Metropolitan State University of Denver

Chemical Hygiene Plan

Updated July 2016

and staff. The Chemical Hygiene Plan cannot, and does not, address every possible hazard; **individual school departments are encouraged to create a departmental Chemical Hygiene Plan to address the specific hazards associated within each area.**

This Chemical Hygiene Plan was based on the outline recommended by the Colorado Department of Public Health and Environment (CDPHE) "***Guidelines for the Development of a Chemical Hygiene Plan***" for the development of a Chemical Hygiene Plan for schools.

The following resources were used in the development of the MSU Denver Chemical Hygiene Plan:

1. ***Prudent Practices in the Laboratory***; Copyright 2011 National Academy of Sciences
2. ***Chemical Hygiene Plan***; University of Colorado Denver, August 2008
3. ***Chemical Hygiene Plan***; Massachusetts Institute of Technology, Department of Materials Science and Engineering, Revised November 9, 2006
4. ***Occupational Exposure to hazardous Chemicals in Laboratories***; OSHA 29CFR 1910.1450
5. ***Creating Safety Cultures in Academic Institutions;*** American Chemical Society, ISBN 978-0-8412-2817-7, 2012

MSU Denver Chemical Hygiene Plan Table of Contents

1. General Rules and Procedures

A. Personal Hygiene Guidelines: Establish Procedures to Avoid Unnecessary Exposure to Chemicals by any Route

All chemicals are toxic at some dose level depending upon the route of exposure. It is therefore necessary to minimize exposure to chemicals. Chemicals can have local or systemic effects. Local toxicity refers to the direct action of chemicals at the point of contact. Systemic toxicity occurs when the chemical agent is absorbed into the body and distributed throughout the body via the bloodstream, lungs, lymph, etc. Acute effects are observed shortly after exposure. Chronic effects result from long term exposure or appear after a latency period. If the effect is observed after a single exposure, it is acute poisoning or acute toxicity. If the effect is a result of long term exposure or repeated exposure, it is chronic poisoning.

When a person handles a potentially hazardous material, he or she must understand how this substance can enter the body. Proper precautions can then be taken to prevent contamination. Toxic substances usually enter the body one of four ways:

1. **Ingestion**

   Most cases of chemical ingestion are explained by poor work habits. Smoking, drinking, or eating in the work area leads to ingestion of hazardous materials. Infrequently or improperly washed hands can contribute to this problem. Eating, drinking, smoking, or applying cosmetics or lip balm is prohibited in all areas where chemicals are handled or stored. Glassware or utensils utilized during laboratory procedures should never be used to prepare or store food and beverages. Food and beverages must not be placed within refrigerators, ice chests, and cold rooms or near other equipment that are used for laboratory operations. Areas where food and drink are permitted shall be clearly marked, and no chemicals, chemical equipment, personal protective equipment (including lab coats or gloves) shall be permitted in these areas.

2. **Skin Absorption**

   One of the most frequent exposures to chemicals is by contact with the skin. Spills and splashes contaminate the skin. A common result of skin contact is localized irritation or burns. However, some chemical materials can be absorbed through the skin and produce systemic poisoning. Skin contact hazards are often associated with caustic or acidic solutions that are highly

corrosive to skin or with petroleum-based products which irritate on repeated contact. Should chemical contamination of the skin occur, the affected area must be flushed for at least 15 minutes with water and any contaminated clothing removed immediately. Symptoms of skin contamination include burning, itching, or discoloration. Medical attention must be sought after any chemical exposure or if any symptoms of exposure occur.

3. **Eyes**

   Few substances are safe or innocuous when in contact with the eye. The eye's sensitivity to chemicals is such that irritation, pain, impairment of vision, or even a loss of vision can result. Chemical contact with the eye can be disastrous. The eye is extremely sensitive to contaminants. Most substances will cause pain and irritation when in contact with the eyes; many will cause burns, loss of vision, or complete blindness. Also, the eye tissue absorbs many chemicals quite rapidly. Any time the eyes are chemically contaminated, they must be flushed a minimum of 15 minutes with water and medical attention sought immediately.

4. **Inhalation**

   The most significant route for toxic chemical exposure is the inhalation of airborne hazardous materials into the respiratory system. Inhalation of toxic vapors, mists, gases, or dust can produce poisoning by absorption through the mucous membranes of the mouth, throat, and lungs and can seriously damage these tissues. Inhaled gases or vapors may pass rapidly into the capillaries of the lungs and be carried into the circulatory system. The degree of injury resulting from inhalation of toxic substances depends on the toxicity of the material, its solubility in tissue fluids, its concentration, and the duration of exposure. Inhalation hazards are most often associated with gases and volatile products such as adhesives, wood finishes or paint thinners. Dust and non-volatile liquids can also be an inhalation hazard. Materials in the form of dusts and particulates can become airborne when transferred from one container to another or by grinding and crushing. Splash created from spills and during vigorous shaking and mixing may also form aerosols. Many of the particulates generated during such procedures do not settle out, but remain suspended in the air and are carried about by air currents in the room. Some of these particulates are capable of being inhaled and deposited in the respiratory tract. In many operations, formation of an aerosol is not always obvious, and personnel may not be aware of the

hazard. Precautions must be considered when working with any chemicals or reagents that may produce gases, vapors, mists, or dust.

5. **Injection**
   Chemicals can be injected into the body via syringes, needles, pipets, etc. Use caution when working with needles or other sharp instruments which could puncture the skin. Proper personal protective equipment can reduce the risks of injection. Use caution around scientific instrumentation such as auto-samplers which could cause injection type injuries.

Procedures for avoiding unnecessary exposure to chemicals include:

A. Education about chemical hazards and routes of exposure
B. Using less chemical or reagent
C. Properly using fume hoods
D. Proper Personal Protective Equipment (PPE)
E. Using a different, less toxic, chemical

B. Policy for Choosing Chemicals Appropriate for the Available Ventilation System

All labs and procedures should be reviewed for the possible substitution of less hazardous chemicals or reagents if possible. Water based (aqueous) reagents are usually less volatile than organic or solvent based chemicals or reagents.

The Auraria campus Science Building has ventilation hoods which run on a continuous basis. Fume hoods are also provided in the Art and Boulder Creek buildings, but are controlled manually. The hoods provide negative pressure in the laboratory rooms in relation to the outside corridors and hallways. The hoods should be used for all laboratory experiments and reactions involving the use of volatile, toxic, or irritating chemicals or reagents, with sashes opened only when required for setup and takedown of experiments. None of the MSU Denver hoods have a washdown mode, and chemicals that can potentially lead to a buildup of reactive or explosive chemicals, such as perchloric acid, should be avoided.

When working with infectious biological materials a biological cabinet or hood must be used. Do not work with biological or infectious materials in chemical fumes hoods, as these may not provide proper levels of protection.

C. Policy Regarding Eating, Drinking, and Smoking

Eating, drinking, or smoking is prohibited in all MSU Denver laboratories, shops, and studios. Do not apply makeup or lip balm while in the laboratories. Wash

hands and face thoroughly after all labs and shops. Food and drink must not be stored in refrigerators designated for chemical storage.

D. Procedures for Safe Use and Handling of Glassware

Use appropriate eye protection when working with glassware. Pyrex or other heat-treated glassware should be used. Handle and store glassware with care to avoid damage. Do not use damaged glassware. Do not reuse glass containers of unknown or questionable origin. Broken glass should be disposed of in designated broken glassware containers. If possible, rinse chemicals and/or residues from broken glassware before disposal.

E. Policies on Laboratory Conduct

Practical jokes or horseplay which might confuse, startle, or distract another student or worker will not be tolerated. The use of radios, tape players, earphones, or other devices which may interfere with communication are not allowed.

F. Policy Regarding Personal Apparel in the Lab, Studios, and Shops

Confine long hair and loose clothing. Shorts are not appropriate due to the potential for chemical exposure to the skin. Wear shoes at all times in the laboratory. Shorts and shoes that expose any part of the foot (i.e., sandals, open toe shoes, etc.) are not appropriate due to the potential for chemical exposure to the skin. Some types of synthetic clothing are flammable and should be avoided. Coats, jackets, etc. should be hung in designated areas. Backpacks, purses, clothes, and all other items should be kept out of work areas and walkways that could pose a tripping hazard.

