



Department of Risk Management

Chemical Hygiene Plan

In accordance with the
Occupational Safety & Health Administration
Laboratory Standard, 29 CFR 1910.1450

Compiled by
Paul Riedel, CIH, MPH
Environmental Health & Safety Manager
Department of Risk Management
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Chemical Hygiene Plan

1. Introduction

As part of the DU Laboratory Safety Program, the University of Denver Chemical Hygiene Plan (CHP) is a document that establishes protocols, in accordance with the Occupational Safety & Health Administration (OSHA) Laboratory Standard, 29 CFR 1910.1450, to ensure employees are protected from exposure to chemical hazards in the laboratory. Each Principle Investigator (PI) is to maintain a copy of the CHP, which contains general requirements implemented by the Environmental Health and Safety (EH&S) office, in the Department of Risk Management, and laboratory-specific documents such as hazard assessments, Standard Operating Procedures (SOP), accident and spill reports, and fume hood monitoring.

The CHP applies to any DU laboratory that engages in the use of hazardous chemicals. The CHP must be made readily available to all employees and regulatory officials. All laboratory employees are expected to use and comply with the CHP.

2. Regulations and Standards

Listed below is summary description of significant Federal regulations and industry standards, related to laboratory safety.

29 CFR 1910.1450, “Occupational Exposures to Hazardous Chemicals in Laboratories”

The Standard dictates that employers limit worker exposure to hazardous chemicals. The Standard requires that employees be apprised of the hazard of chemicals present in their work area through information and training.

29 CFR 1910.1200, “Hazard Communication”

The Standard provides employees with hazard information based on the concept that employees have both a need and a right to know the hazards and identities of the chemicals they are exposed to when working.

29 CFR 1910.132, “Personal Protection”

The Standard requires the use of personal protective equipment (PPE) to reduce employees’ exposure to hazards when engineering and administrative controls are not feasible or effective in reducing these exposures to acceptable levels. Employers are required to determine all exposures to hazard in their workplace and determine if PPE should be used to protect their workers.

29 CFR 1910.151, “Medical Services and First Aid”

The Standard states that where the eyes or body of any person may be exposed to injurious corrosive material, suitable facilities for quick drenching or flushing of the eyes and body shall be provided within the work area for immediate emergency use.



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29 CFR 1910.133, “Eye and Face Protection”

The Standard states the employer shall ensure that each affected employee uses appropriate eye or face protection where there are exposure to eye or face hazards caused by liquid chemicals, acid or caustic liquids, chemical gases or vapors, or potentially injurious light radiation.

ANSI Z9.5, “Laboratory Ventilation Guidelines”

The American National Standard Institute (ANSI) in this Standard establishes minimum requirements and best practices for laboratory ventilation systems to protect personnel from overexposure to harmful or potentially harmful airborne contaminants generated within the laboratory.

ANSI Z358.1, “Emergency Eyewash and Shower Equipment”

This standard establishes minimum performance and use requirements for eyewash and shower equipment for emergency treatment of the eyes or body of a person who has been exposed to injurious materials.

ANSI Z87.1, “Occupational and Educational Eye and Face Protection”

This standard establishes minimum requirements for eye and face protective devices and guidance for the selection, use, and maintenance of these devices.

3. Definitions

Chemical Hygiene Officer (CHO) - an employee who is designated by the employer, and who is qualified by training or experience, to provide technical guidance in the development and implementation of the provisions of the Chemical Hygiene Plan. The CHO is the Environmental Health and Safety Manager.

Hazard – any existing or potential condition in the workplace that can result in death, injury, or property damage.

Hazard assessment -- determination of the health hazards associated with a process or task and the appropriate controls to implement to reduce the hazards.

Hazardous chemical - a chemical for which there is statistically significant evidence based on at least one study conducted in accordance with established scientific principles that acute or chronic health effects may occur in exposed employees. The term "health hazard" includes chemicals which are carcinogens, toxic or highly toxic agents, reproductive toxins, irritants, corrosives, sensitizers, hepatotoxins, nephrotoxins, neurotoxins, agents which act on the hematopoietic systems, and agents which damage the lungs, skin, eyes, or mucous membranes.



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Laboratory use of hazardous chemicals - handling or use of such chemicals in which all of the following conditions are met:

- Chemical manipulations are carried out on a "laboratory scale;"
- Multiple chemical procedures or chemicals are used.
- The procedures involved are not part of a production process.

PI - Principal Investigator - the individual in charge of directing research in a particular laboratory.

4. Responsibilities

Department Head is responsible for:

- ensuring the department remains in compliance with the CHP
- providing the CHO with the support necessary to implement and maintain the CHP.

