CHEMICAL HYGIENE PLAN

Policies and Procedures Regarding Work in Laboratories

Clark University

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Clark University
Chemical Hygiene Plan
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1.0 Clark University Commitment to Safety

Clark University provides a safe and healthy work environment in accordance with the Occupational Safety and Health Act (OSHA) 29 CFR 1910.1450 "Occupational Exposure to Hazardous Chemicals in Laboratories" also known as the Laboratory Standard. Commitment to health and safety is the responsibility of individuals at all levels to protect the safety and health of all personnel and the environment.

1.1 Purpose

The purpose of the Chemical Hygiene Plan (CHP) is to provide guidance to Clark University personnel for working safely in the laboratory environment. The CHP complies with the requirements of OSHA's Laboratory Standard and describes proper laboratory practices, procedures, protective equipment, and hazard identification. The CHP is available in the laboratory and in the office of the Chemical Hygiene Officer. A copy of the CHP should be maintained with or in the Safety Data Sheet (SDS) binder and be readily available to all personnel in the laboratory.

1.2 Scope

The provisions of the CHP apply to all Clark University laboratory personnel, other personnel who routinely visit or occasionally work in the laboratory, and all contractors who might be exposed to laboratory hazards while at Clark University. Personnel are encouraged to contribute their skills and knowledge to the CHP such as routine activities, chemical safety, hazardous material handling, or procedures to minimize chemical exposures. Information about this plan and questions regarding environmental, health and safety at Clark University may be answered at the EHS website located at: http://www.clarku.edu/offices/ehs/.

Frank Abell, Chemical Hygiene Officer (CHO), will annually review the CHP for effectiveness and amend as necessary. New personnel will be required to review and understand the CHP as part of their New Personnel Orientation and all laboratory personnel will receive annual CHP training.

2.0 ROLES AND RESPONSIBILITIES

2.1 Chief Executive Officer

- Has the ultimate responsibility for chemical safety within the university and must provide continuing support for safety at all levels. The Chief Executive Officer for the University is James Collins, Executive Vice President and Treasurer.

2.2 Professors and Assistant Professors

- Responsible for safety within their laboratories/departments.
- Become familiar with the EHS website located at: http://www.clarku.edu/offices/ehs/

2.3 Chemical Hygiene Officer (CHO)

- Development and implementation of appropriate chemical hygiene policies and practices;
- Monitoring the procurement, use, and disposal of chemicals used in the laboratories;
- Conducting formal, documented chemical hygiene/housekeeping inspections of laboratories and safety equipment and assuring that follow-up items are addressed in a timely manner;
- Assisting in the design and development of safe facilities; working with the Director of Facilities to assure that safe facilities are maintained at all times;
- Knowing current legal requirements for regulated substances;
- Assisting Laboratory Professors in developing policies and procedures specific to the work being conducted in their areas;
- Assisting Laboratory Professors in determining which personnel require medical consultations or personal protective equipment;
- Conducting accident investigations and assisting professors in their efforts to reduce the potential for recurrence of these events by using appropriate protective equipment or changing work practices; and
- Reviewing the CHP on an annual basis and making changes as needed.

2.4 Laboratory Professors

Holds the primary responsibility for chemical hygiene in his/her laboratory, including:

- Ensuring that personnel and students read and follow the CHP, which includes the use of appropriate protective equipment and clothing;
- Ensuring that this equipment is available and in working order, and that staff have been trained in its correct usage;
- Determining, with the help of the CHO, the required levels of protective apparel and equipment;
- Ensuring that all hazardous waste is disposed of in accordance with all municipal, state and federal regulations; this includes the segregation, containment, and labeling of materials generated in the laboratory;
- Defining "Designated Areas" within the laboratory space for work with highly toxic and potentially carcinogenic materials, and ensuring that all such work is conducted in these areas;
- Performing informal safety and housekeeping inspections of all his/her laboratory areas;
- Determining the need for medical surveillance for his/her staff; and
- Reporting to the CHO any accident or spill occurring in the laboratory, and instituting necessary procedures or work practices to prevent recurrence of such events; ensuring that any injured personnel receives appropriate medical attention.
- Become familiar with the EHS website located at: http://www.clarku.edu/offices/ehs/

2.5 Assistant/ Associate Professors and Students

- Responsible for reading, understanding, and following the policies and procedures outlined in the CHP;
- Planning and conducting each operation in accordance with the CHP; and, when required, obtaining prior approval from the Chemical Hygiene Officer;
- Wearing appropriate personal protective equipment and following safe work practices as outlined in the CHP;
- Notifying the Laboratory Professor when equipment is malfunctioning or safety apparel is not available;
- Labeling and disposing of hazardous waste in compliance with Clark University's CHP;
- Review and understand the CHP and applicable laboratory specific procedures in their

entirety before beginning work in the laboratory or with hazardous chemicals; and

- Notifying the Laboratory Professor of any incident or accident involving hazardous chemical substances.
- Become familiar with the EHS website located at: http://www.clarku.edu/offices/ehs/

3.0 STANDARD OPERATING PROCEDURES

Clark University supports the implementation of prudent laboratory practices when working with chemicals in a laboratory. These include general and laboratory-specific procedures for work with hazardous chemicals, emergency procedures, and laboratory waste procedures. Procedures have been put in place to protect personnel from health hazards and physical hazards in the Clark University laboratories.