G. Personal Protective Equipment (PPE) Requirements. Eyes, Gloves, Lab Coats, etc.

Eye protection is required in all laboratories, shops, and studios while working with chemicals or hazardous materials. Assure that all persons, including visitors, wear appropriate eye protection. Avoid the use of contact lenses in the laboratory. If contact lenses are required to perform work safely, notify the laboratory supervisor for extra precautionary procedures.

Gloves should be worn during all handling of chemical containers and during chemical manipulations. Ensure that the gloves used provide protection from the chemicals being used. (see Section 4.A) Do NOT wear gloves into hallways or outside of lab areas to prevent the possible spread of contamination.

Lab coats should be worn for extra protection from chemicals used and are present in the laboratories. These coats should be made of a heavy cotton material. Lab coats made from synthetic fibers or non-natural fibers are not recommended due to their tenancy to chemically melt.

Respirators should only be worn in extreme cases, and by personnel trained in there fitting and use.

H. Procedure for Unattended Operations

Leave hood lights on. Place an appropriate sign on the door or hood sash, and provide for containment in the event of failure of a utility service (such as cooling water or electricity) to an unattended operation. Provide unattended operations with automatic controls to prevent accidents, fires, or explosions. Notify the professor or instructor in charge of the laboratory.

I. Procedures for Hood Use

Use fume hoods for operations that may results in the release of toxic chemical vapors, dust, or aerosols. Use a hood or other local ventilation device when working with any appreciably volatile substance with a Threshold Limit Value (TLV) of less than 50 ppm.

Confirm adequate hood performance before use. Keep the hood sash closed at all times except when adjustments within the hood are being made. Keep materials in the hood to a minimum and do not allow them to block vents or air flow.

When working with infectious biological materials a biological cabinet or hood must be used. Do not work with biological or infectious materials in chemical fumes hoods, as these may not provide proper levels of protection.

AHEC performs annual inspections for face velocity and alarm function. If a hood fails or malfunctions, close the sash and contact AHEC EH&S at 303.556.8397 immediately. Remove or contain any hazardous conditions if possible, and place a warning sign on the hood. Notify the instructor or supervisor.

J. Waste Disposal Procedures

Wastes generated in the MSU Denver laboratories, shops, and studios can be divided into six categories:

1. Solid Waste

This is ordinary trash which should be disposed of in trash cans or waste baskets. Do not put trash in glass disposal containers, hazardous waste, sharps, or flammables containers, or recycle bins. Segregate recyclables into recycle bins.

2. **Broken Glass**

   Broken laboratory glassware, test tubes, containers, etc. should be disposed of in specially marked Broken Glass Containers found in most labs. If possible, rinse any chemicals or residues off of the glassware before placing in the containers. Do not place trash, or any other wastes, in the broken glass containers.

3. **Sharps**

   Sharps containers are for the disposal of needles, syringes, and other sharp medical or laboratory wastes. Consult individual department rules for specific requirements and uses of the Sharps containers. Do not place trash, or any other wastes, in the Sharps containers.

4. **Biological Wastes**

   Biological Waste containers are provided by the Biology, Chemistry, and other departments for the disposal of biological materials. This includes cultures, tissues, slides, test tubes, specimens, etc. Check with departmental supervisors or instructors for the specific requirements of each laboratory. Do not place trash, or any other wastes, in the Bio Waste containers.

5. **Flammables**

   Materials which are, or have been contaminated with, flammable materials or solvents must be disposed of in proper Flammables containers. Check with departmental supervisors or instructors for the specific requirements of each laboratory, shop, or studio. Do not place trash, or any other wastes, in the Flammables containers.

6. **Hazardous Waste**

   Hazardous Wastes are solid or liquid wastes that contain chemicals or compounds determined by the US EPA to be hazardous to the environment. The EPA defines hazardous wastes as either "Listed" wastes, those chemicals which are listed on the EPA D, F, K, P, or U list (http://www.epa.gov/osw/hazard/wastetypes/listed.htm), or Characteristic Wastes which are hazardous wastes due to characteristics such as ignitability, corrosivity, reactivity, or toxicity (http://www.epa.gov/osw/hazard/wastetypes/characteristic.htm). Special disposal procedures are required for each type of hazardous waste. Specific hazardous waste disposal instructions can be found in Section 6.F.

The MSU Denver Environmental Protection Department (303.556.5040) is available to provide technical guidance, assistance, and information.

It is a violation of Federal law (RCRA) to dispose of USEPA hazardous wastes improperly by pouring down a drain, into the trash, or onto the ground.

K. Policy for Working Alone

Working alone with chemicals or reagents in MSU Denver laboratories, shops, or studios is not recommended.

Students, interns, or work-study students are never to work alone when working with explosive, highly reactive, volatile toxic, toxic aerosols, or acutely toxic chemicals. All students must be supervised by full-time and/or affiliate faculty, and/or staff when working in MSU's science laboratories, shops, or studios when performing a hazardous procedure. The faculty member directing the student's activities must be in the laboratory, shop, or studio ready to quickly react to any unforeseen accident to ensure student safety. Students must notify their supervisor, instructor, or laboratory/shop staff before working with hazardous chemicals and let them know when work has been completed.

Individual Departments may implement more specific procedures and safety rules for working alone depending on needs or circumstances as deemed necessary by the department chairperson or staff for particular chemicals or processes.

L. Housekeeping Rules

Keep work areas clean and uncluttered, with chemicals and equipment properly labeled and stored. Clean work areas upon completion of an operation, and at the end of each day. Keep hallways, isles and access to emergency equipment clear. Do not store chemicals, reagents, or hazardous wastes on the floor or in fume hoods unless specifically designated for storage.

2. Spill and Accident Procedures

A. Written Spill Response Policy

Remember: A one gallon spill can cover an area of 20 square feet or more.

In the event of a spill of hazardous chemicals in a laboratory:

1. Notify persons in the immediate area about the spill.

2. Evacuate all nonessential personnel (those persons not involved in the spill cleanup) from the spill area.
3. Determine, if possible, the chemical spilled, the toxicity, and estimated quantity.
4. If the spilled material is flammable, turn off ignition and heat sources.
5. If spill control / cleanup are beyond the capabilities of the responding personnel, activate the fire alarm and/or call Auraria Police at 303.556.5000.
   If you call 911 on a cell phone, Denver Dispatch will answer. Be prepared to give Denver Dispatch you name, location on campus, and the type of spill / emergency. Emergency phones are located in many campus hallways and common areas. Emergency phones are the best way to notify campus police of an emergency.
6. Attend to any person(s) who have been contaminated or injured and give first aid, if necessary and appropriate.
7. Persons with chemicals on their skin or eyes should immediately be assisted in using an emergency shower of eye wash (for a period of 15 minutes). Remove contaminated clothing immediately.
8. Escort exposed/injured persons to emergency facilities or personnel.
9. Notify MSU Denver EH&S at 303.913.5555 and/or AHEC EH&S at 303.358.2006.
10. Individuals working directly with the spill shall don all appropriate personal protective equipment (eye protection, gloves, coveralls, etc.)
11. Confine or contain the spill. Do not let it spread. Work the spill from outside edges toward the center.
12. Use designated spill kits including spill containment materials such as vermiculite, sand, spill pads, or spill pillows. For inorganic acids or bases, use a neutralizing agent or absorbent mixture.
13. Sweep up absorbent materials or remove pads / pillows and place them in clearly marked leak proof bags or other containers. Contact MSU Denver EH&S at 303.913.5555 or AHEC EH&S at 303.556.8397 for proper disposal.

B. Procedure For Alerting People Within the Building

Fire Alarm Pulls and Emergency Call Phones are located in campus hallways and common areas. Use the pulls and call phones to signal an emergency situation. Verbally notify persons within the emergency area.

3. Chemical Procurement, Distribution, and Storage Procedures

A. Plan for Keeping Current Inventory Updated

MSU Denver utilizes the ChemSW/CisPro inventory system to track chemical inventories in the laboratories. All newly received chemicals must be bar-coded and logged into the inventory system. Chemical containers sizes/amounts are tracked by the system for inventory and Fire Department requirements. The status of all chemicals should be updated in the system when moved from one location to another within departments, and when used up or disposed of. The AHEC EH&S department currently manages the inventory system and can provide system access and training at 303.556.8397. See Appendix A for the CisPro instruction reference guide.