The Principle Investigator is responsible for controlling hazards in his/her laboratory. These responsibilities include:

- performing a hazard assessment for hazardous procedure
- instructing laboratory personnel on potential hazards
- providing written Standard Operating Procedures (SOP) for laboratory activities involving hazardous chemicals
- ensuring employees have received applicable OSHA required training
- training employees and students in safe practices, on SOP's, and on the specific hazards within the lab
- training employees and students on appropriate spill response measures and the use of the spill kit
- correcting work errors and dangerous conditions
- investigating accidents or spills to determine cause and implement corrective action, as appropriate
- selecting and providing the proper personal protective equipment (PPE) for the hazard
- ensuring personnel wear appropriate attire and proper PPE.

The Chemical Hygiene Officer is responsible for:

- providing technical guidance in the establishment of hazard assessments and SOP's
- presenting OSHA mandated training applicable to laboratory personnel
- performing quarterly inspections of the fume hoods to verify adequate airflow
- inspecting laboratories annually (see Appendix F) to identify any deficiencies and to verify compliance with the CHP.



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Individual laboratory workers are responsible for:

- complying with the SOP's and the CHP
- ensuring that hazards are minimized and controlled
- wearing appropriate attire and proper PPE
- caring for their PPE
- appropriately responding to and reporting any chemical spills.

5. General Laboratory Rules

1. Laboratories shall be outfitted with safety equipment including safety showers, eyewash fountains, fire extinguishers, fire blanket, emergency respiratory protection and access to emergency alarms and telephones.
2. Laboratories shall be provided with sufficient general ventilation for input to laboratory hoods to ensure that laboratory air is continually replaced and to prevent the increase of air concentrations of toxic substances. The exhaust air must pass directly to the exterior of the buildings
3. Personnel, whether working in or visiting the lab, shall wear appropriate attire and personal protective equipment relevant to potential hazards in the work area. **Note: Safety glasses are not designed to protect against chemical splash, only flying fragments, objects, particles, etc. Proper eye protection, i.e., goggles, shall be used when the potential hazard of the splashing of hazardous liquids, including acids, exists.**
4. Employees shall be aware of the location and proper operation of laboratory safety equipment including: fire extinguishers; safety showers; eyewash fountains; and, fire blankets in the laboratory.
5. Work areas shall be maintained clean and uncluttered with chemicals and equipment properly labeled and stored.
6. All employees shall avoid unnecessary exposure to chemicals.
7. The PI must approve laboratory work in which a worker will be performing alone, such as during the weekend or late at night. The approval of such work will be based on the associated hazard, i.e. the toxicity of the material and the potential for exposure.
8. Chemicals shall be dated when received and also when opened to prevent exceeding the manufacturer's recommended shelf life limitation. All containers containing chemicals shall be plainly labeled.



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9. The contents of waste containers must be identified on the container to preclude mixing of incompatible chemicals and to facilitate disposal. Disposal of any chemical waste in sanitary drains is prohibited. Accurately labeled waste can be disposed of by contacting the Hazardous Waste Coordinator. Unknown waste may be refused or billed for laboratory analysis of constituents. Refer to the [Hazardous Materials Management Policy](#) for guidance on hazardous waste.
10. Malfunctioning laboratory equipment shall be labeled or tagged "out of service" and shall not be used until repairs have been performed.
11. Warning signs shall be posted at areas or on equipment where special or unusual hazards exist.
12. Laboratory and non-laboratory areas shall be sufficiently segregated to minimize the potential for chemical exposures in office areas.
13. Designated areas for eating or drinking shall be clearly identified and separated from work areas.
14. Refrigerators or ice machines that are currently or have been used for storage of chemicals shall not be used for food or beverage storage and must be labeled appropriately.
15. All laboratory employees that handle chemicals shall wash their hands with soap and water as necessary when leaving the laboratory and periodically during the day.
16. Any spills or accumulations of chemicals on work surfaces shall be removed as soon as possible using techniques that minimize residual surface contamination.
17. Floors shall be cleaned regularly.

6. Hazard Identification - postings, labels, signs

Notice Boards

Laboratories and other potentially hazardous work areas will have a notice board at all doors leading into the workspace. These notice boards shall have completed and current posting that identifies the general hazards within the room and lists the phone numbers of persons to be contacted in case of an emergency. Specific hazards, such as laser and ionizing radiation, should be identified on the piece of equipment or at the source and, also, at the entrance to the room.



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Labels

Chemical containers shall be labeled with the full chemical or trade name of the contents. The manufacturer's label will provide personnel with specific information regarding the physical and health hazards of the substance. Directions found on the label shall be followed. Substances transferred from an original container to a secondary container shall be labeled with the full trade or chemical name of the contents, any dilution of the chemical, the date of the transfer, appropriate physical and health hazards. An exception is made to the secondary labeling requirements in cases where one worker, during a process or task, completely uses the chemical in the secondary container. No abbreviations or codes of the chemical name are acceptable, unless they are referenced on a placard prominently displayed in the work area. Chemical symbols are allowable only if the compound is a product of the research.