3.1 Laboratory General Safety Procedures

Clark University has established general lab procedures to ensure that laboratory personnel maintain healthy and safe work practices in laboratory. All personnel working in laboratories must adhere to the following policies when laboratory work involves the use of hazardous chemicals. Failure to do so will be reported to the laboratory professor.

- Always read and understand the Material Safety Data Sheet for the chemicals you work with before handling.
- Do not use broken or chipped glassware, and dispose of it in a designated marked container (e.g., "broken glass only").
- Never pipette by mouth; always use a pipette aid or suction bulb.
- Do not apply cosmetics in the laboratory.
- Wash hands and arms thoroughly before leaving the laboratory, even if gloves have been worn.
- Food and drink are forbidden in the laboratory.
- All chemical containers such as test tubes, beakers, and flasks must be labeled with the full chemical name.
- Do not work alone in the laboratory if the procedures being conducted are hazardous.

3.2 Accident and Incident Reporting

All accidents, incidents, and near misses that result in personal injury or illness, damage, and or a potential for significant injury or property loss to Clark University property shall be properly reported and investigated. All accidents/ incidents shall be reported to the CHO via a "Clark University Accident Report". This report is attached as Appendix B. All accidents or near misses should be carefully investigated by the CHO, with the results distributed to all who might benefit.

3.3 Chemical Storage

- All chemicals in the laboratory should have a designated storage area and should be returned after each use. Chemicals are segregated by general hazard class.
- Avoid storing chemicals on bench tops and floors.
- Storage trays or secondary containers should be used to minimize spillage of material if a container breaks or leaks.
- Avoid storing chemicals in the fume hood because containers and equipment can interfere with airflow, clutter the work space, and increase the amount of material that could become involved in a hood fire.
- Avoid storing chemicals in direct sunlight or near a heat source.
- Physically separate incompatible chemicals using a secondary containment bin or tray, and or store at another designated location.
- All chemical containers must be properly labeled and stored in labeled storage areas.
- Avoid storing chemicals above eye level.
- Refrigerators used for storage of flammable chemicals must be explosion-proof, laboratory-safe units.

3.4 Hazardous Waste Management and Disposal

3.4.1 Management

Hazardous waste chemicals regulated by the Environmental Protection Agency must be collected, labeled, packaged, and disposed of according to federal and state hazardous waste regulations. Hazardous waste is any solid, liquid, sludge, or containerized gas that is discarded, has served its intended use, or is manufacturing by-product, and exhibits any of the

characteristics identified below:

- Flammable
- Corrosive
- Reactive
- Toxic

It is the responsibility of the waste generator to adhere to proper waste management and disposal policies. Hazardous waste shall be collected in an appropriate container pending transfer to the Clark University Main Accumulation Area (MAA) or Satellite Accumulation Area (SAA) for chemical waste handling or pickup for disposal.

3.4.2 General Procedures for Disposal

- Any material that meets the criteria of a hazardous waste shall not be treated or otherwise changed to alter its characteristics as a hazardous waste.
- Empty containers of P-listed waste shall be disposed of as hazardous waste.
- Dispose of all waste in designated, labeled containers. Any questions about proper disposal methods should be directed to the CHO.
- Do not combine different waste streams (i.e. incompatible hazardous materials).
- Do not overfill containers.
- Manage common laboratory waste (uncontaminated gloves, paper towels, etc.) in the general trash.

3.4.3 Storage and Handling for Hazardous Waste

- All hazardous waste generated at Clark University must be accumulated and stored in a Satellite Accumulation Area (SAA) before being transferred to the Main Accumulation Area(MAA).
- The SAA's are marked by a sign defining the SAA. The area is used for the accumulation of waste generated at the point of generation.
- All SAA waste containers must be labeled with SAA labels or the words "Hazardous Waste" with the full chemical name and hazard class (e.g. ignitable).
- When an SAA waste container becomes full, date the container with the 'full date'.

- SAA containers can remain in the SAA indefinitely or until they become full. Full containers must be moved into the MAA within three days of the full date.
- All containers must be closed and sealed when not in use.
- Waste must be stored in containers compatible with the constituents of the waste.
- The MAA must remain locked at all times.
- Secondary containment bins must be used to prevent mixing of incompatible waste streams.

3.4.4 Lab-Pack Chemicals

Unwanted chemicals should not remain in chemical stock areas, but should be moved to the SAA.

3.4.5 Broken Glass Disposal

- Broken glass and sharp objects shall never be disposed in general trash receptacles or recycling bins.
- Glass bottles (not eligible for recycling) shall be empty and their labels defaced before discarding.
- Glass bottles or broken glass must be disposed of in cardboard "Deposit Glass Here' boxes. These boxes are available throughout the laboratories.
- Seal the top of the box closed with tape when it is full and label it 'trash'.

3.4.6 Universal Waste Management

- Fluorescent lamps, cathode ray tube (CRT) screens, NiCad or rechargeable batteries, and mercury containing devices such as thermostats/ thermometers are classified as Universal Waste in Massachusetts and cannot be disposed in the general trash. For disposal contact the Campus Sustainability Coordinator.