B. Current Inventory of all Chemicals, Including Amounts and Locations

Chemical and reagent inventories are tracked by the CisPro chemical inventory system. All chemicals shall be kept in bar-coded cabinets or shelves identifying their room and exact location. As chemicals and reagents are used or consumed, the inventory system should be updated. The AHEC EH&S department conducts regular chemical inventories and updates to the CisPro system.

C. Schedule for Annual Examination of Chemical Stores, Replacement, Deterioration

Chemical stocks should be used on a rotating basis with the oldest chemicals being used first. Particular attention should be given to chemicals that can form peroxides. See Appendix B for a list of peroxide forming chemicals. Peroxide forming chemicals should be ordered in the smallest quantities needed, and discarded within one year if not used. MSU Denver EH&S performs testing of peroxide forming chemicals on an annual basis. Chemical stocks should be monitored for any signs of deterioration. Any old, unused, or unwanted chemicals can be turned in to MSU Denver EH&S by calling 303.556.5040.

D. Procedures for Labeling Compounded Chemicals

When preparing compounded chemicals or dilutions of chemicals, the following information shall be on the container:

1. **Contents**
2. **Date**
3. **Concentration**
4. **Hazard info**
5. **Name of responsible person**

E. Personnel Responsible for Ordering Chemicals and Accepting Shipments

Each MSU Denver Department is responsible for ordering needed chemicals and reagents. A single point-of-contact within each department should be responsible for the ordering and acceptance of chemicals and reagents. Chemicals should be bar-coded and entered into the CisPro chemical inventory system immediately upon being received.

Careful consideration should be given as to the types, and amounts, of chemicals ordered. Information on proper handling, storage, and disposal should be known before ordering a chemical or reagent. Consider the following when ordering chemicals:

1. Is it toxic? Is it safe to use?
2. Can I substitute another less toxic or less reactive chemical for it?
3. How much do I need? Buying a large quantity might result in a lower unit cost, but disposing of unused chemicals might offset any savings.
4. How difficult, or expensive, will it be to dispose of unused or left over chemicals?
5. Does the chemical degrade or form dangerous peroxides over time?
6. Does the use or bi-product of this chemical or reagent result in a waste which is difficult or expensive to dispose of?

F. Procedure for Labeling Chemicals with Purchase Date

Each container of new chemicals shall be labeled with the receiving person initials and the date. A CisPro bar code (available from AHEC EH&S) is required and the chemical must be entered into the CisPro chemical inventory tracking system. See Section 2B above.

G. Guidance for Storing in Chemically Compatible Families

Chemicals which are flammable or corrosive should be stored in approved Flammables and Corrosives cabinets. When storing chemicals, follow the basic **incompatibility** guidelines:

1. Acidic and Alkaline
2. Spontaneously Combustible and Acidic
3. Acidic and Flammable
4. Acid and Cyanide
5. Acidic and reactive Sulfides
6. Oxidizers and Organics
7. Nitrates and Acids
8. Ammoniated compounds and Hypochlorites and Bleach
9. Organic Nitrates/Perchlorates and other Oxidizers or Metals
10. Azides and Metals, Metal salts, Acids, Strong Oxidizers, or Metals

11. Perchloric Acid and Metals, Metal salts, Charcoal, Ethers, Organics, Combustibles, Acids

See Appendix C for the Chemical Compatibility Chart

H. Procedures for Labeling Storage Shelves and Cabinets

Labels are the primary source of information concerning the hazardous associated with chemicals found in the laboratories. Shelves and cabinets should be labeled with a signal word – DANGER, WARNING, or CAUTION. Other labeling should include FLAMMABLES or CORROSIVES. Shelves and cabinets should also be labeled with a CisPro bar code label to aid in the location of chemical containers.

I. Identified Personnel who are Authorized to be in Chemical Storage Areas

It is the responsibility of the Department Chair or area supervisor to provide authorization to Chemical Storage areas. Access to the storage areas will be granted thru the AHEC Access Control Department upon receiving written notification from the department chair or supervisor. Keys and/or fobs will be issued to **individuals**, and should not be shared or loaned out. For work-study or temporary workers, the access list should be reviewed and updated at the beginning of each semester. Note: The Science building Chemical Stockroom, SI1085, is under 24-hour video surveillance.

J. Compressed Gas Storage and Handling Procedures

Compressed gasses can be dangerous if improperly handled, used, or stored. Minimize the amounts of gasses stored in laboratories and follow the listed procedures:

1. **Protecting the cylinder valve stem**
   The cylinder valve stem should be covered with the protective cap at all times the cylinder is not in use.
2. **Storage away from heat and direct sunlight**
   Store cylinders away from any heat source such as heating vents, radiators, hot plates, burners, etc. Do not store cylinders in direct sunlight.
3. **Methods for securing gas cylinders in place**
   Safety chains or straps, or a gas cylinder rack, must be used to secure gas cylinders at all times.
4. **Moving gas cylinders**
   Do not move any cylinder which does not have a safety cap in place over the valve stem. Use a cylinder dolly to move gas cylinders.
5. **Grease or Oil**
   Never use grease or oil on any compressed gas regulators or connectors.

K. Flammable Chemicals Handling Procedures

Store flammable chemicals only in designated Flammables cabinets. Do not store flammable chemicals with acids, oxidizers, or reactive chemicals. Move containers of flammable chemicals with a cart, bucket, or other secondary container.

L. Storage Away from Sources of Ignition, including Direct Sunlight

Store all chemicals and reagents away from any source of heat, including heating vents or ducts, hot plates, burners, flames, or direct sunlight.

M. Provision of Explosion-Proof Refrigerator

Extremely volatile, reactive, or explosive chemicals may require storage in explosion-proof refrigerators. Check with the chemical manufacturer and/or MSDS for storage specifications. Do NOT store volatile chemicals in standard refrigerators.

4. Personal Protective Equipment

A. Evaluation of All Hazardous Materials to Assess Protective Equipment Needs

The Occupational Safety and Health administration (OSHA) provides a basis for Personal Protective Equipment (PPE). The OSHA PPE standard, 29 CFR 1910.132, can be found online: http://www.osha.gov/pls/oshaweb/owadisp.show_document?p_table=STANDARDS&p_id=9777

Hazards likely to be encountered in the MSU Denver laboratories, shops, and studios include impact, heat, chemicals, dust, and optical radiation.

PPE selection should follow the minimum requirements for all protective devices:

1. Provide adequate protection against the particular hazard for which they are designed.
2. Be of a safe design and construction for the work or task to be performed.
3. Be reasonably comfortable when worn under the designated conditions.
4. Fit snugly and not unduly interfere with the movements of the wearer.
5. Be durable.
6. Be capable of being disinfected (or be disposable).

1. **Eye Protection**:
   A large percentage of eye injuries are caused by direct contact with chemicals- **Wear Your Safety Glasses**! Injuries often result from an inappropriate choice of PPE that allows the substance to enter from around or under protective eye equipment. Serious and irreversible damage can occur when chemicals substances contact the eyes in the form of splash, mists, vapors, or fumes. Properly sized safety glasses offer some protection, but correctly fitted and worn goggles provide an increased level of protection. Face shields are secondary protectors intended to protect the entire face against exposure.
   It is important the persons working with or around chemicals know the location of emergency eyewash stations and how to access them with restricted vision.

2. **Gloves and Hand Protection**:
   A wide range of chemicals and reagents are used in the MSU Denver laboratories, shops, and studios. No one type of glove can provide adequate protection against all chemicals. It is important to choose the proper type of glove for the task. Consult manufacturer guidelines for specific chemical protection.

Glove Selection Guide

Properties	**Latex**	**Nitrile**	**Vinyl**	**Leather**
Barrier against viral transmission	***	**	*	*
Tear resistance	**	**	*	***
Puncture resistance	*	**	*	***
Tensile strength and elasticity	***	**	*	***
Comfort and finger dexterity	***	**	*	*
Tactile sensitivity for better feel	***	**	*	*
Resistance to oil and solvents	*	***	**	*
Resistance to chemicals	*	***	*	*
Food contact safety	***	***	***	*
Abrasion protection	*	*	*	***
Biodegradable	***	*	*	*
Price	**	*	***	*

Indicator: Fair * Good ** Excellent ***

3. **Body Protection**:
   Sandals or open-toe shoes should not be worn in the laboratories. Shorts or skirts should not be worn in the laboratories. Synthetic fibers provide better

chemical protection than natural fibers such as cotton. Use other protective apparel as appropriate including smocks, aprons, Tyvex suits, etc; preferably made of chemically inert materials. Consult manufacture recommendations for guidance.