Chemical Inventory

Each laboratory shall maintain an inventory of their stored chemicals including approximate quantities. The inventory shall be maintained in the CHP and updated annually.

Material Safety Data Sheets (MSDS)

The MSDS provides valuable information regarding hazardous characteristics, incompatible materials, and recommendations for storage and spill response. As required by the Hazard Communications Standard and Right-to-Know Laws, an MSDS must be available for each chemical used in the laboratory. These must be available in the workplace for laboratory staff review. The MSDS for all hazardous chemicals should be used during the SOP training of lab staff.

7. Hazard Assessment

Each PI is responsible for assessing the hazardous situations, chemicals, biological materials, and energy sources, i.e. radioactive, laser equipment, that may cause potential exposure or injury to staff members working in the lab. The Hazard Assessment (Appendix A), which is a requirement of OSHA for PPE selection, is to be used to develop the SOP's. The purpose of the Hazard Assessment is to identify the potential hazards and then implement applicable measures to control such hazards. See Appendix B for an example of a Hazard Assessment.

Determining hazards is a subjective activity that is made clearer when looking at the two components of workplace hazards: the health effect potential and the frequency potential. The health effects could range from a trivial outcome such as irritation or a minor cut to the more serious result of a catastrophic injury or death. The frequency potential is the likelihood of an occurrence. For example, a process involving a concentrated acid versus a diluted acid is more hazardous due to the severity of



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damage that the stronger acid can cause. Likewise, a process that occurs multiple times versus once is more likely to result in an accident and therefore is more hazardous.

8. Standard Operating Procedures for Hazardous Work

OSHA mandates the development of the SOP for the lab scale use of hazardous chemicals. The SOP is a simple document that identifies a process or the use of a chemical, the associated hazards and hazard controls, special handling and storage requirements, and proper contingency response. There are two types of SOPs: a task or activity specific SOP (Appendix C) and an SOP that relates to a specific chemical. Either type of SOP can be selected and written. If a particular chemical is basically used in the same manner for multiple tasks then one SOP can be sufficient for all work involving that chemical. If a more complicated activity involves multiple chemicals or other types of hazards the task specific SOP would be appropriate. The SOP must include the following elements:

- **General identification**, including name of PI and location
- **Job or process identification or name of specific chemical**
- **Hazard information**, as identified on the Hazards Assessment
- **Required engineering controls and/or special precautions**
- **Required PPE** to be worn during the process
- **Transportation / storage requirements**
- **Accident / spill response**

These laboratory-specific SOPs must be included in the Chemical Hygiene Plan, as a separate section. The CHO will review these SOPs. The PI must ensure that laboratory personnel are trained on the use of the SOPs applicable to their activities.

9. Procurement of chemicals

A **Hazardous Materials Notification List** has been compiled that includes the EPA P-List of acutely hazardous chemicals and certain toxic chemicals as identified by cancer research agencies. The purpose of the notification list is to track certain hazardous chemicals being purchased by the university and to mitigate the generation of hazardous waste. The OSHA Lab Standard requires additional employee protection for work with particularly hazardous substances. The Standard specifically lists three categories of chemicals as particularly hazardous, including select carcinogens, reproductive toxins, and substances with a high degree of acute toxicity. Select carcinogens include any substance which is:

1. regulated by OSHA as a carcinogen
2. identified by the National Toxicology Program (NTP) as “known to be carcinogen”
3. identified by the International Agency for Research on Cancer (IARC) under Group 1 as



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“carcinogenic to humans.

Prior to making a chemical purchase, the PI must evaluate the associated hazards of chemicals to be purchased and to determine if the chemical product or any of its components are identified on the Hazardous Materials Notification List. Written notification (**Hazardous Chemical Purchase Notification**) is required to be submitted to the Hazardous Material Management and the EH&S Manager for the purchase of materials identified on the **Hazardous Materials Notification List**. PI's are responsible for generating as little hazardous waste as reasonably achievable and are therefore encouraged to procure chemicals only in amounts that will be used in the near future. No maximum purchase limit is established but as a general guideline five pounds or about 2200 grams may be considered to be excessive. The Hazardous Materials Manager or the EH&S Manager may contact the PI to discuss potential environmental issues or health and safety risks associated with the request. The cost associated with disposing of hazardous waste may be charged to the respective department if subsequent amounts of wastes are determined to be excessive.

The PI's are encouraged to seek small quantities of chemicals from other laboratories on campus. While exchanging chemicals within the labs is not always possible or feasible, this practice will help reduce inventories. Additionally, prior to procuring a chemical the PI should have a Standard Operating Procedure (SOP) in place that describes the associated hazards, controls to be implemented, and the proper handling, storing, and disposal procedures for the chemical.

