents

Groups that use biohazardous agents must register the agents with CU Biosafety Officer. In addition, the groups must train all members on the hazards of the materials and precautions to be taken when handling them. Documentation of the training is to be maintained by the group and will be audited by the Clark Hall Safety Inspection team biannually. The Guidelines for Reducing Risk in Biological Laboratories (found at [http://www.ehs.cornell.edu](http://www.ehs.cornell.edu)) is to be used for training new group members regarding Standard Operating Procedures before work commences. Biological safety cabinets are to be certified annually or whenever the cabinet is moved. Hand washing facilities must be available within the laboratory. If a sink is not available, a wall mounted dispenser with appropriate disinfectant must be installed near the door.

10.3 Shipping Biohazardous Agents

National and international regulations require that the shipper of dangerous goods be a trained person. This person must comply with regulations, and certify that materials will arrive at their destination in good condition and not present any hazards to humans and animals during shipment. Commercial carriers will refuse to accept any packages that fail to comply with these regulations. Remember that compliance is not an option, IT IS THE LAW. Furthermore, failure to comply can result in substantial fines [http://hazmat.dot.gov/hm207f.htm].
As a service to the University, the Diagnostic Laboratory of the Veterinary College serves as the central shipping point for biological and infectious materials. The Diagnostic Laboratory has the resources and the trained, knowledgeable people who can properly and safely ship your packages. Please contact Jeff Talcott at 253-3936 or Karen Jerkes 253-3626 for assistance and information. Remember, don’t take any unnecessary risks. Shipping must be carried out by trained personnel.

10.4 Regulated Medical Waste

Personnel from EHS will pick up properly packaged and tagged waste and transport it to the Veterinary College for disposal at no cost to the individual laboratories. To ensure the safety of the personnel handling and packaging the waste, each generator must complete the Biohazard Identification Form. This form lists the subcategories of RMW as well as the necessary actions needed to comply with state and federal regulations and to guarantee safe handling of the waste. Note, all waste for transport must have a completed Medical Waste Tracking Tag attached to the container. These tags are available in room UC-6 East in the basement of Clark Hall.

10.5 Biosecurity

Check the CU EHS web site (http://www.ehs.cornell.edu/) for information on required biosecurity practices/equipment. Failure to follow the requirements of the current and emerging regulations for using, storing, acquiring, and shipping select agents and other biohazardous materials can result in significant fines and incarceration. The CU Biosafety Officer will assist you in determining practices and controls that are required for your research.
11.0 MAGNETS AND CRYOGENS


11.1 Nature of the Magnetic Field

The greatest hazard presented by a superconducting magnet is the magnetic fringe field. Once a persistent magnet (such as in the NMR facility in ST Olin) is energized, the magnetic field remains, even when all power to the system has been turned off.

For field swept magnets (such as in some of the Low Temperature laboratories in Clark Hall) the magnetic field is only activated some of the time. One cannot tell by looking at a magnet if the field is active or not, and thus, unless told otherwise by an authorized person, one should assume the field is present and obey all precautions.

The magnetic field extends above, below and to the sides of the magnet. It extends through doors, walls ceilings, and floors.

The strength of the magnetic field increases dramatically as the magnet is approached. Objects and people at risk from the magnetic field are considered safe outside the 5 gauss line.

11.2 Hazards presented by the Magnetic Field

The strong magnetic field creates hazards because it strongly attracts ferromagnetic metal alloys. Ferromagnetic metal alloys usually contain iron, nickel or cobalt although many alloys containing these elements, notably 300 series stainless steel, are non magnetic. They are used in most types of tools and equipment and in some surgical implants.

The strong magnetic field can cause the following hazards:

- Projectiles
- Displacement of surgical implants
- Stoppage of electrical and mechanical implants and devices

A loose metal object (such as a wrench or pen) is attracted to the magnetic center of a magnetic field. Such an object has the capability of becoming a projectile if it gets too close to the magnet, as the force of the magnetic field pulls the object towards the magnetic center. This metal projectile can seriously injure anyone standing between it and the magnet.

Ferromagnetic metals are sometimes used in surgical implants and prosthetic devices. The magnetic field can twist metallic implants out of place, causing tissue damage and pain to the person in whom they are implanted, possibly creating a life threatening situation.

Some cardiac pacemakers, biostimulators and neurostimulators are mechanically activated and may stop in the presence of the magnetic field. This could also create a life threatening situation.

For people without implants or pacemakers, magnetic fields present no known direct hazards. Patients are routinely subjected to 2 Tesla (20,000 gauss) fields in MRI exams and on an experimental basis have been subjected to fields up to 10 Tesla without after effects.
11.2.1 Exclusion Zone

All rooms that house magnets that can cause an individual to be exposed to the 5-gauss line must have warning signs on the door.
The exclusion zone comprises the area (rooms, hallways and so on) inside the magnet 5 gauss line.
Individuals with cardiac or other mechanically active implants must be prevented from entering this area.
The 5-gauss line must be indicated inside the room and the means of indication described on the sign.

11.3 Nature of Liquid Cryogens

A superconducting magnet uses two types of cryogens, liquid helium and liquid nitrogen. Helium is a naturally occurring, inert gas that becomes a liquid at approximately 4K. It is colorless, odorless, non flammable and non toxic. In order to remain in a superconducting state the magnet is immersed in a bath of liquid helium.

Nitrogen is a naturally occurring gas that becomes liquid at approximately 77K. It is also colorless, odorless, non flammable and non toxic. It is used to cool the shield which surrounds the liquid helium reservoir. Liquid nitrogen is often used as a coolant by itself in labs where no liquid helium is used.

During normal operation, liquid cryogens evaporate and will require replenishment on a regular basis. The cryogens will be delivered to the site in Dewars. Almost all Cornell-owned Dewars are magnetic. Almost all the liquid nitrogen large Dewars (160L-170L) in use in Clark are magnetic. In regions of very high field gradients this is a potential risk. In some of the low temperature group systems, a wooden structure is used to ensure a minimum gap from the magnet to fill Dewars.

11.4 Hazards presented by Cryogens

Helium and nitrogen in both their liquid and gaseous forms, present the following hazards:

- Liquids or cold gases can cause cryogenic burns.
- The filling procedure produces an oxygen rich liquid, which is a fire hazard when it drops on a combustible material.
- A large quantity of gas released in an area that is not well ventilated can cause asphyxiation.