B. Schedule and Procedure for Testing Safety Equipment

Safety equipment such as eyewash stations, safety showers, fire extinguishers, etc. shall be tested and inspected on a regular basis. The Auraria Higher Education Center (AHEC) is responsible for the testing of MSU Denver eyewash stations, safety showers, and fire extinguishers. AHEC EH&S (303.556.8397) conducts all testing of campus safety equipment; contact AHEC with any faulty or defective safety equipment.

5. Information and Training Program

A. Content and Location of Chemical Hygiene Plan

The MSU Denver Chemical Hygiene Plan (CHP) was developed as a general campus-wide guidance document. The CHP is a living document meant to be reviewed and updated as needed or required. Specific issues and needs of individual departments and offices may not be addressed within the CHP, and should be further evaluated and documented as necessary by department Chairpersons, faculty, and staff. The CHP is maintained by the MSU Denver Environmental Protection Office, 303.556.5040, and both hard and electronic copies are available upon request.

B. Potential Hazards Involved With Using Chemicals

Each laboratory, shop, or studio shall follow general practices to minimize exposure to chemicals. Before laboratory work begins, persons need to be familiar with all potential hazards (chemical, physical, biological) associated with the task. Appropriate precautions should be taken to minimize risks and the proper personal protective equipment should be used when necessary.

All chemicals are toxic at some dose level depending upon the route of exposure. It is therefore necessary to minimize exposure to chemicals. Chemicals can have local or systemic effects. Local toxicity refers to the direct action of chemicals at the point of contact. Systemic toxicity occurs when the chemical agent is absorbed into the body and distributed throughout the body via the bloodstream, lungs, lymph, etc. Acute effects are observed shortly after exposure. Chronic effects result from long exposure or appear after a latency period. If the effect is observed after a single exposure, it is called acute poisoning or acute toxicity. If the effect is a result of long term exposure or repeated exposure, it is called chronic poisoning.

When a person handles a potentially hazardous material, he or she must understand how this substance can enter the body. Proper precautions can then be taken to prevent contamination. Toxic substances usually enter the body one of four routes:

1. **Ingestion**

   Most cases of chemical ingestion are explained by poor work habits, smoking, drinking, or eating in the work area leads to ingestion of hazardous materials. Infrequently or improperly washed hands can contribute to this problem. Eating, chewing gum, drinking, smoking, or applying cosmetics or lip balm and prohibited in all areas where chemicals are handled or stored. Glassware or utensils utilized during laboratory procedures should never be used to prepare or store food and beverages. Food and beverages must not be placed within refrigerators, ice chests, and cold rooms or near other equipment that are used for laboratory operations. Areas where food and drink are permitted shall be clearly marked, and no chemicals, chemical equipment, personal protective equipment (including lab coats) shall be permitted in these areas.

2. **Skin Absorption**

   One of the most frequent exposures to chemicals is by contact with the skin. Spills and splashes contaminate the skin. A common result of skin contact is localized irritation or burns. However, some chemical materials can be absorbed through the skin and produce systemic poisoning. Skin contact hazards are often associated with caustic or acidic cleansers that are highly corrosive to skin or with petroleum-based products which irritate on repeated contact. Should chemical contamination of the skin occur, the affected area must be flushed for at least 15 minutes with water and any contaminated clothing removed. Symptoms of skin contamination include buring, ithching, or discoloration. Medical attention must be sought after any chemical exposure or if any symptoms of exposure occur.

3. **Eyes**

   Few substances are safe or innocuous when in contact with the eye. The eye's sensitivity to chemicals is such that irritation, pain, impairment of vision, or even a loss of vision can result. Chemical contact with the eye can be disastrous. The eye is extremely sensitive to contaminants. Most substances will cause pain and irritation when in contact with the eyes; many will cause burns, loss of vision, or complete blindness. Also, the eye tissue absorbs many chemicals quite rapidly. Any time the eyes are chemically contaminated, they must be flushed a minimum of 15 minutes with water and medical attention sought immediately.

4. Inhalation

The most significant route for toxic chemical exposure is the inhalation of airborne hazardous materials into the respiratory system. Inhalation of toxic vapors, mists, gases, or dust can produce poisoning by absorption through the mucous membranes of the mouth, throat, and lungs and can seriously damage these tissues. Inhaled gases or vapors may pass rapidly into the capillaries of the lungs and be carried into the circulatory system. The degree of injury resulting from inhalation of toxic substances depends on the toxicity of the material, its solubility in tissue fluids, its concentration, and the duration of exposure. Inhalation hazards are most often associated with gases and volatile products such as adhesives, wood finishes or paint thinners. Dust and non-volatile liquids can also be an inhalation hazard. Materials in the form of dusts and particulates can become airborne when transferred from one container to another or by grinding and crushing. Splash created from spills and during vigorous shaking and mixing may also form aerosols. Many of the particulates generated during such procedures do not settle out, but remain suspended in the air and are carried about by air currents in the room. Some of these particulates are capable of being inhaled and deposited in the respiratory tract. In many operations, formation of an aerosol is not always obvious, and personnel may not be aware of the hazard.

5. Injection

Chemicals can be injected into the body via syringes, needles, pipets, etc. Use caution when working with needles or other sharp instruments which could puncture the skin. Proper personal protective equipment can reduce the risks of injection. Use caution around scientific instrumentation such as auto-samplers which could cause injection type injuries.

C. Signs and Symptoms of Overexposure to Chemicals

The symptoms of overexposure to a chemical will be listed on the substance's Material Safety Data Sheet, MSDS. Common signs and symptoms of exposure to chemicals include:

1. Skin rashes or dermatitis
2. Irritation to the eyes, nose, throat, upper respiratory tract, or skin
3. Burns to the eyes or skin
4. Fatigue, dizziness, headaches, lightheadedness, loss of coordination, insomnia, muscle or joint pain
5. Persistent cough, wheezing, tightness of the chest, chest pain, difficulty breathing, shortness of breath
6. Nausea, vomiting, abdominal pain

If you are experiencing any of these symptoms, or symptoms listed on the materials MSDS sheet, stop work immediately and inform your supervisor and seek medical attention if necessary.

D. Locations and Availability of MSDS: Material Safety Data Sheet

Material Safety Data Sheets (MSDS) provide safe storage and chemical use information. They must be available for employees use in the laboratory or other work areas. Material Safety Data Sheets are provided by manufacturers, vendors or distributors of chemical products following initial purchase or change in the chemical product.

A central location of all MSU Denver campus MSDS sheets is not maintained. It is the responsibility of the individual departments, labs, shops, and studios to maintain an updated MSDS inventory. An alternative to maintaining a hard-copy set of MSDS sheets is the use of an on-line source.

Current MSDS sheets are available on-line at the follow sites:

http://hazard.com/msds/

http://www.ehso.com/msds.php

E. Proper Use and Location of All Safety Equipment

All personnel should read and understand the Material Safety Data Sheets and labels for the chemicals present in their work areas.

1. Eye Washes

Emergency eyewash fountains are located in Science Building laboratories, and in many Art and Shop studios. For chemical splashes, at least a 15-minute flush is recommended. Check for and remove contact lenses immediately, but do not delay irrigation of the eye if contact lens removal is not possible. After flushing, the injured person must be given prompt medical attention, regardless of the severity of the injury.

AHEC EH&S is responsible for the maintenance and periodic inspections of all campus eye wash stations; contact AHEC EH&S at 303.556.8397 to report issues or problems with eyewash stations.

2. Safety Shower

Emergency Safety Showers are located in Science Building laboratories, and in many Art and Shop studios. For chemical splashes, at least a 15-minute flush is recommended. The immediate removal of clothing is highly recommended. After flushing, the injured person must be given prompt medical attention, regardless of the severity of the injury. AHEC EH&S is responsible for the

maintenance and periodic inspections of all campus safety showers; contact AHEC EH&S at 303.556.8397 to report issues or problems with safety showers.

3. Fire Extinguishers

Fire extinguishers are accessible to each lab, shop and studio area. Fire extinguishers are also located in campus building hallways.

Use the **P.A.S.S.** system for fire extinguisher use:

P: Pull the pin. This will unlock the safety system, allowing the fire extinguisher to be used

A: Aim at the base of the fire, not the flames.