3.5 Chemical Procurement

Before a chemical is received, information on proper handling, storage, and disposal will be reviewed by the CHO. No container should be accepted without an adequate label. All chemicals will be received in the university mail room and then forwarded to the CHO.

3.6 Chemical Inventory Control

Clark University uses a Microsoft Access Database to track their chemical inventory. The only administrator for the database is the CHO. This system allows personnel to search for the location and/or quantity of a specific chemical. The system will also prevent orders of chemicals that will exceed Clark University's flammable storage limits.

3.7 Housekeeping

- Laboratory fume hoods and work areas should be kept clean and free of debris at all times.
- Do not allow trash to accumulate in any area. It can be a fire hazard and or obstruct emergency equipment and egress.
- Do not store food or drink in any chemical laboratory.
- Access to exits, emergency equipment, and utility controls should never be blocked.

3.8 Emergency Procedures

- In the event of an emergency, all personnel are trained to exit the building immediately and meet outside at their designated assembly area. Upon meeting, personnel are to let their professor know they are accounted for. Personnel should not enter the building until they have received notification to do so from the appropriate authority. The university police shall be notified upon discovery of a spill or accident, and is trained to take the appropriate response actions. University police can be reached by telephone at **x7575.** Emergency evacuation procedures for Biology, Chemistry, Physics and Math buildings are posted on the university EHS website http://www.clarku.edu/offices/ehs/.

3.9 Hazard Assessment

A hazardous chemical means a chemical for which there is statistically significant evidence that acute or chronic health effects may occur in exposed laboratory personnel. An acute health effect is an adverse health effect characterized by severe symptoms that develop rapidly. A chronic health effect is an adverse health effect with symptoms that develop slowly over a relatively long period of time.

A hazard assessment must be completed to identify the physical and health hazards of chemicals used in the laboratory and determine the risk of exposure to the body. A physical chemical hazard is a chemical that is proven to be a combustible liquid, flammable, a compressed gas, explosive, an organic peroxide, an oxidizer, pyrophoric, unstable or water reactive. A health hazard means a chemical for which there is statistically significant evidence that acute or chronic health effects may occur in exposed personnel. Chemicals that are health hazards include carcinogens, toxic or highly toxic agents, reproductive toxins, irritants, corrosives, sensitizers, hepatotoxins, nephrotoxins, neurotoxins, agents which act on the hematopoietic system, and agents which damage the lungs, skin, eyes, or mucous membranes.

A hazard assessment should include: identifying the hazard type (s), selection of appropriate PPE, training laboratory personnel, storage and handling requirements, control measures, signs and symptoms of an exposure, and spill and decontamination procedures.

3.10 Bonding and Grounding

Bonding and grounding of flammables is extremely important to reduce the risk of explosion and fire due to static electricity that builds up during the transfer of flammable liquids. Bonding prevents the generation of static electricity by minimizing the electrical potential between two objects, such as a dispensing drum and a safety can. Grounding minimizes the electrical potential between the containers and the ground. Bonding and grounding shall be used when transferring Class I flammable liquids, those with a flash point below 100 F (ethyl ether, benzene, xylene, and acetone) in metal equipment in order to avoid static generated sparks.

3.11 Procedures for Prior Approval

There will be times were there is a significant change in chemical amounts, new equipment, or a situation where one must work alone with highly hazardous chemicals. It is recommended that laboratory personnel communicate these changes to their coworkers. General safety considerations include:

- Experimental design

- Equipment design
- Work space adequacy
- Development of an SOP
- Work preparedness
- Hazard assessment

3.12 Procedures for Particularly Hazardous Substances (Carcinogens, Reproductive Toxins, Highly Toxic Chemicals, and Chemicals of Unknown Toxicity)

The following procedures must be followed when performing laboratory work with particularly hazardous substances.

- These substances must be used and stored only in areas with restricted access.
- Designated area may be used for work with these materials and may be the entire laboratory, a glove box, an area of a laboratory, or a device such as a chemical fume hood. The designated area must be clearly posted with signs that;
  - Identify the hazards
  - When the hazardous material is in use
  - No untrained personnel allowed in the work area
  - Clearly define the designated area
- Only the smallest amount of a chemical required by the procedure shall be used or stored.
- When possible only order the required amounts to avoid unnecessary decanting or weighing out the material.
- Specific spill procedures for the hazardous materials must be developed and posted in the designated area.
- All laboratory personnel working with these chemicals shall be familiar with the hazards and proper procedures for accidental release.
- General PPE to be worn at all times when working with these materials are safety glasses, gloves, long sleeve laboratory coats, and no open toed shoes.
- The designated work area shall always be decontaminated after each process, experiment, or when the work is completed.

- All waste products from the process shall be managed in a compatible container.

3.13 Chemical Substances Developed in the Laboratory

If the composition of the chemical substance produced for the laboratory's use is known, the laboratory personnel shall determine if it is a hazardous chemical. If the chemical is determined to be hazardous, the personnel shall wear the appropriate PPE and use proper safety precautions. If the chemical produced is a byproduct whose composition is not known, the laboratory personnel shall assume that the substance is hazardous. If the chemical substance is produced for another user outside of the laboratory, the laboratory personnel shall comply with the Hazard Communication Standard (29 CFR 1910.1200) including the requirements for preparation of SDSs and labeling.