The extremely low temperature of the liquids and their cold vapors can cause severe frostbite, or a cryogenic burn. This is mainly a danger during the filling process, when the filling line and other equipment gets very cold. Touching the filling line or any other piece of equipment during a transfer can freeze the skin or cause it to stick to the surface of the equipment. Protective gloves and a face shield should be worn to prevent cryogenic burns. Absorbent clothing is one hazard seen frequently. Heavy wool shirts, and socks worn with sandals, can collect cryogens and therefore present a contact risk.

During the filling process, atmospheric air condenses on the fill line or pipes, leaving an oxygen-rich liquid. If this oxygen rich liquid dripped onto a combustible material, like oil or grease, a fire could start. To prevent this, ensure that any surface onto which this liquid could drip is clean and non combustible.

Helium or nitrogen gas released in an area that is not well ventilated can displace air and reduce the oxygen content to an unsafe level, leading to asphyxiation.* The greatest risk will be during commissioning of the magnet. However, after the magnet is in service, a risk of asphyxiation could still occur during a "quench".

A "quench" occurs when the magnet loses its superconductivity, and warms the liquid helium, causing it to turn to gas. This large amount of gas escapes through the magnet venting.
Once a magnet begins a quench, evacuate the area immediately. There is no opportunity to stop a quench once it has started. The escaping gas can cause an oxygen deficient atmosphere in the room. Do not attempt to re-enter the room until the room oxygen concentration has been tested and is found to be greater than 19.5%. Do not re-enter the room even momentarily to turn off equipment, etc. if O₂ level is below 10% (at this concentration within 10 minutes one may lose consciousness).

*”Typically, a ratio of 1000 to 1 is assumed as a rough estimate of the volume of the resulting gas at ambient conditions, compared to that of the original liquid. If all of the liquid in a 160-liter Dewar of liquid nitrogen were to be spilled into a room that is 20 ft. wide by 20 ft. long by 10 ft. high, the resulting volume of gas would be almost equal to that of the room.” Edeskuty, Frederick J., Edeskuty on Safety, Cold Facts, Spring 2002, p.23.

Helium hazards are greatly reduced for apparatus connected to helium recovery for re-liquefaction, as the helium doesn’t go off into the room.

Nitrogen is typically a greater hazard in most cases, as it is denser. Helium tends to rise relative to the air in the room at temperatures above 40K (-230° C), which it will achieve almost instantly after release from cryostat.

Liquid nitrogen is often also used as a resource of pressurized dry nitrogen gas, with some 160-170L LN₂ Dewars, and pressure of up to 200 psi may be produced. It is important when refilling such a Dewar to first vent this excess gas pressure gradually, so that the fill lines are not subjected to excessive pressures.

Pressures developed by liquid cryogens in sealed volumes: pressures up to several hundreds of atmospheres (up to almost 10,000 psi, more than the pressure in a compressed gas bottle) may be achieved by completely filling a volume with a liquid cryogen, then sealing it off and allowing it to warm up. While a convenient technique for achieving moderately high pressure if appropriate design is used, it can also be an effective and lethal way to produce a “bomb” if done unintentionally. Pressure relief valves and/or burst discs should be installed on any plumbing line or vessel which has the capability of being filled with a liquid cryogen, then sealed off.

Pressure at lower levels also requires attention. Cryogenic vessels are often constructed with very thin walled vacuum spaces in order to reduce conductive heat leaks and minimize heat capacity. They often as a consequence have low maximum pressure ratings. It is possible to create a hazardous situation and potential explosion by overpressuring such a vessel. This happens most frequently with careless use of “pressure building” nitrogen transport Dewars.

Tipping Dewars over when transporting them down the hall is easy if you push from too far above center of gravity. Move them using the side handles, not the top ring.

A moving nitrogen Dewar is heavy and has much inertia. A 160L Dewar, including contents full, will weigh about 500 lbs. Don’t move them too fast, particularly around turns. Even a slight incline may present a control problem.
12.0 SAFE HANDLING OF COMPRESSED GAS CYLINDERS

This document is based upon the pamphlet “Safe Handling of Compressed Gases in the Laboratory and Plant”, Matheson Gas Products, Rev. 3/99.

12.1 Definition

The U. S. Department of Transportation defines a compressed gas as “any material or mixture which exerts in the packaging an absolute pressure of 280 kPa (40.6 psia) or greater at 20°C (68°F)”.

12.2 Hazards

The handling of compressed gases must be considered more hazardous than the handling of liquid and solid materials. Compressed gasses by their nature are hazardous. They are capable of creating environments that are either flammable, oxygen enriched, or oxygen deficient. High pressure, low flash points for flammable gases, low boiling points, and no visual and or odor detection are all hazards.

Hazards may arise as a result of equipment failure and leakage from systems that are not pressure-tight. Also, improper pressure control may cause unsafe reaction rates due to poor flow control. Diffusion of leaking gases may cause rapid contamination of the atmosphere, giving rise to toxicity, anesthetic effects, asphyxiation, and rapid formation of explosive concentrations of flammable gases. The flash point of a flammable gas under pressure is always lower than ambient or room temperature. Leaking gas can therefore rapidly form an explosive mixture with air.

Low-boiling point materials can cause frostbite on contact with living tissue. This is common among cryogenic liquids but it also can result from contact of the liquid phase of liquefied gases such as carbon dioxide, fluorocarbons, and propylene. Some compressed gases are similar to other chemicals in that they are corrosive, irritating, and highly reactive.

12.3 General Precautions for handling, storing, and using compressed gases.

Safe Handling

1. Before using cylinders, read all label information and Material Safety Data Sheets associated with the gas being used. Observe all applicable safety practices. Note: NEVER rely on the cylinder color to identify the contents. Cylinders are not color coded, in the U.S. Cylinders must have their contents clearly identified.

2. Never drop cylinders or permit them to strike each other violently.

3. Cylinders should always be kept in the vertical position. Some compressed gas containers with a water volume less than 1.3 gallons (very small cylinders and lecture bottles) are allowed to be stored in a secure horizontal position. Cylinders should be secured with a metal chain or chain plus strap to prevent them from falling over. The cylinder should be secured at a height of approximately 2/3 distance from floor to top of cylinder.