S: Squeeze the level slowly, releasing the extinguishing agent.

S: Sweep from side to side; move the fire extinguisher from side until the fire is out.

When a fire extinguisher is discharged to extinguish a fire, the Fire Department must be called. The Fire Department will confirm that the fire is completely out, and that it will not rekindle.

Fire extinguisher recharging, maintenance, and periodic inspections are performed by AHEC EH&S, 303.556.8397.

4. Spill Response Materials

Chemical/Hazardous Waste Spill response kits are located in Science rooms SI1004A, SI1085, SI2098, and SI3091A; ART rooms AR168 and AR198, and Student Success Building room SSB302. Call MSU Denver Environmental at 303.913.5555 or AHEC EH&S at 303.358.2006 for assistance with small spills, or Auraria Police at 303.556.5000 for large or hazardous spills. Auraria Police will contact the Denver Fire Department as needed. Please note: Dialing 911 on cell phones on the Auraria campus will connect directly to Denver Dispatch. Be prepared to give Denver Dispatch your name, **exact location** on campus, and the type of spill or emergency. Spill response training is available from MSU Denver Environmental at 303.556.5040.

6. Procedure-Specific Safety Rules and Guidelines

A. Identification of Chemicals that Require Use of Fume Hoods

Fume hoods serve to control toxic, corrosive, offensive, or flammable vapors. The laboratory fume hood is the primary protective device available. It is designed to capture chemicals that escape or are produced during laboratory procedures and experiments and to remove them from the laboratory environment before they can be inhaled.

In determining whether a fume hood is necessary for a particular operation, the following chemical characteristics should be considered: physical state (solid, gas, liquid), volatility, toxicity, flammability, extent of potential eye and skin irritation, odor, and the potential for producing aerosols.

Procedures that can generally be performed safely outside of the fume hood include:

a. Water-based solutions of salts, very dilute acids & bases
b. Very low volatility liquids or solids
c. Closed systems that do not allow significant escape to the laboratory environment

B. Requirement to Use a Fume Hood for All Carcinogens, Mutagens, Teratogens, Allergens, and Toxic, Corrosive, Flammable, and Noxious Chemicals

Chemicals that are known or suspected carcinogens, mutagens, teratogens, allergens, as well as toxic, corrosive, flammable and noxious chemicals should be used only in fume hoods. Do not use these chemicals for experiments or processes that are not performed in working fume hoods.

C. Flammable Solids and Safety Precautions

A flammable solid is a solid, other than an explosive or blasting agent, that can ignite thru (1) friction, (2) absorption of moisture, (3) spontaneous chemical change, or (4) which can be ignited easily and, when ignited, burns so vigorously or persistent as to create a serious fire hazard. Flammable and combustible liquids are to be stored in approved containers. Additionally, the flammable and combustible storage containers should be constructed according to specifications outlined by OSHA, DOT, and the National Fire Protection Agency (NFPA). All storage containers, cabinets, and rooms should have warning labels identifying the flammability hazard. Work activities that could potentially create sparks should be prohibited in these storage areas.

D. Storage Methods for Water-Reactive Solids

In the presence of water, water-reactive chemicals can generate heat and flammable gases (hydrogen or acetylene). Examples of water-reactive chemicals include: alkali metals (sodium, potassium, lithium), metal hydrides, aluminum alkyls, acid anhydrides, and acid chlorides.

General safe storage and handling practices for water-reactive chemicals are listed below. Consult the Material Safety Data Sheets for specific chemicals for additional precautions and specific guidance.

• Purchase and store minimal quantities of water-reactive chemicals.
• Segregate from all other chemical classes.
• Store in a desiccated atmosphere in a protected location. Examples for storing include inside desiccators or sealed secondary containers containing desiccant (i.e. well-sealed "paint" type shipping containers, screw-top bottles, etc.). Desiccants must contain indicators so that the drying quality of the desiccant can be determined.
• Storage areas must be protected from contact with water. Cabinets under sinks or fume hoods supplied with water are not acceptable.
• If appropriate for the specific water-reactive chemical of interest, purchase and store under oil (i.e., mineral oil). Follow the manufacturer's guidelines.

E. Procedures for Handling Dust-Like Materials, Which May Form Explosive Mixtures with the Air

Combustible dusts are fine particles that present an explosion hazard when suspended in air under certain conditions. Follow the manufacturer's MSDS for guidance on proper storage and handling of finely divided chemicals. Minimize dust generation and accumulation. Routine housekeeping should be instituted to ensure that dusts do not accumulate on surfaces. Dry powders can build static electricity charges when subjected to the friction of transfer and mixing operations. Provide adequate precautions, such as electrical grounding and bonding, or inert atmospheres for large or extended processes.

F. Disposal Requirements For Chemical Waste, Outdated Chemicals, and/or Chemicals That Have Degraded

When a chemical, reagent, or mixture thereof, has no further use and has been declared excess or a waste by the user, it must be clearly labeled as a waste. The responsibility for the identification and handling of chemical waste within MSU Denver rests with the individuals who have created the waste. It is a violation of Federal law (RCRA) to dispose of USEPA hazardous wastes improperly by pouring down a drain, into the trash, or onto the ground. The MSU Denver Environmental Protection Department (303.556.5040) is available to provide technical guidance, assistance, and information.

All persons handling, generating, working with, or otherwise involved with hazardous wastes are REQUIRED by the Colorado Department of Public Health and Environment (CDPHE) to have specialized hazardous waste training. Hazardous waste training is available thru the MSU Denver Environmental Department at 303.556.5040.

Under the provisions of the Resource Conservation and Recovery Act of 1976 (RCRA), Metropolitan State University of Denver is licensed by the USEPA (ID# COR000227694) as a Small Quantity Generator (SQG) of Hazardous Waste. An SQG produces between 100kg and 1000kg of hazardous waste per month. The USEPA has listed several hundred substances as hazardous wastes. (http://www.epa.gov/waste/hazard/wastetypes/listed.htm)

In addition, any substance possessing one or more of the following **characteristics** is also an USEPA Hazardous Waste: Ignitability, Corrosivity, Reactivity, and Toxicity.

1. **Ignitability**
   (EPA Code D001)
   - **a.** Liquids with a flashpoint below 60° C (140° F); most organic solvents such as methanol, ethanol, acetone, and xylene.
   - **b.** Solids capable of causing a fire by friction, absorption of moisture, or spontaneous chemical change and when ignited burn vigorously and persistently to create a hazard (e.g. picric acid)
   - **c.** Flammable, compressed gasses (e.g. hydrogen, methane)
   - **d.** Oxidizers (e.g. potassium permanganate)

2. **Corrosivity**
   (EPA Code D002)
   - **a.** Aqueous solutions with a pH of less than 2 or greater than 12.
   - **b.** Liquids capable or corroding steel at a specific rate.

3. **Reactivity**
   (EPA Code D003)
   - **a.** Substances that react with water and may produce flammable and/or toxic gasses (e.g. sodium, potassium)
   - **b.** Substances that are normally unstable.
   - **c.** Chemicals containing cyanide or sulfide that generate toxic gasses.
   - **d.** Capable of detonation when exposed to an initiating source or to heat under confinement.

4. **Toxicity**
   (EPA Codes D004-D043)

a. Wastes that contain one or more of the heavy metals antimony, arsenic, barium, cadmium, chromium, lead, mercury, selenium; and/or one or more of 23 organics and 8 pesticides as determined by the Toxicity Characteristic Leaching Procedure (e.g. benzene, 2,4-D)

In order to comply with federal regulations and personnel safety requirements, it is important that "unknowns" not be generated. The generation of such materials can be avoided by labeling ALL containers of chemicals and reaction mixtures.

1. **Chemical / Hazardous Waste Collection**

Chemical wastes should be collected in a container that is compatible with the waste type:

- **a.** Flammable liquids: glass bottles, steel cans, high density plastics
- **b.** Concentrated Acids and Bases: 2.5 liter "acid" bottles, high density plastics
- **c.** Aqueous Solutions: glass or high density plastics
- **d.** Solids: high density plastics or glass

Containers should not be overfilled, with sufficient headspace for expansion due to temperature changes.

Containers must be sealed with a screw-type cap and should only be open when actively adding chemicals.
Once chemical waste has been added to the container, the container must be labeled with a completed green "HAZARDOUS WASTE" label.