4.0 SPECIAL PROCEDURES FOR HANDLING HAZARDOUS CHEMICALS

The Lab Supervisor shall ensure that all lab personnel are aware of the locations, hazards, and appropriate control measures for work involving hazardous chemicals. In some cases, laboratory-specific procedures may be required for working with highly hazardous materials. Review the SDS for specific handling and storage requirements of hazardous chemicals. Some specific hazards that may be present in various laboratories at Clark University are listed below:

4.1 Asphyxiants

Asphyxiants are substances that interfere with the transport of an adequate supply of oxygen to the vital organs of the body. Simple asphyxiants are substances that displace oxygen from the air being breathed to such an extent that adverse effects result. Acetylene, carbon dioxide, argon, helium, ethane, nitrogen, and methane are common asphyxiants. It is important to recognize that even chemically inert and biologically benign substances can be extremely dangerous under certain circumstances, such as carbon monoxide.

4.2 Compressed Gas

Gas cylinders contain either compressed liquids or gases. Gas cylinders represent the most insidious hazard, as puncture, heat, faulty valves, pressure or regulators may result in a rapid release of the entire contents. The following safety considerations should be implemented

where applicable:

- The cylinder contents must be clearly identifiable.
- Handle cylinders carefully and do not roll, slide, or drop. Use a cart or hand truck to transport.
- Do not lift a cylinder by its cap.
- Secure all cylinders while in storage, transport, or use.
- Never tamper with cylinder valves, force connections, or use homemade adapters. Use only approved equipment. Never repair or alter cylinders, valves, or safety relief devices.
- Only use a regulator compatible with the cylinder contents.
- Close the cylinder valve when not in use.
- When empty, turn off the cylinder valve and label the cylinder as empty. Store separately from full cylinders.
- Store cylinders in a well ventilated area away from ignition sources, heat, flames, and flammable chemicals.
- Keep the protective caps on the cylinders at all times except when the cylinders are in active use.
- Check for gas leaks using soapy water around the connections.
- Do not store flammable gas cylinders with oxidizers such as nitrous oxide or oxygen. They must be separated by a minimum of 20 ft. or a 5 foot fire wall.

4.3 Corrosive Chemicals

The Resource Conservation and Recovery Act (RCRA) defines a corrosive chemical as a liquid with a pH ≤2 or >12.5. Acids and bases can cause severe tissue damage depending on the corrosivity of the chemical. The primary means of protection from corrosive chemicals is the use of gloves, goggles, face shields, aprons, lab coats, and other chemical resistant clothing. Exercise extreme caution when handling corrosive chemicals. The following safety considerations should be implemented where applicable:

- Transport acids and bases in a bottle carrier or cart. Do not handle by the neck alone; support the weight of the bottle from the bottom when handling or pouring.

- Do not store acid and bases with flammable liquids or oxidizing chemicals. Store perchloric acid by itself.
- Isolate corrosive chemicals from incompatible chemicals.
- Reference the chemical's SDS for proper handling, PPE, and storage requirements.
- If an acid or base comes in contact with your skin or clothing, thoroughly wash the affected areas utilizing the safety showers or eyewash units.

4.3.1 Hydrofluoric Acid

Hydrofluoric acid (HF) has a number of chemical, physical and toxicological properties that make handling this material particularly hazardous. HF solutions are clear, colorless and have a density similar to water. Exposure to concentrated (>50%) HF solutions will cause immediate, severe, penetrating burns. Exposure to less concentrated solutions can also have serious effects, but the appearance of symptoms can be delayed for up to 24 hours. Clark University personnel exposed to HF must seek immediate medical attention, even if they do not feel pain.

When working with HF, laboratory personnel must wear the appropriate PPE (safety glasses, lab coat, and nitrile gloves) and conduct all work in a fume hood because HF vapors can also cause serious burns. HF must be used and stored in polyethylene, polypropylene, Teflon, wax, lead or platinum containers.

4.4 Flammable and Combustible Chemicals

Flammable chemicals are considered to be liquids with a flashpoint below 100 °F and solid materials that readily sustain combustion. Liquids with a flashpoint between 100 °F and 200 °F are generally classified as combustible; the same basic procedures should be applied when handling combustible liquids.

- Do not allow smoking or other sources of open flames in areas where flammable chemicals are used.
- Know the location of fire extinguishers, fire alarms, and emergency exits in the laboratory.
- Do not store flammable liquids in domestic-type refrigerators. Use only refrigerators

rated for flammables.

- Do not store flammables with oxidizing agents (e.g., nitric, perchloric, and sulfuric acids).
- Do not expose flammable liquids to potential sources of ignition such as electrical equipment, heat, burners, or open flames.
- To prevent accidental electrical charge, the use of bonding and grounding equipment should be used whenever applicable. The use of non-sparking tools can prevent an ignition source.
- Store flammable liquids in an approved fire rated flammable storage cabinet.
- Do not store flammable liquids on the floor, unless protected by secondary containment.
- Minimize the amount flammable liquids that are in use, being stored, and that are generated as wastes.
- Storage of flammable liquids greater than 10 gallons within a laboratory fire area must be in an approved and labeled flammable storage cabinet.
- The Material Safety Data Sheet (SDS) shall be reviewed by the owner/user of the materials for additional safety requirements and precautions.