The PI must also ensure that the manufacturer or vendor sends the applicable Material Safety Data Sheet (MSDS) to the laboratory in which the chemical will be used. No container of chemicals should be accepted without a proper identification label or a MSDS.

10. Personal protective equipment

PPE must be worn whenever required as determined by posted areas, hazard assessments, the SOP, MSDS or the PI/Laboratory Supervisor. PPE is not a substitute for engineering controls, but should be used in conjunction with engineering controls and safe practices. Refer to ANSI Z87.1, “Occupational and Educational Eye and Face Protection” for guidance in selecting proper PPE for eye and face protection. All eyewear must meet the requirements of ANSI Z87.1.

- Laboratory personnel are responsible for the care and cleaning of assigned PPE, such as eyewear and for the proper disposal of PPE, as appropriate.
- Chemical goggles shall be worn when a splash hazard exists. Such hazards include pouring of corrosive materials or processes where component failure may release hazardous chemicals with velocity. The additional use of a face shield may be necessary based on the hazard assessment.
- The appropriate gloves, laboratory coats, aprons, shoes or chemical resistant suits shall be used during work where a dermal exposure potential exists, as determined by the hazard assessment and during any chemical spill clean up.



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- If a laboratory procedure requires respiratory protection, employees must have, prior to use, (1) respiratory protection training, (2) medical certification, and (3) documentation of fit testing. Contact the CHO for assistance.

11. Laboratory Hood Operation

Every laboratory ventilation hood used for the control of air contaminants shall be tested quarterly by the CHO to assure that adequate airflow is being maintained to provide continued protection against employee exposure. The hood shall be tested using a calibrated airflow anemometer and/or indicator smoke. The ANSI guideline of 80 to 120 feet per minute (fpm) as an average face velocity, at the working sash height, will be used as acceptance criteria. A sticker will be affixed to the side of the hood indicating the hood has adequate airflow. Any hood that does not meet the acceptable airflow criteria shall be removed from service until repairs can be completed. Signs shall be posted indicating the hood is "Out of Service".

12. Use of Laboratory Hoods

1. Laboratory equipment that may discharge hazardous chemicals shall be vented to local exhaust devices.
2. Laboratory fume hoods shall be used when working with any material that might release hazardous chemical vapors or dust. Work activities that would require the use of a fume hood would include:
 - handling chemicals with significant inhalation hazard, i.e. a chemical with an OSHA permissible exposure limit (PEL) or American Conference of Governmental Industrial Hygienists (ACGIH) Threshold Limit Value (TLV) of 100 parts per million (ppm) or less which has appreciable volatility
 - performing procedures with chances of splatter or splash of hazardous chemicals
 - operating processes where component failure may release hazardous chemicals with velocity
 - handling of heated chemicals
 - handling of corrosive materials
 - carrying out reactions with strong exothermic reaction
 - handling chemicals with significant vapor pressure
 - where monitoring shows significant exposure
3. Personnel using a fume hood shall confirm that it is operating properly prior to use. For hoods without static pressure or airflow gauges, an airflow indicator (tell tale) such as an eight-inch strip of light material dangling from the sash can be used to verify airflow into the hood.



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4. Equipment in fume hoods shall be kept to a minimum to avoid blockage of airflow or hood face turbulence effects.
5. Laboratory hood sashes shall be kept in the down or closed position when not in use. Hood sashes should be kept as low as practicable during actual use to utilize the barrier capabilities of the sash.

13. Chemical Storage

1. Both the storage amounts and working amounts of toxic, flammable or hazardous chemicals in a laboratory shall be kept to a minimum.
2. Chemicals shall only be stored in a cool, dry, well-ventilated location and in containers with which they are chemically compatible.
3. No chemicals shall be brought into or stored in laboratory offices, equipment storage rooms or other locations not specifically intended for chemical storage.
4. Each lab shall maintained adequate control of known or suspected carcinogens and highly toxic materials. The lab shall post a warning sign, which is highly visible, that depict the carcinogens and highly toxic materials that are used within the lab.
5. Larger capacity storage containers shall be stored on lower shelves.
6. Use of laboratory hoods as permanent storage devices is not permitted.
7. Where under-hood cabinets are used for chemical storage, venting of the cabinet to the fume hood is desirable.
8. Metal containers involved in the transfer of a flammable or combustible liquid shall be grounded and bonded together to minimize potential for ignition by a static electricity discharge.
9. Flammable materials shall not be stored with water reactive, explosive or self-igniting materials or next to strong oxidizing agents.
10. Flammable liquids shall be stored in approved flammable liquid storage cabinets, in accordance with NFPA 45, Standard on Fire Protection for Laboratories Using Chemicals, (see Appendix H). Flammable storage cabinets shall **not** be vented to the laboratory. The cabinet shall have the port hole closed or be vented directly into an exhaust system.
11. Concentrated reagents and other chemicals which could be harmful on skin contact shall be stored well back on properly constructed shelves where they are not likely to be knocked off. They should also be stored below eye level.
12. Chemical reagents shall be kept in closed containers when not in use.