Labels are available from MSU Denver environmental at 303.556.5040.

Labels must include:

a. Room/Lab # and Department
b. Contact and phone #
c. Container size and % full
d. Individual constituents list in percentages
e. pH (if applicable)
f. date

When a hazardous waste container is full and ready for pickup; complete the Hazardous Waste Pickup Form (Appendix D) and contact MSU Denver Environmental Department for a pickup. The hazardous waste must be kept in the Hazardous Waste Accumulation Area (fume hoods) and will be picked up within 48 hours.

Old or unused chemicals can be disposed of by calling MSU Denver Environmental at 303.556.5040 for a pickup.

One of the high priority goals of MSU Denver is to reduce the amount of hazardous chemical wastes generated. Benefits of waste reduction include increased safety of personnel, reduced environmental contamination, and decreased operating costs.

7. Exposure Evaluation Procedures

A. How does the school handle suspected overexposure to chemicals

The symptoms of overexposure will vary depending on the product in question. MSDS sheets will provide information on chemical exposure; both short term and long term.

Common symptoms of overexposure include:

- Dizziness or nausea
- Headache
- Skin rashes or burns
- Stomach pain
- Burning eyes or throat
- Difficulty breathing

Persons who encounter these symptoms should seek medical assistance immediately.

It is important that employees know and understand the symptoms of either long term or short term exposure to the chemicals that they work with. This is the only reliable way that employees will be able to report any problems to management for corrective action or medical attention.

Supervisors should ensure that all at-risk employees are trained on the use of any dangerous chemicals that they may be exposed to during the performance of their work.

Supervisors and employees should inspect chemical containers to ensure that the labels are intact and legible.

Managers and supervisors should also be aware of the hazards associated with the chemicals are that used and have contact numbers for medical assistance readily available in case of an overexposure incident.

Supervisors should ensure that all required PPE is worn and in a good working state.

8. Emergency Evacuation Plan

All MSU Denver laboratories, classrooms, shops, studios, and office have an Auraria Campus Emergency Procedures sheet and an Emergency Evacuation Plan posted by the room exit

The Auraria Campus Emergency Procedures sheet outlines general evacuation information as well as specific procedures for Actives Shooter, Bomb Threat, Fire, Earthquakes/Tornados/Severe Weather, Power Outage, Suspicion Person, Suspicious Object, and Campus Closures. See Appendix E.

The Emergency Evacuation Plan provides a detailed map of the building and egress routes out of the building, as well as fire extinguisher and emergency phone locations.

Appendix A

Chemical Inventory Tracking System

CHEMSW/CisPro: Chemical Inventory System

Step by Step instructions

Material: The chemical contents of any size or manufacturer of products. Ideally, there will be only one material listing for each type of chemical, though particular grades (anhydrous) or concentrations can be listed as well.

Ex: acetone, methanol, ethanol

Package: The product number, size(s) that have been previously entered into the system. There can be multiple packages for each material, and multiple sizes for each type of package.

Ex: acetone (Fisher, A18-4 and A18-1; Mallinckrodt M35X-004)

Container: The unique bottles/containers that are delivered to our location which must be individually identified with bar codes.

Ex: 00368 500 mL Acetone, Mallinckrodt M35X-004, CRathbun owner, SI 3115A

Login: https://www.chemswlive.com/

Customer: Auraria (spelling counts)

User: _____

Password: _____

To delete empty container:

Home page: container search. Enter barcode number

If container comes up: click box next to "Disposed container", then Save, OK to confirm.

If container does not come up, try searching for "contains" or "begins with" rather than "exact." Leading zeros for the lower numbers are important.

Material Search:

Enter the chemical name. If not found, try synonyms, dashes, "contains", "begins with" etc. Search by CAS number. If found under an unexpected synonym, add that on the "Material: Viewing" page on the Identity tab (click on "more" under the synonyms section).

If you are convinced that the material does not exist in the system, then add a new material (directions at end of this document).

Once the material is located, then you can receive containers. The Package will either be in the system or not.

To receive a new container (Package exists in system):

Material search; look at list of Search Results (left hand column). Select the one you want, by supplier and catalog number (if present).

(teal colored link, top of page): Receive this material

Confirm the package/supplier/size info (check drop down and add new size if necessary)

RECEIVE (as prompted, enter barcode #, owner, location, SUBMIT)

To receive a new container (Package does not exist in the system)

From the Package listing, Configure Packages (blue link below list)

(teal colored link, top of page) Package/New Package

Search vendors, then select supplier

Enter product #, grade, etc. *fill this in if the same for all sizes*

SAVE

Note that on left side, the new package appears; click on that link

Set up initial size (row 1):

Qty (ex 100)

Unit (ex milliliters)***

Catalog # (ex if catalog number reflects size A18-1 vs A18-4)

Container type (ex glass bottle or jug)

Qty per each (100 milliliters)***

SAVE

If necessary: Add New Sizes

If you know that you will have different sizes of the same package. Follow the same procedure as above.

SAVE

You can proceed to receiving from the link at the bottom of this page; be careful because it will not automatically take you to the package you just entered. Select the package that you want to receive and follow the directions listed above.

To add a new Material:

(from Material Search page)

(teal colored link, top of page): Material/Create a New Material

Material type: Chemical

Material Name: enter name

** be cautious with capital letters, spaces, ( ), +, -, dashes, etc.

Consider adding synonyms to the material listing.

Physical State: Use drop down box

Click the box to "Create Sizes Next"

Add packages as instructed above; receive container as instructed above.

Appendix B

Peroxide Forming Chemicals

Peroxide Formation

Peroxide formation in common laboratory chemicals is caused by an autoxidation reaction. The reaction can be initiated by light, heat, introduction of a contaminant, or the loss of an inhibitor. Some chemicals have inhibitors such as BHT (2,6-di-tert-butyl-4-methyl phenol) hydroquinone and diphenylamine to slow peroxide formation. Most organic peroxide crystals are sensitive to heat, shock, or friction, and their accumulation in laboratory reagents has resulted in numerous explosions. For this reason, it is important to identify and control chemicals that form potentially explosive peroxides.

Peroxide-Forming Compounds

In general, the more volatile the compound, the greater its hazard, since the evaporation of the compound allows the peroxide to concentrate. Peroxide accumulation is a balance between peroxide formation and degradation. Some common compounds that are known to form peroxides are listed in the following table. NOTE: This is not an exhaustive list. Researchers must consult the MSDSs and other sources of information for the chemicals used in their work areas to determine their peroxide-forming potential. Group A are chemicals that spontaneously form peroxides on exposure to air without further concentration or evaporation. These materials should be tested or disposed of within three months of opening (testing is discussed later in this section). Group B lists chemicals that form peroxides only upon concentration by evaporation or distillation. The materials in this list should be tested or disposed of within one year of opening their containers. Group C is a representative list of monomers that form peroxides that may act as a catalyst, resulting in explosive polymerization.

Group A: Chemicals That Form Explosive Levels of Peroxides Without Concentration
(Safe Storage Time After Opening: 3 Months)

Chemical	CAS	Synonyms	State	Reference
Butadiene(1,3)	106-99-0	1,3-Butadiene	G	4
Chloroprene (1,3)	126-99-8	2-Chloro-1,3-butadiene	L	4
Divinyl acetylene	821-08-9	1,5-Hexadien- 3-yne	L	5
Isopropyl ether	108-20-3		L	5
Tetrafluoroethylene	116-14-3		G	4
Vinyl ether	109-93-3	Divinyl ether	L	5
Vinylidene chloride	75-35-4	1,1-Dichloroethylene	L	5

Group B: Chemicals That Form Explosive Levels

of Peroxides on Concentration
(Safe Storage Time After Opening: 12 Months)