4.5 Irritants

An irritant is a chemical, which is not corrosive, but which causes a reversible inflammatory effect on living tissue by chemical action at the site of contact. A wide variety of organic and inorganic chemicals are irritants; thus, skin contact with all laboratory chemicals should be avoided. Use a properly functioning chemical fume hood when handling irritants that can be inhaled. At minimum, safety glasses, lab coat, long pants, protective gloves, and closed toed shoes should be worn.

4.6 Organic Peroxides

Organic peroxides are hazardous because of their extreme sensitivity to shock, sparks, heat, light, strong oxidizing and reducing agents, and other forms of detonation. Organic peroxides may cause fire, create explosion hazards, and may be toxic or corrosive. Some organic peroxides are dangerously reactive, decomposing very rapidly or explosively if they are

exposed to only slight heat, friction, mechanical shock or contamination with incompatible materials. Precautions for handling peroxides should include the following:

- Limit the quantity of peroxides.
- Do not return unused peroxides to the container.
- Clean up all spills immediately. Solutions of peroxides can be absorbed using vermiculite or other absorbing material.
- Do not permit smoking, open flames, and other sources of heat near peroxides. Areas should be labeled that contain peroxides so that this hazard is evident.
- Avoid friction, grinding, and other forms of impact near peroxides, especially solid peroxides. Glass containers that have screw-cap lids or glass stoppers should not be used. Polyethylene bottles that have screw-cap lids may be used.
- Isolate from incompatible materials such as strong acids and bases, flammable and combustible liquids, and reducing agents.

4.7 Oxidizers

Oxidizers are chemicals other than a blasting agent or explosive as defined in § 1910.109(a), that initiates or promotes combustion in other materials, causing fire either of itself or through the release of oxygen or other gases. Examples include perchloric acid, potassium persulfate, and lead nitrate. Precautions for handling oxidizers should include the following:

- Minimize the amount of oxidizers used and stored.
- Isolate from incompatible chemicals (e.g., organics, flammable, dehydrating, or reducing agents).
- Do not store oxidizers in wooden cabinets or on wooden shelves.
- Do not return unused material to the original container.
- Store in a tightly closed container and in a cool, dry, ventilated area.
- Perchloric acid may not be used in any fume hood except those specifically designed for perchloric acid use.

4.8 Pyrophoric Chemicals

Pyrophoric chemicals are extremely reactive toward oxygen and water, and must never be

exposed to the atmosphere. Examples include Sodium Hydride and Lithium Aluminum Hydride. Exposure of these chemicals to the air could result in spontaneous combustion, which could cause serious burns or other injuries to the person handling the chemical or others in the immediate area. In addition, all combustible materials, including paper products, should not be allowed to come in contact with any pyrophorics at any time. Pyrophorics can be handled and stored safely as long as all exposure to atmospheric oxygen and moisture is avoided. Solids must be transferred under an inert atmosphere in an efficient glove box. Glass bottles of pyrophorics should not be handled or stored unprotected. The metal container shipped with each bottle should be retained as a protective container for each bottle for transporting and storage

4.9 Reproductive Toxins

Reproductive toxins are chemicals which affect the reproductive capabilities including chromosomal damage (mutations) and effects on fetuses (teratogenesis). Reproductive toxins have adverse effects on various aspects of reproduction, including fertility, gestation, lactation, and general reproductive performance. Reproductive toxins can affect both men and women. Male reproductive toxins can in some cases lead to sterility. Two well-known male reproductive toxins are ethylene dibromide and dibromochloropropane. When a pregnant woman is exposed to a chemical, generally the fetus is exposed as well because the placenta is an extremely poor barrier to chemicals.

4.10 Select Carcinogens

A carcinogen is a substance capable of causing cancer. Carcinogens are particularly insidious toxins because they may have no immediate apparent harmful effects. Carcinogens should be handled using prudent practices. A chemical is considered to be a carcinogen if:

- It has been evaluated by the International Agency for Research on Cancer (IARC), and found to be a carcinogen or potential carcinogen; or
- It is listed as a carcinogen or potential carcinogen in the Annual Report on Carcinogens published by the National Toxicology Program (NTP) (latest edition); or,
- It is regulated by OSHA as a carcinogen.

4.11 Toxic Chemicals

Toxic is defined by OSHA 29 CFR 1910.1200 as a chemical which falls in any of these three categories:

- A chemical that has a median lethal dose (LD50) of more than 50 milligrams per kilogram but not more than 500 milligrams per kilogram of body weight when administered orally to albino rats weighing between 200 and 300 grams each.
- A chemical that has a median lethal dose (LD50) of more than 200 milligrams per kilogram but not more than 1,000 milligrams per kilogram of body weight when administered by continuous contact for 24 hours (or less if death occurs within 24 hours) with the bare skin of albino rabbits weighing between two and three kilograms each.
- A chemical that has a median lethal concentration (LC50) in air of more than 200 parts per million but not more than 2,000 parts per million by volume of gas or vapor, or more than two milligrams per liter but not more than 20 milligrams per liter of mist, fume, or dust, when administered by continuous inhalation for one hour (or less if death occurs within one hour) to albino rats weighing between 200 and 300 grams each.

4.12 Water-Reactive Chemicals

Water-reactive chemicals are likely to become spontaneously flammable or give off flammable or toxic gas when in contact with water. Examples include aluminum powder, sodium and potassium metal, and sodium borohydride. Protect from moisture and separate from incompatibles. Store these chemicals in accordance with manufacturer or applicable SDS requirements.