4. Never deliberately breathe, or allow others to breathe any compressed gas of any type. It is possible to cause rapid suffocation and death. (Helium)

5. Always install the protective cap on the cylinder when they are being stored or transported. The valve-protection cap should be left on the cylinder until it has been secured and is ready to be used. Secure all cylinders with a chain. Many cylinders contain pressures in excess of 2000 PSI and a broken valve is all it takes to turn a cylinder into an unguided missile.
6. Most compressed gas cylinders are heavy, some can weigh in excess of 200 pounds or more. Avoid dragging, rolling, or sliding cylinders, even for a short distance. The best way to move a cylinder is with a cylinder cart. Such a cart should be provided with a chain for securing the cylinder on the cart. Cylinders should not be stored on the cart.

7. Never tamper with pressure relief devices in valves or cylinders.

8. Never attempt to repair the cylinder, it’s valve, or other attachments.

9. Never use oil or other lubricants on the cylinder, valve, or other attachments.

10. No part of a cylinder should be subjected to a temperature higher than 125°F. A flame should never be permitted to come in contact with any part of a compressed gas cylinder.

11. Cylinders should not be subjected to artificially created low temperatures (≤-40°F or lower), since many types of steel will lose their ductility and impact strength at low temperatures. Special stainless steel cylinders are available for low temperature use.

12. Do not place cylinders where they may become part of an electric circuit. When electric arc-welding, precautions must be taken to prevent striking an arc against a cylinder.

13. A suitable check valve should be used to prevent liquid from getting back into the cylinder or regulator when discharging gas into a liquid or a trap.

14. When using compressed gases, wear appropriate protective equipment, such as safety goggles or face shield and protective gloves.

15. When returning empty cylinders, close the valve before shipment, leaving some positive pressure in the cylinder. Airgas recommends that you treat a cylinder with 25 psi remaining material as empty.

**Dangerous Gases.**

16. Toxic, flammable, and corrosive gases should be carefully handled in a hood where possible. Proper containment systems should be used and minimum quantities of these products should be kept on-site. It is advisable that some device be used to warn of the presence of toxic concentrations. Always check cylinders and all connections under pressure for leaks prior to using the contents. Find the location of the closest emergency eyewashes and showers. Excess flow valves should be used and are designed to shut down gas supply systems in the event of abnormal flow conditions caused by rupture, fire, open free flowing valves, etc. **Approved Standard Operating Procedures (SOPs) are required for using toxic or flammable gases.** Submit draft SOPs to Clark Hall Safety Committee for building use approval. The CU EHS group also requires SOP submittals for poison inhalation hazards (materials such as corrosive and toxic gases).

17. Whenever a flammable gas in a cylinder is to be used a simple flash arrestor MUST be installed in the line. Bond and ground all cylinders, lines, and equipment. Check cylinders and all connections under pressure for leaks prior to using the contents. Keep a fire extinguisher close at hand.

18. When corrosive gases are being used, the cylinder valve stem should be periodically opened and closed to prevent “freezing.” The valve should be closed when the cylinder is not in use. Regulators and valves should be closed when the cylinder is not in use and flushed with dry air or nitrogen after use. Such control devices should not be left on a cylinder, except when it is in use.
frequent use. When corrosive gases are to be discharged into a liquid, a trap, check valve, or vacuum break devices should always be employed to prevent dangerous reverse flow.

19. Corrosive gases should be stored for the shortest possible periods before use, preferably less than three months. Cylinders used and then put back in storage should have all appurtenances (regulators, control valves, etc.) removed from the valve outlet and should preferably be flushed with dry nitrogen or air to keep them in good working order.

**Storage**

20. Cylinders may be stored in the open, but should be protected from the ground beneath to prevent rusting. If ice or snow accumulates on a cylinder, thaw at room temperature.

21. Do not store full and empty cylinders together. **All gas cylinders must have tags identifying the status of the cylinder (empty, in use, full) and date received.** Reverse flow can occur when an empty cylinder is attached to a pressurized system. If cylinders are stored within a lab they should be grouped by type of gas. Incompatible gases must be segregated from each other (ex. flammable gases should not be stored near oxidizing gases). 20 ft. is the distance to maintain between incompatible gas cylinders. If segregation by distance is not done, isolate incompatible materials in storage by a non-combustible partition extending not less than 18” above and to the sides of the material. (Information source: Fire Code of New York State #2703.9.8.) Storage in the laboratory should be confined to only those cylinders in use. Hazardous gas storage space is provided in Clark in rooms G40 and G36.

22. Storage areas should be set up to permit proper inventory rotation. Cylinders should be used in rotation as received from the supplier.

**12.4 Pressure Regulating equipment handling and use**

For most applications a pressure regulating device must be used. Regulators must be used only with the gases and pressures for which they are designed. Always use the correct Compressed Gas Association (CGA) fittings for the contents of the cylinder. A regulator should be attached to a cylinder without forcing the threads. If the of a regulator does not properly fit the cylinder, no effort should be made to try to force the fittings together. A poor fit may indicate that the regulator is not intended for use on the gas chosen. Never use a sealing material such as Teflon tape for making the connection between a cylinder and a regulator. Leak checking should be done with an approved oil free fluid. Check cylinders and all connections under pressure for leaks prior to using the contents.

The following procedure should be used to attach a regulator to a cylinder:

1. Secure cylinder to prevent tipping or falling
2. Remove protective cap
3. Attach regulator tightly using a wrench.
4. After the regulator has been attached to the cylinder valve, turn the pressure-adjusting screw counterclockwise until it turns freely releasing the regulator pressure.
5. Do not place yourself in front or behind regulator when opening the cylinder valve. Try to place the cylinder between you and the regulator. Open the cylinder valve slowly until the high pressure gauge on the regulator registers the full cylinder pressure. At this point, the cylinder pressure should be checked to see if it is at the expected value. Then open the cylinder valve all the way.
NOTE: contact your gas supplier if pressure is less than expected. (Low cylinder pressure may indicate a leaking valve which can be a serious safety issue.)