Chemical	CAS	Synonyms	State	Reference
Acetal	105-57-7		L	5
Acetaldehyde	75-07-0		L	4
Benzyl alcohol	100-51-6		L	4
2-Butanol	78-92-2		l	4
Cyclohexanol	108-93-0		l	4
Cyclohexene	110-83-8		l	5
2-Cyclohexen-1-ol	822-67-3		l	4
Cyclopentene	142-29-0		l	5
Decahydronaphthalene	91-17-8		l	4
Diacetylene	460-12-8		g	5
Dicyclopentadiene	77-73-6		l	5
Diethylene glycol dimethyl ether	111-96-6	Diglyme	l	5
Dioxane	123-91-1	1,4-Dioxane	l	5
Ethylene glycol dimethyl ether	110-71-4	Glyme	l	5
Ethyl ether	60-29-7	Diethyl ether	l	5
Furan	128-37-0		l	5
4-Heptanol	589-55-9		l	4
2-Hexanol	626-93-7		l	4
Isopropyl benzene	98-82-8	Cumene	l	5
Methyl acetylene	74-99-7	Propyne	g	5
3-Methyl-1-butanol	123-51-3	Isoamyl alcohol	l	4
Methyl cyclopentane	96-37-7		l	5
Methyl isobutyl ketone	108-10-1	Methyl-i-butyl ketone	l	5
4-Methyl-2-pentanol	108-11-2		l	4
2-Pentanol	6032-29-7		l	4
4-Penten-1-ol	821-09-0		l	4

1-Phenylethanol	98-85-1	alpha-Methyl-benzyl alcohol	l	4
2-Phenylethanol	60-12-8	Phenethyl alcohol	l	4
2-Propanol	67-63-0	Isopropanol	l	6, 7
Tetrahydrofuran	109-99-9		l	5
Tetrahydronaphthalene	119-64-2		l	5

Group C: Chemicals That May Autopolymerize

as a Result of Peroxide Accumulation
(Safe Storage Time After Opening:

Inhibited Chemicals, 12 Months;

Uninhibited Chemicals, 24 Hours)

Chemical	CAS	Synonyms	State	Reference
Acrylic acid(2)	79-10-7		l	5
Acrylonitrile(2)	107-13-1		l	5
Butadiene(1,3)	106-99-0		g	5
Buten-3-yne	689-97-4	Vinyl acetylene & Butenyne	g	5
Chloroprene(1,3)	126-99-8	2-Chloro-1,3-butadiene	l	5
Chlorotrifluoroethylene	79-38-9		g	5
Methyl methracrylate(2)	80-62-6		l	5
Styrene	100-42-5		l	5
Tetrafluoroethylene	116-14-3		g	5
Vinyl acetate	108-05-4		l	5
Vinyl chloride	75-01-4	Mono-chloroethylene	g	5
Vinylidene chloride	75-35-4	1,1-Dichloroethylene	l	5
2-Vinyl pyridine	100-69-6		l	5
4-Vinyl pyridine	100-43-6		l	5

Notes

1. When stored as a liquid monomer.
2. Although these form peroxides, no explosions involving these monomers have been reported.
3. Also stored as a gas in gas cylinders.
4. Kelly, R.J., Review of Safety Guidelines for Peroxidizable Organic Chemicals, Chemical Health and Safety, September/October, 1996.
5. National Research Council, Prudent Practices in the Laboratory, Handling and Disposal of Chemicals; National Academy Press; Washington, D.C., 1999.
6. Clark, D.E., Peroxides and Peroxide-Forming Compounds, Chemical Health and Safety, September/October, 2001.
7. This material is peroxidizable but not dangerous unless distilled or concentrated. Testing (see "Peroxide Testing Method") is required only prior to distillation or concentration.

Appendix C

Chemical Storage Compatibility

The following list is not a complete listing of incompatible materials. It contains some of the more common incompatible materials. Always research materials you work with in order to work safely in the lab.

Chemicals listed in Column A should not be stored with or used near items in Column B.

Column A	**Column B**
Acetic acid	Chromic acid, nitric acid, hydroxyl compounds, ethylene glycol, perchloric acid, peroxides, permanganates
Acetic anhydride	Hydroxyl-containing compounds such as ethylene glycol, perchloric acid
Acetone	Concentrated nitric and sulfuric acid mixtures, hydrogen peroxide
Acetylene	Chlorine, bromine, copper, fluorine, silver, mercury
Alkali and alkaline earth metals such as powdered magnesium, sodium, potassium	Water, carbon tetrachloride or other chlorinated hydrocarbons, carbon dioxide, halogens
Ammonia (anhydrous)	Mercury, halogens, calcium hypochlorite, hydrofluoric acid
Ammonium nitrate	Acids, metal powders, flammable liquids, chlorates, nitrites, sulfur, finely divided organic or combustible materials
Aniline	Nitric acid, hydrogen peroxide
Arsenical materials	Any reducing agent
Azides	Acids, heavy metals and their salts, oxidizing agents
Calcium oxide	Water

Carbon, activated	All oxidizing agents, calcium hypochlorite
Carbon tetrachloride	Sodium
Chlorates	Ammonium salts, acids, metal powders, sulfur, finely divided organic or combustible material
Chlorine dioxide	Ammonia, methane, phosphine, hydrogen sulfide
Chromic acid and chromium trioxide	Acetic acid, alcohol, camphor, glycerol, naphthalene, flammable liquids in general
Copper	Acetylene, hydrogen peroxide
Cumene hydroperoxide	Acids (organic or inorganic)
Cyanides	Acids
Flammable liquids	Ammonium nitrate, chromic acid, hydrogen peroxide, nitric acid, sodium peroxide, halogens, other oxidizing agents
Fluorine	All other chemicals
Hydrides	Water
Hydrocarbons (e.g., butane, propane, benzene)	Fluorine, chlorine, bromine, chromic acid, peroxides
Hydrocyanic acid	Nitric acid, alkalis
Hydrofluoric acid (anhydrous)	Ammonia (aqueous or anhydrous)
Hydrogen peroxide	Copper, chromium, iron, most metals or their salts, any flammable liquid (i.e., alcohols, acetone), combustible materials, aniline, nitromethane
Hydrogen sulfide	Fuming nitric acid, oxidizing gases
Hypochlorites	Acids, activated carbon
Iodine	Acetylene, ammonia (aqueous or anhydrous), hydrogen

Mercury	Acetylene, fulminic acid, ammonia
Metal hydrides	Acids, water
Nitrates	Acids
Nitric acid (concentrated)	Acetic acid, acetone, alcohol, aniline, chromic acid, hydrocyanic acid, hydrogen sulfide, flammable liquids, flammable gases, copper, brass, any heavy metals
Nitrites	Acids
Nitroparaffins	Inorganic bases, amines
Oxalic acid	Mercury and silver and their salts
Oxygen	Oils, grease, hydrogen; flammable liquids, solids, or gases
Perchloric acid	Acetic anhydride, alcohol, bismuth, paper, wood, grease, oils
Permanganates	Concentrated sulfuric acid, glycerol, ethylene glycol, benzaldehyde
Peroxides, organic	Acids (organic or mineral), avoid friction, store cold
Phosphorus, white	Air, oxygen, alkalis, reducing agents
Potassium	Carbon tetrachloride, carbon dioxide, water
Potassium chlorate	Sulfuric and other acids, ammonium salts, metal powders, sulfur, finely divided organics, combustibles
Potassium perchlorate (see also chlorates)	Sulfuric and other acids
Potassium permanganate	Glycerol, ethylene glycol, benzaldehyde, sulfuric acid
Silver and silver salts	Acetylene, oxalic acid, tartaric acid, ammonium

	compounds, fulminic acid
Sodium	Carbon tetrachloride, carbon dioxide, other chlorinated hydrocarbons, water
Sodium nitrate	Ammonium nitrate and other ammonium salts
Sodium peroxide	Ethyl or methyl alcohol, glacial acetic acid, acetic anhydride, benzaldehyde, carbon disulfide glycerin, ethylene glycol, ethyl acetate, methyl acetate, furfural
Sulfides	Acids
Sulfuric acid	Chlorates, perchlorates, permanganates

Adapted from *Prudent Practices in the Laboratory: Handling and Disposal of Chemicals*, National Research Council, 1995, with additions from OHS.

Table 2. Basic Chemical Segregation

Hazard Class of Chemical	**Recommended Storage Method**	**Examples**	**Incompatibilities**
Compressed gases - Flammable	Store in a cool, dry area, away from oxidizing gases. Securely strap or chain cylinders to a wall or bench.	Methane Hydrogen Acetylene Propane	Oxidizing and toxic compressed gases, oxidizing solids.
Compressed gases - Oxidizing	Store in a cool, dry area, away from flammable gases and liquids. Securely strap or chain cylinders to a wall or bench.	Oxygen Chlorine Bromine	Flammable gases
Compressed gases - Poisonous	Store in a cool, dry area, away from flammable gases and liquids. Securely strap or chain cylinders to a wall or bench.	Carbon monoxide Hydrogen sulfide Nitrogen dioxide	Flammable and/or oxidizing gases.