Below is a concise guide to the storage of most lab scale chemicals.

- perchloric acid is separated from all other materials
- hydrofluoric acid is separated from all other materials
- concentrated nitric acid is separated from all other materials

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- inorganic acids (except bulleted items above) are stored separately
- highly toxic materials (LD₅₀ of 50 mg/kg or less) are stored separately
- carcinogenic chemicals are stored separately.
- bases are stored separately
- strong oxidizing agents are stored separately
- strong reducing agents are stored separately
- water reactive, pyrophoric and explosive materials are stored separately
- flammable organic materials (solvents, organic acids, organic reagents) are stored separately.

The easiest and most efficient way to separate chemicals by compatibility group is to use secondary containments. Place the chemicals to be stored separately in a heavy gauge Nalgene (or similar plastic) tub. Plastic secondary containers must be compatible with the material being stored. Strong acids, especially perchloric, nitric and hydrofluoric are best stored in plastic containers designed to store strong mineral acids. Small containers of compatible chemicals may be stored in a dessicator or other secure container. This is especially useful for highly toxic materials and carcinogens.

Dry chemicals stored in approved cabinets with doors may be grouped together by compatibility type on separate shelves or areas of shelves separated by taping off sections of shelving to designate where chemicals of one type are stored. Physically separated cabinets may be used to provide a barrier between groups of stored incompatible chemicals. Strong mineral acids may be stored in one cabinet and strong bases stored in a second cabinet, for example.

14. Eyewash Stations, Emergency Showers, and Other Safety Equipment Installation and Operability

All laboratories must be equipped with eyewashes and safety showers wherever chemicals have the possibility of damaging the skin or eyes. ANSI Z358.1, "Emergency Eyewash and Shower Equipment" provides for minimum performance requirements (see below).

- The units should be marked with a highly visible sign.
- The units should be located in areas that will be immediately accessible (reachable within 10 seconds).
- The units should be free of obstructions at all times.
- The eyewash units should be checked weekly by a designated lab worker, by flushing for 60 seconds. Emergency showers should be tested every six months, by Facilities Maintenance, to be certain that water flows through it and to clear the lines of stale water and debris.
- Water flow should be 1.5 liters per minute (lpm) for 15 minutes for eyewash stations and 20 gallons per minute for safety showers.



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- Safety equipment, including fire extinguishers, fire blankets, emergency respiratory protection, and spill cleanup equipment should also be inspected monthly. Inspections shall be documented on the monthly inspection sheet (see below).

15. Inspections

Each laboratory will perform a monthly inspection that will cover general safety, safety equipment checks, housekeeping, chemical inventory, use of PPE, chemical safety, and fire safety. Stored chemicals shall be examined periodically for replacement, deterioration, and container integrity. Any problems noted with regard to any laboratory safety equipment shall be reported to the laboratory supervisor. Unneeded items shall be discarded or returned to the control storage location. The monthly inspection will be signed by the laboratory inspector and approved by the PI. The inspection form, Appendix E, will be appended to the CHP, with a copy sent to the CHO.

Additionally, the CHO will perform an annual laboratory inspection, to ensure compliance with the Standard. The inspection report, see Appendix F, will be submitted to the PI who is responsible for correcting identified deficiencies.

16. Training

The CHO will provide generic laboratory safety training to all laboratory employees on the contents of the OSHA Laboratory Standard, the Chemical Hygiene Plan, and other applicable regulatory and industry standards. Laboratory personnel should attend this training within 30 days of initial assignment to a laboratory. Listed in Appendix G is a table indicating required training per OSHA. The required frequency that is denoted may be increased at the discretion of the PI. Additionally, the PI will provide specific training to their employees on the associated hazards in their laboratory. This training shall include:

- health information on all hazardous chemicals used in the laboratory
- instruction on all Hazard Assessments
- instruction on SOP's

17. Accidents and Spills

Each lab is responsible for implementing measures to prevent accidents and spills and to appropriately respond to any spill that occurs. Spills should be treated as potentially dangerous until it is cleaned up or evidence exists indicating no hazard is present. In the event of a large or uncontrolled spill activation of the Denver Hazardous Material response team shall be considered.



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- written accident and spill response procedures shall be implemented for tasks or processes involving hazardous chemicals
- laboratories shall have a spill response kit available in the laboratory to adequately mitigate or control the spill
- personnel shall be trained by the PI on spill procedures and the use of the spill kit
- spill kits shall be inspected monthly
- overpack containers shall be located in labs to handle leaking containers of 5 gallons or more. Leaking containers shall be placed inside an overpack container.