5.0 Control Measures

For the laboratory use of OSHA regulated substances, Clark University shall assure that laboratory personnel exposure to such substances do not exceed the permissible exposure limits specified in 29 CFR 1910, subpart Z. To minimize personnel exposure to hazardous chemicals, the following control measures for reducing chemical exposure should be implemented:

- Substitution of less hazardous chemical or processes
- Engineering controls

- Administrative controls
- Personal protective equipment (PPE)

Substitution, engineering controls, administrative controls, and personal protective equipment (PPE) are basic principles used to control hazards and exposures. Before the proper control (s) can be selected, a hazard assessment of the process, activity, or material should be conducted.

5.1 Substitution

Every hazard assessment should first determine if the hazardous conditions can be prevented, e.g., substituting with a less hazardous chemicals or process. Substitution is one of the most effective ways to eliminate or reduce exposures because it removes the hazard at the source.

5.2 Administrative Controls

Administrative controls are changes in work procedures such as written safety guidelines, rules, supervision, schedules, signs, labels, SDSs, and training to reduce personnel exposure to hazardous chemicals.

5.2.1 Safety Data Sheets (SDS)

SDSs are documents created by the chemical manufacturer that describe the substance. Some information found on an SDS includes: chemical and physical characteristics, handling requirements, storage and disposal information, and signs and symptoms of exposure. SDSs are required for all chemicals at Clark University and must remain on file for 30 years after employment. OSHA requires up-to-date SDSs that are readily available for each chemical. The Chemical Hygiene Officer is responsible for obtaining SDSs for chemicals used and stored at Clark University. SDSs shall be maintained in binders in Sackler Science Center Annex, Room S222. SDSs are accessible to all personnel and regulatory inspectors as needed. Personnel have a right to access any or all SDSs. If an SDS is not included in the shipment, Clark University shall contact the chemical manufacturer in order to obtain the SDS.

5.2.2 Signs and Labels

All hazardous materials, hazardous waste, and chemical storage areas shall be appropriately labeled indicating the hazards present and any other relevant regulatory requirements. All

chemical containers at Clark University must be labeled regardless of size and whether or not they are hazardous. Labeling of all chemical containers assists emergency personnel and others in identifying what is and what is not hazardous should a spill occur or other emergency situation arise. Original labels on chemical containers must not be removed or defaced. Labels must be in English and they must contain the complete name of the chemical and be traceable or easily linked to the appropriate SDS (chemical formulas are not allowed). The manufacturer's label is generally sufficient to meet OSHA labeling requirements and should be replaced only if it becomes damaged or illegible. All containers into which chemicals are transferred also need to be legibly labeled in English and include the name of the chemical and appropriate hazard warnings (chemical formulas are not allowed). The National Fire Protection Association (NFPA) 702 diamond should be utilized to ensure uniform labeling. The NFPA system requires the chemical name to be listed along with health, flammability, reactivity and specific hazard ratings. Refrigerators or freezers containing either chemicals or food should be appropriately labeled, e.g., chemicals only, no food or drink, or food and drink only.

All laboratories shall be posted with signage addressing the hazards of the materials contained in the lab, requirements for personal protective equipment, and any special hazards located in the lab. An NFPA 702 diamond can be used for hazard notification.

5.3 Engineering Controls

Engineering controls eliminate or reduce exposure to a chemical or physical hazard through the use or substitution of engineered machinery or equipment. Engineering controls include process change, substitution, isolation, ventilation, and source modification.

- **Process change** consists of changing a process to make it less hazardous (e.g., paint dipping in place of paint spraying).
- **Substitution** consists of substituting for a less hazardous material, equipment, or process (e.g., use of soap and water in place of solvents, use of automated instead of manually operating equipment).
- **Isolation** is applied when a barrier is inserted between a hazard and those who might be affected by that hazard. Separating personnel from hazardous operations, processes,

equipment, or environments using a physical barrier or distance may provide the necessary isolation.

- **Ventilation** can be either local (direct air movement) or general (dilution of air contaminants) that exhausts or supplies air properly.
- **Source modification** consists of changing a hazard source to make it less hazardous (e.g., wetting dust particles or lowering the temperature of liquids to reduce off-gassing and vaporization).

5.4 Personal Protective Equipment (PPE)

Clark University is required to determine if PPE should be used to protect their laboratory personnel. PPE should be used in conjunction with guards, engineering controls, and administrative controls. PPE may be required to reduce personnel exposure to hazards when engineering and administrative controls are not feasible or effective in reducing these exposures to acceptable levels. PPE should always be worn if there is a possibility that personal clothing could become contaminated with hazardous materials. Examples include: laboratory coats, aprons, jumpsuits, boots, shoe covers, and gloves. Review SDSs to determine the necessary PPE to limit exposure. The kind of PPE needed depends on how the chemical enters the body. This is called route of exposure and is listed on the SDS. The four major routes of exposures are skin absorption, inhalation, ingestions, and injection.

5.4.1 Eye and Face Protection

Safety glasses with side shields that conform to ANSI standard Z87.1-1989 should be required for work with hazardous chemicals. Ordinary prescription glasses with hardened lenses do not serve as safety glasses.