6. With the flow-control valve at the regulator outlet closed, turn the adjusting screw clockwise until the required delivery pressure is reached. (Control of flow can be regulated by means of the valve supplied in the regulator outlet or by a supplementary valve placed in series downstream from the regulator).

7. The regulator itself should not be used as a flow control by adjusting the pressure to obtain different flow rates. This defeats the purpose of the pressure regulator, and in some cases where higher flows are obtained in this manner, the pressure setting may be in excess of the design pressure of the system.

8. After flow is established, set the delivery pressure. Check to see that the delivery pressure is as desired and make any necessary adjustments.

12.5 Leak Checking

1. Check for leaks at the regulator to cylinder connection.

2. For gases not soluble in water, a soap bubble solution such as Snoop is convenient and effective.

3. For water soluble gases, a pressure check may be carried out if there is a shut off valve just downstream from the regulator. Close the shutoff valve and the cylinder valve, and observe that the pressure indicated on the regulator does not drop significantly over five minutes. If a leak is observed, close the cylinder valve, remove the regulator, and wipe the regulator to cylinder connection surfaces with a clean cloth or Kimwipe. Look for scratches or corrosion on the surfaces, which may inhibit formation of a seal. Assemble, tighten, and test again. Do not use the regulator or cylinder if a leak is detected and it cannot be eliminated. If the regulator is determined to be the cause of the leak, do not use it until it is repaired. If the cylinder is the source of the leak close the valve and do not use it. Contact the supplier.

12.6 Training

All users must receive training in the proper handling procedures for compressed gas cylinders.
Appendices

Items included:

Clark Hall Emergency Evacuation Action Plan

Clark Hall New Employee Orientation – Academic and Non-Academic Experimentalists Form

Clark Hall New Employee Orientation - Theoretical

Chemical Spill Kit Instruction Sheet

Appendix G: What Everyone Should Know About This Policy – Frequently Asked Questions of Cornell University Policy 2.9, Environmental Compliance and Voluntary Environmental Initiatives.

OSHA Lead Standard – Content of Appendices A and B

Clark Hall Incident Report

Clark Hall Laser Safety Program
Clark Hall Emergency Evacuation Action Plan

A. Exiting Procedures:
1. General instructions for faculty, staff, and students of Clark Hall

   Upon Hearing an Alarm:
   a. Stop working. Stabilize any experiments in progress if it can be done safely and quickly.
   b. Notify others of the alarm if they are not aware of the alarm or can't hear it.
   c. Leave the lights on.
   d. Leave the room & close all doors.
   e. Exit the room via the nearest safe route (see posted maps). If your main exit path is blocked, choose a safe secondary exit.
   f. Walk, do not run. Take personal items but do not hold up others by searching for your belongings.
   g. Do not use elevators.
   h. If you have left your area in a condition that could result in a hazard, inform Environmental Health and Safety, Fire Department personnel, or the building chief fire warden immediately upon exiting the building.
   i. Once you are outside, move well away from the building to protect yourself.
   j. Do not return to the building until the alarm stops.

2. Instructions for the Physically Challenged:
   Individual evacuation plans will be developed by you (if you are faculty, staff, or a member of a research group) and the group safety representative and/or safety manager. If you have physically challenged guests in the building, you are responsible for assisting the guests to an area of safety in the event of an alarm activation. Advise an emergency responder (Ithaca Fire Dept., CU Environmental, Health, and Safety personnel, or an evacuation floor monitor) of your guest's location.

   Upon Hearing an Alarm:
   a. Stop working. Stabilize any experiments in progress, if it can be done safely and quickly.
   b. Notify others of the alarm if they are not aware of the alarm or can't hear it.
   c. Leave the lights on.
   d. Leave the room and close all doors.
   e. Notify someone who is leaving the building to advise Fire Department personnel of your intended whereabouts and proceed to (if you are in the):
      i. Basement: Go to the loading dock area.
      ii. First floor north: Choose the exit that is closest to you (see posted maps) Go to the south end of the hallway and exit through the main doors located on each side of the elevators.
      iii. First floor south: Exit through the main doors located on each side of the stairway or go to the west exit into Rockefeller Hall.
      iv. Second floor: Go to the nearest building link where Baker Laboratory and Clark Hall meet or Clark Hall and Rockefeller Hall meet (see posted maps) or the nearest stairwell. The stairwells are designed to be protected by two-hour fire doors and walls on all sides.
      v. Third, Fourth, Fifth, Sixth or Seventh Floors: Go to the nearest stairwell and exit on the first floor.
B. **Escape Route Assignment by Floor:**
   See Emergency Evacuation maps posted about the building. Primary escape routes are identified by a solid line. A secondary means of escape is indicated on the posted maps by a dashed line.

C. **Procedure to Account for All People Following Evacuation:**
   Fire Marshals check designated areas to make sure the building is empty then report the status of their area with the Fire Warden.

   People with information, such as missing persons or potentially dangerous situations inside the building, should report such information to the fire marshals, chief fire warden, or emergency responders.

D. **Assignment of Rescue and Medical Duties for Employees:**
   None in the department. These duties will be provided by the University and the Ithaca Fire Department.

E. **Preferred Method for Reporting Emergencies:**
   **Fires:** First activate the pull station. Then call Cornell Police (911, 255-1111 if you have a cellular telephone, or use an emergency phone) from an area that poses no risk.
   **Medical:** Use the emergency phone in the hallway or dial 911 from desk/lab telephones (255-1111 for cellular telephones).
   **Odors:** Call 911 after hours (255-1111 if you use a cellular telephone (between 8:00 AM and 4:00 PM call the Building Manager at 5-5079). Meet the Environmental Health and Safety responder at a prearranged location in the building to help direct him/her to the correct problem location.
   **Other:** Use emergency phones or dial 911.

F. **Individuals Who May Be Contacted for More Information and/or Explanation of Plan Duties:**
   Safety Manager 5-8773 or Associate Director-Technical Services LASSP 5-3524
Provide the following safety information to any new member on the first day of employment and/or joining the group. Check off each item after it has been discussed with the new member. Sign and date the form and have the new member also sign and date it. Have the new group member take this completed form and the key authorization card to David Bowman in G22 Clark Hall. David will then issue the new member his/her building key(s). If the new member will not receive keys send the completed form to Cheryl Lewkowicz, 205 Baker Lab.