In the event of a spill or accident the following steps should be taken:

1. Alert associated laboratory personnel of the event. If it is safe to do so, stop the source of the spill and turn off any ignition sources. If spill is uncontrolled the room or building may need to be evacuated.
2. Assist individuals who may have been injured. If someone has been splashed with a chemical take him or her to an eye wash station or shower, as appropriate. Flush exposed tissue continuously for 15 minutes. Remove any clothing that may potentially be contaminated.
3. Call emergency services at **911** and Campus Safety at ext. 13000 if an individual is injured or if the spill is too hazardous to abate locally.
4. Before attempting to clean up a spill, personnel must confirm the identity of the material, the appropriate mitigation procedures and material, i.e. appropriate absorbent to use, and the appropriate ppe to use. The CHO and the Hazardous Materials Manager should be consulted with to determine the best course of remediation. If feasible, read and follow the chemical's MSDS recommendation for spill cleanup procedures.
5. Spills, accidents, and near accidents should be investigated by the PI for the purpose of determining corrective actions and preventing like instances in the future. The CHO should be contacted for all investigations. Written findings and any recommendations should be distributed to all relevant departments as a safety to reduce future mishaps.
6. All injuries or exposures must be reported within 24 hours to Risk Management (1-2354). Refer to the Employee Workers Compensation Policy.

18. Hazard Waste

Hazardous waste must be managed in accordance with the *Hazardous Materials Management* policy.

19. Exposure Monitoring



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Personal exposure monitoring will be performed if EH&S or the lab staff has reason to believe that the exposure level of any chemical may exceed the action level or PEL.

20. Medical Consultation and Examination

The employer must provide all employees who work with hazardous chemicals an opportunity to receive medical attention, under the following circumstances.

- Whenever an employee develops signs or symptoms associated with a hazardous chemical to which the employee may have been exposed in the laboratory, the employee shall be provided an opportunity to receive an appropriate medical examination.
- Where exposure monitoring reveals an exposure level routinely above the action level (or in the absence of an action level, the PEL) for an OSHA regulated substance for which there are exposure monitoring and medical surveillance requirements, medical surveillance shall be established for the affected employee as prescribed by the particular standard.
- Whenever 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, the affected employee shall be provided an opportunity for a medical consultation. Such consultation shall be for the purpose of determining the need for a medical examination.

21. Recordkeeping

The employer shall establish and maintain for each employee an accurate record of any measurements taken to monitor employee exposures and any medical consultation and examinations including tests or written opinions required by this standard.



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Appendix B Hazard Assessment Examples

A Hazard Assessment is about identifying unexpected events and establishing methods to control those events. This is a simple example of a two-step procedure. Each step had more than one potential hazard. For each hazard, controls are described. If the hazard cannot be eliminated the best controls are engineering controls, followed by the use of PPE. Often the control for minor hazards may simply be to use caution or to be aware of the surrounding area.

Job or process: Refilling a Dewar

Job step or process	Hazard	Controls
Wheel laboratory dewar to room to refill it from a LN ₂ tank.	Back strain	Ensure dewar is free wheeling
	Pinched toes or fingers	Survey route, use leather gloves
Insert hose into dewar and open valve on LN ₂ tank.	Cryogenic burn or getting hit - from whip-like motion of hose disconnecting	Ensure hose is secured. Stay clear of hose Wear safety glasses, face shield, cryogenic gloves, long pants and long sleeve lab coat
	Oxygen deficient atmosphere - asphyxiation	Perform work in well ventilated area



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Appendix C Hazardous Activity Standard Operating Procedure

Principal Investigator: _____ Dept.: _____

Building: _____ Room(s): _____

Author: _____ Date: _____

Description of process: _____

Chemical(s) Used	Approx Qty	Hazard Class	Health Hazards

Significant hazards (identified in the Hazard Assessment):

Required engineering controls and special precautions: _____

Required PPE: _____

Transportation / Storage Requirements: _____

Exposure / Accidental Contact: _____

Spill Response: _____



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Appendix D Standard Operating Procedure for Chemicals

Principal Investigator: _____ Dept.: _____

Building: _____ Room(s): _____

Author: _____ Date: _____

Chemical name: _____

Description of Chemical Hazard: _____

Engineering controls to be implemented: _____

PPE to be worn: _____

Transportation / Storage Requirements: _____

Exposure / Accidental Contact: _____

Spill Response: _____



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Appendix E Monthly Laboratory Inspection Checklist

Department: _____ Principal Investigator: _____

Building & room: _____ Lab inspector: _____ Month/Year _____

Mark items as satisfactory (✓) or deficient (X). In comments section, describe any deficiencies and how and when they were abated.