Corrosives - Acids	Store separately in acid storage cabinet. Segregate oxidizing acids (i.e., Chromic, nitric, sulfuric, and perchloric acids) from organic acids	Acetic acid Phenol Sulfuric acid Chromerge Nitric acid Perchloric acid Chromic acid Hydrochloric acid	Flammable liquids, flammable solids, bases, oxidizers
Corrosives - Bases	Store in separate corrosive storage cabinet. Store solutions of inorganic hydroxides in labeled polyethylene containers.	Ammonium hydroxide Sodium hydroxide Calcium hydroxide	Flammable liquids, oxidizers, poisons, and acids
Flammable Liquids	Store in flammable storage cabinet and away from sources of ignition. Store highly volatile flammable liquids in an explosion-proof refrigerator.	Acetone Benzene Diethyl ether Methanol Ethanol Toluene Glacial acetic acid	Acids, bases, oxidizers, and poisons
Flammable Solids	Store in a separate dry, cool area away from oxidizers, corrosives, flammable liquids	Phosphorus, yellow Calcium carbide Picric acid Benzoyl peroxide	Acids, bases, oxidizers, and poisons
General Chemicals - Non-reactive	Store on general laboratory benches or shelving preferably behind glass doors and below eye level.	Agar Sodium chloride Sodium bicarbonate Most non-reactive salts	See specific MSDS.

Oxidizers	Store in a spill tray inside a chemical storage cabinet. Separate from flammable and combustible materials.	Ammonium persulfate Ferric chloride Iodine Sodium hypochlorite Benzoyl peroxide Potassium permanganate Potassium dichromate (The following are generally considered oxidizing substances: Peroxides, perchlorates, chlorates, nitrates, bromates, superoxides.)	Separate from reducing agents, flammables, and combustibles.
Poisons/Toxic Compounds	Store separately in vented, cool, dry area, in unbreakable chemically-resistant secondary containers and in accordance with the hazardous nature of the chemical.	Aniline Carbon tetrachloride Chloroform Cyanides Heavy metals compounds, i.e., cadmium, mercury, osmium Oxalic acid Phenol Formic acid	Flammable liquids, acids, bases, and oxidizers. See specific MSDS.
Water-Reactive Chemicals	Store in dry, cool location, protect from water fire sprinkler.	Sodium metal Potassium metal Lithium metal Lithium aluminum hydride	Separate from all aqueous solutions and oxidizers.

Carcinogens	Label all containers as "Cancer Suspect Agents". Store according to the hazardous nature of the chemical, using appropriate security when necessary.	Benzidine Beta-naphthylamine Benzene Methylene chloride Beta-propiolactone	See specific MSDS.
Teratogens	Label all containers as "Suspect Reproductive Hazard". Store according to the hazardous nature of the chemical, using appropriate security when necessary.	Lead and mercury compounds Benzene Aniline	See specific MSDS.
Peroxide-Forming Chemicals	Store in air-tight containers in a dark, cool, dry area. See Table 3 for recommended storage time limits.	Diethyl ether Acetaldehyde Acrylonitrile	See specific MSDS.
Strong Reducing Agents	Store in cool, dry, well-ventilated location. Water reactive. Segregate from all other chemicals.	Acetyl chloride Thionyl chloride Maleic anhydride Ferrous sulfide	See specific MSDS.

Appendix D

Hazardous Waste Pick-Up Request Form

Hazardous Waste Pick Up Request Form

Instructor: Building: Room:
Contact: Phone:

I certify the accuracy of this record; that **I have received MSCD Hazardous Waste Training within the last year,** that biological materials have been rendered inactive/non-infectious, and that I am actively seeking to minimize the generation of hazardous waste.

Generator Signature: **Date:**

Chemical Constituents (list all) No trade names	**pH**	**Qty**	**Container size & type (G,P,M)**	**Net Amt per Container (trace, ¼, ½, ¾, full)**	**Physical State (S/L)**
(**example**: 40% methanol, 1-3% barium hydroxide,5% acetonitrile, balance: water)	8	1	4L - Glass	Full	L

Appendix E

Auraria Campus Emergency Procedures

AURARIA CAMPUS EMERGENCY PROCEDURES

COMMUNITY COLLEGE OF DENVER

METROPOLITAN STATE COLLEGE of DENVER

University of Colorado Denver

ACTIVE SHOOTER

- Seek sanctuary by proceeding to a room that can be locked, close and lock all windows and doors and turn off all lights OR exit the building if safe conditions exist.
- Get down on the floor and ensure that no one is visible from outside the room. Call 911 from a campus phone or dial (303) 556-5000 from any other phone to access the Auraria Campus Police and advise the dispatcher of the events, inform him/her of your location, and remain in place until the police give the "all clear."
- If an active shooter enters your office or classroom, try to remain calm. Call 9-1-1 from a campus phone or dial (303) 556-5000 from any other phone, and if possible, alert police of the shooter's location. If you can't speak, leave the line open so the dispatcher can listen to what's taking place.
- If the shooter leaves the area, proceed immediately to a safer place and do not touch anything that was in the vicinity of the shooter.

BOMB THREAT

- Evacuate the building.
- Do not use cell phones or radios within 300 feet of the area suspected of containing explosive device.
- Faculty/Staff should check for, but not disturb, unusual objects as they depart the classroom or offices. Report these unusual objects to the Auraria Campus Police and Emergency Personnel.
- Do not enter a building until authorized by Emergency Personnel/Auraria Campus Police.

FIRE

- Activate the nearest fire alarm pull station and call 911 from a campus phone to access Auraria Campus Police or dial (303) 556-5000 from all other phones.
- Evacuate the building.
- Do not re-enter the building until authorized by Emergency Personnel.

POWER OUTAGE

- Move cautiously to a lighted area. Exits may be indicated by lighted signs.
- Turn off and unplug computers and other voltage sensitive equipment.
- For information about a prolonged outage, check Auraria Campus website at www.ahec.edu or the local media.

SUSPICIOUS PERSON

- Do not physically confront the person.
- Do not let anyone into a locked building/office.
- If the individual is inside, do not block the person's access to an exit.
- Call 911 from a Campus phone or dial (303) 556-5000 to access Auraria Campus Police. Provide as much information as possible about the person and their direction of travel.

SUSPICIOUS OBJECT

- Do not touch or disturb object.
- Call 911 from a campus phone to access Auraria Campus Police or dial (303) 556-5000 from all other phones.
- Notify your supervisor, faculty or staff member immediately.
- Be prepared to evacuate.

GENERAL EVACUATION INFORMATION

- In the event of a building alarm or official notification, evacuate the building using the nearest exit (or alternate if nearest exit is blocked).
- Do not use elevators!
- Take personal belongings (keys, wallets, etc.).
- Secure any hazardous materials or equipment before leaving.
- Follow directions given by emergency personnel and/or Auraria Campus Police Officers.
- Gather 500 feet from the building unless otherwise instructed by Emergency Personnel and/or Auraria Campus Police.
- If it is safe for you to assist persons with disabilities or special needs, do so. If you are unable to assist, notify emergency responders of the location and number of disabled or special needs persons located in your area.
- Wait to be contacted. Do not return to the building or move to another side of the building unless told to do so by emergency personnel.

EARTHQUAKES/TORNADOS/ SEVERE WEATHER

- If an underground or designated shelter is not available, move to an interior room or hallway on the lowest floor and get beside not under a sturdy piece of furniture.
- Stay away from windows. DO NOT open windows.
- Any fire doors in hallways should be closed.
- Remain in the safe area until all danger has passed.
- If the facility is damaged, evacuate after the storm passes and stay clear of the damaged area. Be aware of fallen debris, downed power lines and gas leaks.
- Follow directives of Emergency Personnel/ Auraria Campus Police.

SNOW CLOSURES

- Closure options include: Closed for the day and evening; Closed for the evening beginning at 4 p.m.
- Tune to a local radio or TV station for closure information and/or call the 24 hour info line at (303) 556-2401 for status on snow closures.

REMAIN CALM. PROVIDE ASSISTANCE TO OTHERS, IF NECESSARY.

Auraria Higher Education Center
www.ahec.edu

To Report a Campus Emergency: DIAL 911 from a campus phone OR DIAL (303) 556-5000 to directly access the Auraria Campus Police

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