Group Name______________________________  Date  ________________
Print New Member Name ________________________________________________
Job Title (check one):      Department(check one):
  _____ Faculty                        _____ LASSP
  _____ Graduate Student          _____ A&EP
  _____ Post Doc                   _____ Physics
  _____ Visiting Sci               _____ CCMR
  _____ RA/Assoc.                  _____ CNS
  _____ Undergraduate Student     _____ Other: ___________
  _____ Staff                      
  _____ Other
Laboratory/Facility room number ________   Telephone  __________________

Location of emergency equipment:
  _____ Chemical Hygiene Plan and Material Safety Data Sheets for lab chemicals and how to access MSDSs from web site
  _____ Fire extinguishers
  _____ Emergency shower and eyewash stations
  _____ Emergency telephones or lab phone (dial 911 for emergencies)
  _____ Spill control kit and first aid kit (if applicable)
  _____ Safety glasses, lab coats, protective gloves, safety shields, other unique protective equipment (list)______________________________________
  _____ Nearest fire pull station

Egress from lab/building during evacuation
  _____ Location of the emergency exit(s) from lab
  _____ instruct new member to:
    _____ close door
    _____ leave the lights on
    _____ show emergency route from the floor (primary and secondary routes)
    _____ explain that after leaving the building people should move 50' from the building

If new member will fill Dewars:
  _____ Take them to the nitrogen fill station and explain proper fill procedures (cryogen gloves, which fill station to use for Dewar, how to set up, etc.)

Cornell University Clark Hall New Employee Orientation –
Academic and Non-Academic Experimentalists
If new member will use Class 3b or 4 Lasers:
   _____ Complete Clark Hall Laser Safety Program form

Chemical storage/transport/shipping:
   _____ Location of gas cylinder receiving and storage areas
   _____ Location of bottle carriers
   _____ Location of chemical storage facilities within group (solvent cabinets, acid/base, oxidizer storage)
   _____ Advise new member that all chemical containers must be labeled with the full chemical name
   _____ Clark Hall Chemical Inventory System
   _____ Transport chemicals via bottle carriers, chemical shipping box, or a sealed secondary container
   _____ Shipment of chemicals (including samples to other institutions, returns to vendors) through CU EH&S at 58200.
   _____ Shipment of radioactive materials go through CU EH&S, shipment of biological agents go through the Vet School.

Hazardous Waste
   _____ Container location and the need for secondary containment
   _____ How to label bottles and complete waste labels including when to date
   _____ Bottles are to remain capped unless person is pouring material into bottle
   _____ Location of waste storage/pickup station (if different from fill station)
   _____ Drain disposal limited to approved materials and neutralization of some acids and bases (show Chemical Hygiene Plan)
   _____ Used oil disposal

Sharps (hypodermic syringes and needles)
   _____ Inventory system for group
   _____ Location of locked drawers
   _____ Disposal containers location

_____ Lab Specific Procedures: (HF treatment and spill clean-up, high voltage systems, Standard Operating Procedures, Biohazard containment and disposal, etc.)
   Describe: ______________________________________________________
   _____________________________________________________________
   _____________________________________________________________
   _____________________________________________________________

This new member safety orientation was given by _______________________________ (group member signature) on _______________(date).

I, _______________________________ (new member signature) was trained on the above date.
My email address is ______________________________
Cornell University Clark Hall New Employee Orientation –
Theoretical Academic Staff and Non-Academic Staff

Provide the following safety information to any new member on the first day of employment and/or joining the staff. Check off each item after it has been discussed with the new member. Sign and date the form and have the new member also sign and date it. Have the new group member take this completed form and the key authorization card to David Bowman in G22 Clark Hall. David will then issue the new member his/her building key(s). Keys will be provided to new members of the Clark Hall community upon receipt of this completed form. If the new member will not receive keys, please send the completed form to Cheryl Lewkowicz, 205 Baker Lab.

Supervisor Name ______________________ Date ________________
Print New Member Name ________________________________
Job Title (check one):
   ______ Faculty ______ RA/Assoc.
   ______ Graduate Student ______ Undergraduate Student
   ______ Post Doc ______ Staff
   ______ Visiting Sci ______ Other

Room number __________________________ Telephone ________________

Location of emergency equipment:
   ______ Fire extinguishers
   ______ Emergency shower and eyewash stations – if in your area
   ______ Emergency telephones or office phone (dial 911 for emergencies)
   ______ Nearest fire pull station

Egress from lab/building during evacuation
   ______ Location of the emergency exit(s) from lab

Instruct new member to:
   ______ close the door
   ______ leave the lights on
   ______ show the emergency route from the floor (primary and secondary routes)
   ______ explain that after leaving the building people should move 50’ from the building.

This new member safety orientation was given by ________________________________
(group member signature) on _______________ (date)

I, _______________________________ (new member signature) was trained on the above date. My email address is _______________________________
Chemical Spill Kit Stored Here
Small Spill Clean-up Instructions

Report all spills to the lab/facility supervisor.
If you find spills of highly toxic materials or large volume spills evacuate the area and, from a safe location, call 911 immediately.

Spill Kit Contents:
- SlikWik, spill pillows, or other organic material absorption compounds
- Sodium bicarbonate (baking soda) – for acid (except HF) or base spills
- Calcium carbonate or HF specific spill pillow– for HF spills
- Hazardous waste labels
- Heavy nitrile gloves
- Zip lock bags or plastic bags and tape to close
- Dust pan and brush

Wear gloves, ANSI approved eye protection, and a lab coat or apron when cleaning up a spill.