Laboratory information

- 1. Entrance posting & room warning signs, i.e., radiation area, food only, no food, exit)
- 2. CHP and SOP's available
- 3. MSDS current and available
- 4. Lab personnel current on OSHA training and knowledgeable of SOP's

General Emergency/Safety Equipment

- 5. Eyewash stations and showers accessible, tested, and operational
- 6. PPE available, worn, and stored properly
- 7. Fire extinguishers present, inspected and posted
- 8. Spill & first aid kits inspected for necessary items

General Safety and Housekeeping

- 9. No trip or fall hazards; clear routes of egress
- 10. Laboratory work in safe configuration
- 11. Shielding on vacuum/pressurized glassware
- 12. Provisions for food & drinks clearly identified & segregated from work areas
- 13. Sharps managed properly (razor blades, needles, broken glass, scalpels)
- 14. Bench covers routinely changed

Chemicals

- 15. Chemicals segregated by chemical compatibility
- 16. Containers sealed and labeled; unused chemicals properly stored
- 17. Flammable cabinets inspected; no flammables stored elsewhere
- 18. Liquids below eye level; no stacking
- 19. Designated areas provided, if applicable (acutely toxic, carcinogens, reproductive hazards)
- 20. Hazardous waste properly segregated, labeled

Equipment & Material Handling

- 21. Fume hoods – free from clutter, proper sash height, flow-indicating device, current sticker
- 22. Gas cylinders properly transported, secured, and capped when not in use
- 23. Electrical cords inspected; good condition, no fraying

Comments: _____

Inspected by _____ Date: _____ Approved by _____



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Appendix F Annual Laboratory Inspection

Department: _____ Principal Investigator: _____

Building & room: _____ Date: _____

Please note the item marked deficient (X) and comments below. The PI is responsible for correcting the noted items or implementing corrective actions by _____

Emergency egress, information and safety equipment

- 1. All exits are clearly marked, visible and unobstructed
- 2. All aisles are free of obstruction
- 3. *Laboratory Hazard Information* sheet (blue) & other posting are accurate
- 4. Eyewash stations and showers are in place, unobstructed, and operational
- 5. Eye wash stations and showers have been inspected and tested per the CHP
- 6. Fire extinguishers are available, with current inspection stickers
- 7. Spill kit are complete and available

Chemical Hygiene Plan and Material Safety Data Sheets

- 8. The Chemical Hygiene Plan is in the lab and available to the workers
- 9. The CHP contains current Hazard Assessments and SOP's
- 10. Monthly laboratory inspections are current
- 11. Monthly laboratory inspection deficiencies have been corrected
- 12. Material Safety Data Sheets are available and current

General Safety & Housekeeping

- 13. Walkways and routes of egress are clear and unobstructed
- 14. Food areas are segregated and clearly demarcated
- 15. Ongoing experiments or processes are maintained in a safe configuration
- 16. Sharps managed properly (razor blades, needles, broken glass, scalpels)
- 17. Bench covers are routinely changed
- 18. Work surfaces, benches, and sinks are free of clutter or unnecessary items
- 19. Sprinkler heads are not blocked
- 20. Lab equipment is use according to manufacturers directions

Fume hoods

- 21. Fume hoods have current stickers indicating sufficient airflow
- 22. Airfoils and slots are free of obstructions
- 23. Fume hoods have a flow-indicating device
- 24. Sashes are lowered to appropriate height per the sticker
- 25. Storage of chemicals and equipment is kept to a minimum



Chemical Hygiene Plan Annual Laboratory Inspection

Chemical use and storage

- 26. Notification given to HMM & EHS on purchases of materials on Chemical Control List
- 27. Containers sealed, labeled, dated, and segregated by chemical compatibility
- 28. Liquid chemicals are stored below eye level
- 29. No containers are stacked
- 30. Acutely toxic, carcinogenic, and reproductive hazard materials are identified and posted
- 31. Flammables are stored in approved flammable storage cabinets with sealed vents

Gas cylinders

- 32. Gas cylinders stored in enclosures are vented
- 33. Contents of cylinders are clearly labeled
- 34. Gas cylinders stored vertically, properly secured and capped when not in use.

Electrical

- 35. Electrical cords are in good condition (no frayed or damaged insulation)
- 36. Circuit breaker panel unobstructed and properly sealed
- 37. Ground Fault Circuit Interrupters (GFCI) are used near sinks and wet areas
- 38. Lab appliances are plugged directly into electrical outlets (UL rated power surge protectors may be used when there is a lack of electrical outlets but extension cords can't be used as a permanent power supply).