Although safety glasses can provide protection from injury from flying particles, they offer little protection against chemical splashes. Splash goggles should be worn if there is a splash hazard in any operation involving hazardous chemicals. Full face shields are worn in conjunction with either safety glasses or splash goggles. When there is a possibility of liquid splashes, both a face shield and splash goggles should be worn; this is especially important for work with highly corrosive liquids. Full-face shields with throat protection and safety glasses with side shields should be used when handling highly hazardous chemicals. If work in the laboratory could

involve exposure to lasers, ultraviolet light, infrared light, or intense visible light, specialized eye protection should be worn. Safety glasses should be provided for visitors in the laboratory.

5.4.2 Hand Protection

When handling hazardous chemicals, personnel shall select and wear the appropriate gloves. No single glove can provide appropriate protection in every work situation. It is important to assess the hazards in each task and select a glove that provides the required protection. Below are general recommendations for glove selection and use:

- Similar gloves supplied by different manufacturers may not offer the same level of protection; therefore, the manufacturer's glove selection chart may need to be reviewed.
- Select gloves which are resistant to the chemicals you may be exposed to. Consult the relevant SDS which may recommend a particular glove material.
- Select gloves of the correct size and fitting; gloves that are too small are uncomfortable and may tear whereas larger gloves may interfere with dexterity.
- Before use, check gloves (even new ones) for physical damage such as tears and pin holes.
- When removing gloves, do so in a way that avoids the contaminated exterior contacting the skin.
- Wash hands after removing gloves.

Many factors affect the breakthrough times of gloves including: thickness of glove material, chemical concentration, amount of chemical that comes into contact with the glove, length of time the glove is exposed to the chemical, temperature at which the work is done, and possibility of abrasion or puncture. Glove selection guides are available from most manufacturers.

If chemicals do penetrate the glove material, they could be held in prolonged contact with the hand and cause more serious damage than in the absence of a proper glove. Gloves should be replaced immediately if they are contaminated or torn. The use of double gloves may be appropriate in situations involving chemicals of high or multiple hazards. Leather gloves are appropriate for handling broken glassware and inserting tubing into stoppers, where protection

from chemicals is not needed. Gloves should be decontaminated or washed appropriately before they are taken off and should be left in the laboratory and not be allowed to touch any uncontaminated objects in the laboratory or any other area. Gloves should be replaced periodically, depending on the frequency of use.

5.4.3 Lab Coats, Protective Suits & Aprons

Appropriate laboratory coats should be worn, buttoned, with the sleeves rolled down. Laboratory coats should be fire-resistant and fully covering. Laboratory coats or laboratory aprons made of special materials are available for high-risk activities. Laboratory coats that have been used in the laboratory should be left there to minimize the possibility of spreading chemicals to eating and office areas, and they should be cleaned regularly. Rings, bracelets, watches, or other jewelry that could trap chemicals close to the skin, come in contact with electrical sources, or get caught in machinery should not be worn. Leather clothing or accessories should not be worn in situations where chemicals could be absorbed in the leather and held close to the skin.

5.4.4 Laboratory Attire

When performing work with hazardous materials, laboratory personnel should cover all exposed parts of their body to prevent unnecessary chemical exposure. Tie long hair back, avoid loose clothing such as neckties and flowing sleeves.

5.4.5 Foot Protection

Closed toed shoes should be worn in areas where hazardous chemicals are in use or mechanical work is being done. Clogs, perforated shoes, bare feet, sandals, and cloth shoes do not provide protection against chemicals. Shoe covers may be required for work with especially hazardous materials.

6.0 EQUIPMENT, MAINTENANCE, AND INSPECTIONS

6.1 Fume Hoods

The laboratory fume hood is the most common local exhaust method used in laboratories. When working with hazardous chemicals, the use of the fume hood is required at Clark

University. A properly operating and correctly used fume hood will control vapors, dusts, and mists released from volatile liquids. Fume hoods can also protect from accidental spills. Fume hoods are inspected and certified annually. The Chemical Hygiene Officer is responsible for ensuring that fume hoods have updated certification labels and are functioning properly. Except when adjustments to the apparatus are being made, the hood should be kept closed, with vertical sashes down and horizontal sashes closed, to help prevent the spread of a fire, spill, or other hazards into the laboratory. Basic guidelines for operating a fume hood include the following:

- Confirm that the fume hood has been certified within the last year (label with date).
- Confirm that the chemical can be used in the fume hood.
- Conduct procedure at least six inches behind the plane of the sash.
- Never put your head inside a fume hood to check an experiment.
- Work with the sash at the lowest position possible to protect your face and body.
- Do not clutter the fume hood with bottles, chemicals, or equipment as it restricts airflow and work space.
- Immediately report any suspected fume hood malfunctions to the Chemical Hygiene Officer.
- Limit foot traffic behind while performing operations in the hood.

6.2 Safety Showers and Eyewash Stations

In case of an exposure to hazardous substances, a reliable, clean source of water must be available to rinse contaminants from the body. Eyewash stations and safety showers are located in all of Clark University's laboratories. Laboratory professors must ensure that safety showers and eyewash stations are free from obstruction. Laboratory supervisors are responsible for ensuring that their personnel are aware of the nearest safety shower and eyewash station location and how to use the device. Clark University is responsible for conducting periodic inspections of the safety showers and eyewash stations to ensure they are working properly.