Spills of Oils, Organic liquids, and/or Solvents:
- Cover spilled material with enough SlikWik or use Spill pillows to contain all liquid
- Start from the outer edge of the spill and work towards center
- Use a brush and dust pan to sweep up saturated SlikWik: avoid creating dust.
- Or, while wearing gloves, pick up saturated Spill Pillows
- Place material in zip lock bag and seal the bag
- If the material is hazardous, affix a hazardous waste label to the bag and hold for a hazardous waste pickup
- Small amounts of oils mixed with an absorbent may be bagged and placed in the dumpster if there are no hazardous materials present

Spills of Acids (except HF) or Bases
- Apply enough sodium bicarbonate to cover the spill
- Start from the outer edges of the spill and move toward the center
- Wait until the bubbling action has stopped
- Check the pH of the mixture, slowly add sodium bicarbonate until the pH is between 5.5 and 9.0
- Materials with a pH of 5.5-9.0 may be drain disposed with plenty of water

Spills of HF
- Avoid all skin, eyes, or respiratory contact with the vapor or liquid
- Cover spill completely with calcium carbonate (or an HF-compatible spill pillow) working from the outer edge toward the center of the spill
- Cover spill and calcium carbonate mixture with absorbent material
- Place saturated material in zip lock bag and seal the bag
- Affix a hazardous waste label to the bag and hold for a hazardous waste pickup
APPENDIX G: WHAT EVERYONE SHOULD KNOW ABOUT THIS POLICY—FREQUENTLY ASKED QUESTIONS

The Policy on Environmental Compliance and Voluntary Environmental Initiatives is directed toward managers, supervisors, and those who are directly involved in environmental activities. This appendix is directed toward the numerous people at Cornell who don't need to read the entire policy, but should be aware of it and may have questions about it.

What do I need to know about University Policy 2.9, Environmental Compliance and Voluntary Environmental Initiatives?
- It is everyone's responsibility to comply with environmental laws and regulations.
- This policy sets up a management system, the Cornell Management System for the Environment and Chemical Management (CMS) to assist with compliance university-wide, and each college or division has a role to play in its development.
- The policy also establishes the Environmental Stewardship Council to coordinate and promote environmental stewardship activities that are not legally required.

How do I comply with this policy?
- You need to understand what's required to be in environmental compliance for your activities.
- If environmental compliance requirements for your work result in the collection of data and preparation of reports or other documents, these may need to be submitted to or approved by the Environmental Compliance Program Administrator that is responsible for university-wide compliance in specific environmental areas. Your college or division's Environmental Representative can help you identify when this is necessary.
- Special requirements for construction and similar activities are identified in Appendix C. There are instances when you are required to obtain approval from the Environmental Compliance Office (ECO) or submit documents to them before proceeding. Review Appendix C early in the development of your project.

Where can I get information on the laws and regulations that I need for this policy?
- If you are a student or staff member, your instructor or supervisor is the first place to go. Your college or division's Environmental Representative can also assist with identifying requirements, including training.

My work is not located at the Ithaca campus. Does this policy apply to me?
- Yes, University Policy 2.9, Environmental Compliance and Voluntary Environmental Initiatives covers all university operations, no matter where they are located. If your work is located outside the United States, it is the responsibility of you and your college or division to identify environmental requirements.

What is the Cornell Management System for the Environment and Chemical Management (CMS)?
APPENDIX G: WHAT EVERYONE SHOULD KNOW ABOUT THIS POLICY – FREQUENTLY ASKED QUESTIONS, CONTINUED

- The CMS is a management system that integrates Cornell’s environmental compliance into day-to-day decisions and practices. ECO and other Environmental Compliance Program Administrators will centrally administer environmental programs that support each college or division’s efforts to achieve and maintain environmental compliance.

Is there anything I need to do for the CMS?

- Each college and division must develop and implement a plan for conformance to the CMS. You probably won’t be directly involved or affected by this process. However, you may be involved in the development of Environmental Standard Operating Procedures (see Form A) for your activities, if needed.

I’m interested in doing more to help the environment. How can I get more involved?

- See opportunities listed on the Cornell Sustainable Campus website (www.sustainablecampus.cornell.edu).

Whom should I contact for more information?

Your college or division has an Environmental Representative who can give you more specific information on compliance and other environmental stewardship activities. Contact your college or division’s administrative office to identify your environmental representative.
I. SUBSTANCE IDENTIFICATION

A. Substance: Pure lead (Pb) is a heavy metal at room temperature and pressure and is a basic chemical element. It can combine with various other substances to form numerous lead compounds.

B. Compounds Covered by the Standard: The word "lead" when used in this standard means elemental lead, all inorganic lead compounds and a class of organic lead compounds called lead soaps. This standard does not apply to other organic lead compounds.

C. Uses: Exposure to lead occurs in at least 120 different occupations, including primary and secondary lead smelting, lead storage battery manufacturing, lead pigment manufacturing and use, solder manufacturing and use, shipbuilding and ship repairing, auto manufacturing, and printing.

D. Permissible Exposure: The Permissible Exposure Limit (PEL) set by the standard is 50 micrograms of lead per cubic meter of air (50 ug/m³), averaged over an 8-hour workday.

E. Action Level: The standard establishes an action level of 30 micrograms per cubic meter of air (30 ug/m³), time weighted average, based on an 8-hour work-day. The action level initiates several requirements of the standard, such as exposure monitoring, medical surveillance, and training and education.

II. HEALTH HAZARD DATA

A. Ways in which lead enters your body. When absorbed into your body in certain doses lead is a toxic substance. The object of the lead standard is to prevent absorption of harmful quantities of lead. The standard is intended to protect you not only from the immediate toxic effects of lead, but also from the serious toxic effects that may not become apparent until years of exposure have passed.

Lead can be absorbed into your body by inhalation (breathing) and ingestion (eating). Lead (except for certain organic lead compounds not covered by the standard, such as tetraethyl lead) is not absorbed through your skin. When lead is scattered in the air as a dust, fume or mist it can be inhaled and absorbed through your lungs and upper respiratory tract. Inhalation of airborne lead is generally the most important source of occupational lead absorption. You can also absorb lead through your digestive system if lead gets into your mouth and is swallowed. If you handle food, cigarettes, chewing tobacco, or make-up which have lead on them or handle them with hands contaminated with lead, this will contribute to ingestion.

A significant portion of the lead that you inhale or ingest gets into your blood stream. Once in your blood stream, lead is circulated throughout your body and stored in various organs and body tissues. Some of this lead is quickly filtered out of your body and excreted, but some remains in the blood and other tissues. As exposure to lead continues, the amount stored in your body will increase if you are absorbing more lead than your body is excreting. Even though you may not be aware of any immediate symptoms of disease, this lead stored in your tissues can be slowly causing irreversible damage, first to individual cells, then to your organs and whole body systems.