Work practices / Training

- 39. Personnel are knowledgeable of associated work hazards; documentation indicates that personnel have read and understand the CHP, SOPs, and emergency procedures
- 40. Personnel handle chemicals and job tasks in accordance the SOP
- 41. Job tasks are performed using sound ergonomic principles
- 42. Chemicals are transported using a bottle carrier, cart or other secondary container
- 43. Personnel are aware of the proper emergency procedures applicable to their work
- 44. Personnel are wearing the proper PPE per the Hazard Assessment
- 45. Personnel are current on training; training records maintained

Hazardous Waste Collection, Storage, & Disposal

- 46. Outdated and unused chemicals are disposed properly
- 47. Waste containers in good condition and properly capped
- 48. Hazardous waste is properly segregated
- 49. Hazardous waste containers are labeled
- 50. Secondary containment provided for containers ≥ 5 gallons
- 51. Emergency spill procedures in place
- 52. Weekly inspections performed
- 53. Records maintained (waste inspections, removal requests, chemical purchase notification)



Chemical Hygiene Plan

Appendix G OSHA training requirements relevant to laboratory work.

Subject /Standard	Training Frequency	Description
Asbestos 1926.1101	Annual training	Awareness training for workers who may contact asbestos containing materials
Bloodborne Pathogens 1910.1030	Annual training	Persons with occupational exposure
Fire Extinguishers 1910.157	One time	Training to familiarize employees with the fire extinguisher use of and associated hazards.
Fire hazards 1910.38	One time	Training to familiarize each employee those parts of the fire prevention plan which the employee must know to protect the employee in the event of an emergency
Hazard Communication 1910.1200	One time	Training to ensure that chemical hazards in the workplace are evaluated and that this hazard information is transmitted to affected employers
Laboratories 1910.1450	Annual training	Training on the location of hazardous chemicals, the methods to detect the presence and release of hazardous chemicals, specific implemented procedures to protect employees from exposures, such as appropriate work practices, emergency procedures, and ppe use, and on the applicable details of the Chemical Hygiene Plan.
Personal Protective Equipment 1910.132	Annual training	Training on the use of PPE, when PPE is necessary; what type is necessary; how it is to be worn; and what its limitations are, as well as know its proper care, maintenance, useful life, and disposal.
Respiratory Protection 1910.134	Annual training	Training on why the respirator is necessary and its proper use and maintenance, the limitations and capabilities of the respirator, how to inspect and store the respirator, how to recognize medical signs and symptoms that may limit or prevent the effective use of respirators.



Chemical Hygiene Plan

Appendix H Flammable Liquid Storage in Laboratories

A. Scope

This document applies to University of Denver laboratories only, but should be used as a guideline for University non-laboratory areas.

B. Definitions

Flammable liquid: those liquids having a flash point below 100 degrees F. and a vapor pressure not to exceed 40 psia at 100 degrees F. All flammable liquids are classified as Class I liquids.

Combustible liquid: Those liquids having a flash point above 100 degrees F. Combustible liquids are subdivided as follows:

- Class II: Liquids with flash points at or above 100 degrees F. and below 140 degrees F.
- Class IIIA: Liquids with flash points at or above 140 degrees F. and below 200 degrees F.
- Class IIIB: Liquids with flash points above 200 degrees F.

C. Need for a Flammable Storage Cabinet

The need for a Flammable Storage Cabinet is driven by the class of flammable or combustible liquid present as well as the total quantity and location of these liquids. The total amount of flammable and combustible liquids allowed shall be in accordance with the amount shown in the applicable table below.

Table 1: Maximum Quantities of Flammable and Combustible Liquids in Non-Sprinklered Labs

Flammable or Combustible Liquid Class	Maximum Quantity per (100 sq. ft.), not stored in a Cabinet	Maximum Quantity per Laboratory, not stored in a Cabinet	Maximum Quantity per (100 sq. ft.), including that stored in a Cabinet	Maximum Quantity per Laboratory, including that stored in a Cabinet
I*	7.5L (2 gal)	284 L (75 gal)	15 L (4 gal)	570 L (150 gal)
I*, II and IIIA	15 L (4 gal)	380 L (100 gal)	30 L (8 gal)	760 L (200 gal)

*This category includes Class I flammable liquids and liquefied flammable gases.



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Table 2: Maximum Quantities of Flammable and Combustible Liquids in Sprinklered Labs

Flammable or Combustible Liquid Class	Maximum Quantity per (100 sq. ft.), not stored in a Cabinet	Maximum Quantity per Laboratory, not stored in a Cabinet	Maximum Quantity per (100 sq. ft.), including that stored in a Cabinet	Maximum Quantity per Laboratory, including that stored in a Cabinet
I*	7.5 L (2 gal)	570 L (150 gal)	15 L (4 gal)	1136 L (300 gal)
I*, II and IIIA	15 L (4 gal)	757 L (200 gal)	30 L (8 gal)	1515 L (400 gal)

*This category includes Class I flammable liquids and liquefied flammable gases.