6.3 Inspections

The CHO will periodically conduct laboratory inspections. Inspections will include a walk-

through of the selected area(s) and will cover lab safety, PPE, waste management, and related topics. Results of the inspections will be brought to lab supervisors, and will be used as a guide to identify and correct similar and/or other environmental, health and safety issues in their area(s).

7.0 INFORMATION AND TRAINING

7.1 Information

Clark University will provide the following information to laboratory personnel prior to working with any chemical:

- The availability and location of the CHP.
- SDSs for all hazardous chemicals the personnel will use.
- Laboratory Experimental Procedures for all of the operations the personnel will conduct.
- A description and use of the Clark University labeling system.
- Additional information on the hazards, safe handling, storage and disposal of hazardous chemicals can be obtained from the OSHA website, NIOSH website, and the chemical manufacturers.

7.2 Training

All personnel working in a laboratory shall be trained to the contents of the CHP and all applicable procedures that are pertinent to a procedure, experiment, or task. Training shall include but is not limited to:

- Provisions of the CHP.
- Hazards in the laboratory.
- OSHA regulated substances or recommended exposure limits
- Signs and symptoms associated with exposures to hazardous chemicals.
- Safe handling, storage, and disposal of hazardous chemicals.
- How to read an SDS.
- The selection and use of PPE.

7.3 Frequency of Training

Training shall be provided for laboratory personnel prior to starting work in the laboratory; before each new possible hazard exposure; before use on new or altered equipment; and on changes to procedures or the CHP. Refresher training is required annually.

7.4 Recordkeeping

The Chemical Hygiene Officer (CHO) is responsible for establishing and maintaining records for personnel training, personnel environmental monitoring, and compliance records.

8.0 MEDICAL CONSULTATION AND EXAMINATIONS

Clark University shall provide their personnel who work with hazardous chemicals the opportunity for medical attention and follow-up by a competent physician if they show signs and symptoms of exposure.

8.1 Medical Surveillance

Personnel shall be provided an opportunity to receive an appropriate medical examination performed by a licensed physician at a reasonable time and free of cost under the following circumstances.

- At any time laboratory personnel believe they have been significantly exposed to hazardous materials.
- Whenever laboratory personnel develop signs or symptoms associated with a hazardous chemical to which they may have been exposed in the laboratory
- If an event takes place in the work area such as a spill, leak, explosion or other occurrence resulting in the likelihood of a hazardous exposure.
- Where exposure monitoring reveals an exposure level routinely above the action level for an OSHA regulated substance.

8.2 Information Provided to the Physician

Clark University shall provide the following information to the physician:

- The identity of the hazardous chemical(s) to which the personnel may have been exposed and the SDS;
- A description of the conditions under which the exposure occurred including

quantitative exposure data, if available; and

- A description of the signs and symptoms of exposure personnel are experiencing, if any.

8.3 Physician's Written Opinion

Clark University shall obtain a written opinion from the examining physician which shall include the following:

- Recommendation for further medical follow-up.
- The results of the medical examination and any associated tests.
- Any medical condition which may be revealed in the course of the examination which may place personnel at increased risk as a result of exposure to a hazardous workplace.
- A statement that the personnel have been informed by the physician of the results of the consultation or medical examination and any medical condition that may require further examination or treatment.
- The written opinion shall not reveal specific findings of diagnoses unrelated to occupational exposure.

APPENDIX A

Emergency Contact List

Frank Abell, Chemical Hygiene Officer	**508-793-7280 Office**
David Thurlow, Radiation Safety Officer	**508-793-7621 Office**
Triumvirate Environmental	**800-966-9282**
University Police	**508-793-7575**

Clark University EHS website: http://www.clarku.edu/offices/ehs/

APPENDIX B

Clark University Accident Report

Clark University Accident Report

Injured party_____ Date of birth_____ Social Security # ____/____/____

Address_____
Street City State Zip

Job title_____ Department_____

Telephone #_____ Date of injury_____ Time of injury_____

Date reported_____ Was injured employee engaged in usual job activities? ☐ Yes ☐ No

Where did the injury/accident occur? _____

Describe *how* the injury/accident occurred_____

_____

_____

Nature of the injury (cut, burn, sprain, etc.) _____

Injured body part(s)_____

Did the injury/accident involve exposure to bloodborne pathogens (bodily fluids)? ☐ Yes ☐ No

Type of injury (check all that apply):

☐ No treatment required
☐ On-campus first aid only
☐ Off-campus physician/hospital
(please indicate name of medical provider):_____
☐ No lost time
☐ Lost time (number of days ____)

Was the injury/accident witnessed? ☐ Yes ☐ No

If yes, name(s) of witnesses: _____

_____

_____ _____
Name of person completing this form (please print) Signature

Release of Information

I hereby authorize Clark University (or any of its insurance representatives), to be furnished any information regarding this injury, including reports and records, results of diagnosis, treatment, prognosis, and recommendations for further treatment. This information is to be used for the purpose of evaluating and handling my claim for injury as a result of an incident occurring on or about the above noted date of injury/accident and for no other purpose, now or in the future.

_____ _____
Signature of injured party Date

Please return this completed form to the Office of Human Resources.