B. Effects of overexposure to lead - (1) Short term (acute) overexposure. Lead is a potent, systemic poison that serves no known useful function once absorbed by your body. Taken in large enough doses, lead can kill you in a matter of days. A condition affecting the brain called acute encephalopathy may arise which develops quickly to seizures, coma, and death from
cardiorespiratory arrest. A short term dose of lead can lead to acute encephalopathy. Short term occupational exposures of this magnitude are highly unusual, but not impossible. Similar forms of encephalopathy may, however, arise from extended, chronic exposure to lower doses of lead. There is no sharp dividing line between rapidly developing acute effects of lead, and chronic effects which take longer to acquire. Lead adversely affects numerous body systems, and causes forms of health impairment and disease which arise after periods of exposure as short as days or as long as several years.

(2) Long-term (chronic) overexposure. Chronic overexposure to lead may result in severe damage to your blood-forming, nervous, urinary and reproductive systems. Some common symptoms of chronic overexposure include loss of appetite, metallic taste in the mouth, anxiety, constipation, nausea, pallor, excessive tiredness, weakness, insomnia, headache, nervous irritability, muscle and joint pain or soreness, fine tremors, numbness, dizziness, hyperactivity and colic. In lead colic there may be severe abdominal pain.

Damage to the central nervous system in general and the brain (encephalopathy) in particular is one of the most severe forms of lead poisoning. The most severe, often fatal, form of encephalopathy may be preceded by vomiting, a feeling of dullness progressing to drowsiness and stupor, poor memory, restlessness, irritability, tremor, and convulsions. It may arise suddenly with the onset of seizures, followed by coma, and death. There is a tendency for muscular weakness to develop at the same time. This weakness may progress to paralysis often observed as a characteristic "wrist drop" or "foot drop" and is a manifestation of a disease to the nervous system called peripheral neuropathy.

Chronic overexposure to lead also results in kidney disease with few, if any, symptoms appearing until extensive and most likely permanent kidney damage has occurred. Routine laboratory tests reveal the presence of this kidney disease only after about two-thirds of kidney function is lost. When overt symptoms of urinary dysfunction arise, it is often too late to correct or prevent worsening conditions, and progression to kidney dialysis or death is possible.

Chronic overexposure to lead impairs the reproductive systems of both men and women. Overexposure to lead may result in decreased sex drive, impotence and sterility in men. Lead can alter the structure of sperm cells raising the risk of birth defects. There is evidence of miscarriage and stillbirth in women whose husbands were exposed to lead or who were exposed to lead themselves. Lead exposure also may result in decreased fertility, and abnormal menstrual cycles in women. The course of pregnancy may be adversely affected by exposure to lead since lead crosses the placental barrier and poses risks to developing fetuses. Children born of parents either one of whom were exposed to excess lead levels are more likely to have birth defects, mental retardation, behavioral disorders or die during the first year of childhood.

Overexposure to lead also disrupts the blood-forming system resulting in decreased hemoglobin (the substance in the blood that carries oxygen to the cells) and ultimately anemia. Anemia is characterized by weakness, pallor and fatigability as a result of decreased oxygen carrying capacity in the blood.

(3) Health protection goals of the standard. Prevention of adverse health effects for most workers from exposure to lead throughout a working lifetime requires that worker blood lead (PbB) levels be maintained at or below forty micrograms per one hundred grams of whole blood (40 ug/100g). The blood lead levels of workers (both male and female workers) who intend to have children should be maintained below 30 ug/100g to minimize adverse reproductive health effects to the parents and to the developing fetus.
The measurement of your blood lead level is the most useful indicator of the amount of lead being absorbed by your body. Blood lead levels (PbB) are most often reported in units of milligrams (mg) or micrograms (ug) of lead (1 mg=1000 ug) per 100 grams (100g), 100 milliters (100 ml) or deciliter (dl) of blood. These three units are essentially the same. Sometime PbB's are expressed in the form of mg% or ug%. This is a shorthand notation for 100g, 100 ml, or dl.

PbB measurements show the amount of lead circulating in your blood stream, but do not give any information about the amount of lead stored in your various tissues. PbB measurements merely show current absorption of lead, not the effect that lead is having on your body or the effects that past lead exposure may have already caused. Past research into lead-related diseases, however, has focused heavily on associations between PbBs and various diseases. As a result, your PbB is an important indicator of the likelihood that you will gradually acquire a lead-related health impairment or disease.

Once your blood lead level climbs above 40 ug/100g, your risk of disease increases. There is a wide variability of individual response to lead, thus it is difficult to say that a particular PbB in a given person will cause a particular effect. Studies have associated fatal encephalopathy with PbBs as low as 150 ug/100g. Other studies have shown other forms of diseases in some workers with PbBs well below 80 ug/100g. Your PbB is a crucial indicator of the risks to your health, but one other factor is also extremely important. This factor is the length of time you have had elevated PbBs. The longer you have an elevated PbB, the greater the risk that large quantities of lead are being gradually stored in your organs and tissues (body burden). The greater your overall body burden, the greater the chances of substantial permanent damage.

The best way to prevent all forms of lead-related impairments and diseases-both short term and long term- is to maintain your PbB below 40 ug/100g. The provisions of the standard are designed with this end in mind. Your employer has prime responsibility to assure that the provisions of the standard are complied with both by the company and by individual workers. You as a worker, however, also have a responsibility to assist your employer in complying with the standard. You can play a key role in protecting your own health by learning about the lead hazards and their control, learning what the standard requires, following the standard where it governs your own actions, and seeing that your employer complies with provisions governing his actions.

(4) Reporting signs and symptoms of health problems. You should immediately notify your employer if you develop signs or symptoms associated with lead poisoning or if you desire medical advice concerning the effects of current or past exposure to lead on your ability to have a healthy child. You should also notify your employer if you have difficulty breathing during a respirator fit test or while wearing a respirator. In each of these cases your employer must make available to you appropriate medical examinations or consultations. These must be provided at no cost to you and at a reasonable time and place.

The standard contains a procedure whereby you can obtain a second opinion by a physician of your choice if the employer selected the initial physician.
This abbreviated appendix shows key provisions of the standard that you as a worker should become familiar with.

I. PERMISSIBLE EXPOSURE LIMIT (PEL) - (50 ug/m(3)),

II. EXPOSURE MONITORING - PARAGRAPH (D)

If lead is present in the workplace where you work in any quantity, your employer is required to make an initial determination of whether the action level is exceeded for any employee.

III. METHODS OF COMPLIANCE - PARAGRAPH (E)

Your employer is required to assure that no employee is exposed to lead in excess of the PEL. The standard establishes a priority of methods to be used to meet the PEL.

IV. RESPIRATORY PROTECTION - PARAGRAPH (F)

V. PROTECTIVE WORK CLOTHING AND EQUIPMENT - PARAGRAPH (G)

VI. HOUSEKEEPING - PARAGRAPH (H)

VII. HYGIENE FACILITIES AND PRACTICES - PARAGRAPH (I)

VIII. MEDICAL SURVEILLANCE - PARAGRAPH (J)

IX. MEDICAL REMOVAL PROTECTION - PARAGRAPH (K)

X. EMPLOYEE INFORMATION AND TRAINING - PARAGRAPH (L)

XI. SIGNS - PARAGRAPH (M)

The standard requires that the following warning sign be posted in work areas where the exposure to lead exceeds the PEL:

WARNING
LEAD WORK AREA
NO SMOKING OR EATING

XII. RECORDKEEPING - PARAGRAPH (N)

XIII. OBSERVATIONS OF MONITORING - PARAGRAPH (O)

XIV. EFFECTIVE DATE - PARAGRAPH (P) - March 1, 1979

XV. FOR ADDITIONAL INFORMATION

A. Copies of the Standard and explanatory material may be obtained by writing or calling the OSHA Docket Office, U.S. Department of Labor, room N2634, 200 Constitution Avenue, N.W., Washington DC 20210. Telephone: (202) 219-7894.
CLARK HALL INCIDENT REPORT

Instructions
This form is intended to assist in identifying and correcting safety hazards in the Clark Hall. The supervisor should complete this form for any incident—whether or not an injury resulted—occurring in the building. An incident is anything that causes personal injury or property damage, or could have caused such injury or damage. Thus, fires, floods, chemical spills, explosions, hazardous gas releases, and other such events must be reported even if no injuries occur.

The Safety Manager will complete the university online report for incidents that result in injuries.

Submit completed forms within 24 hours of the accident to the Clark Hall Safety Manager, 205 Baker Lab. Incident report forms may be obtained in the Clark Hall stockroom.

1. Information

<table>
<thead>
<tr>
<th>Name</th>
<th>Cornell ID#</th>
</tr>
</thead>
<tbody>
<tr>
<td>Net ID</td>
<td>Job Title/Position</td>
</tr>
<tr>
<td>Dept.</td>
<td>Phone</td>
</tr>
<tr>
<td>Permanent Address</td>
<td></td>
</tr>
<tr>
<td>City</td>
<td>State</td>
</tr>
<tr>
<td>Home telephone number</td>
<td></td>
</tr>
</tbody>
</table>

2. The Incident

Date of Incident: ____________________________

Time: ____________________________ AM PM

Time person began work that day: ____________________________ AM PM

Location of Incident (Room & Building) ____________________________

Is this room a laboratory? (check one) yes no

Describe the Incident. What happened? Specify chemicals or equipment involved. (E.g., dropped and broke 4-L bottle of acetone; reaction vessel containing sodium caught fire; tubing popped out of sink causing flooding)

__________________________________________

__________________________________________

What was the person doing when the incident occurred?

__________________________________________

__________________________________________

Did an injury result from this incident? Yes No

If yes, describe the injury (E.g., cut on right hand; chemical burn on left leg).

__________________________________________

__________________________________________

Who witnessed this incident?

<table>
<thead>
<tr>
<th>Name</th>
<th>Address</th>
<th>Phone</th>
</tr>
</thead>
</table>

Complete and sign other side of form

6/14/2004 ver.
3. Safety
What protective equipment or other safeguards were in use at the time of the incident? (E.g., safety glasses or goggles, gloves, use of hood, blast shield, water flow monitor, water hoses clamped, etc.)

What emergency personnel were involved in the incident?
- EHS
- Cornell Police
- Local Fire Department
- Other

4. Treatment/Lost Time
What treatment was received: (Please check all that apply)
- No Treatment
- First Aid
- Beyond First Aid
- Treatment Refused
- Unknown

Please describe the treatment given (Enter ‘None’ if not applicable):

Physician Name:
Medical facility name:
Medical facility other:
Was the person treated in an Emergency Room:
- Yes
- No

Hospital:
- In Patient
- Out Patient

Is it anticipated that there will be lost work days as a result of the incident?
- Yes
- No
- Unknown at this time

5. Signature of Supervisor
Name
Dept. Address
Signature
Title
Phone
Date

Submit completed form to Laboratory Safety Manager, 205 Baker Laboratory.

6. Comments and Follow up by Manager of Laboratory Safety

6/14/2004 ver.
Clark Hall Laser Safety Program
Group Level for Class 3b and Class 4 Laser Users

New Laser User Name (please print) ___________________________ Group __________
Trained by (print name) ___________________________ on date: _______________

Please check items discussed/completed with new laser user. These items are to be completed prior to use of the laser by the new group member. Send the completed form to Cheryl Lewkowicz, 205 Baker Lab.

____ Laser User Safety Training
   All users of Class 3b and Class 4 lasers must be trained.
   Training is scheduled for ________________ (date)

____ Instruct the new group member to have the baseline eye exam done. This exam is to be done PRIOR to laser work. The new member should call Dr. Lempert’s office to schedule a laser baseline exam. He/she should complete the “Patient’s name, date of birth, phone #, Student ID#” sections on the CU Consultation/Referral Form (form can be obtained from Cheryl or in Clark Hall Stockroom) and bring this form to the doctor’s office. The form is to be given to Dr. Lempert or his office staff.

____ Show the location of safety eyewear, gloves, lab coats, other required personal protective equipment.

____ Discuss any Standard Operating Procedures (SOP’s) for the operation, maintenance, and alignment of laser(s), and any other SOP’s. The new member is to review these documents in detail prior to use.

____ Discuss the use of any controls for the laser system including required procedures and the location of any equipment.

I completed training in the above elements of the Cornell University Clark Hall Laser Safety Program on ________________ (date).

Signature of new user ________________________________

2/28/07