Chemical Hygiene Plan

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Introduction

Policy statement

The University of North Texas recognizes its legal and social obligations to provide a safe working environment and believes students, faculty, and staff have a right to know about health hazards associated with their work. This manual includes responsibilities, policies and procedures designed to develop an awareness of potentially hazardous chemicals in a laboratory and to promote safe laboratory practices.

The University of North Texas assumes the responsibility for laboratory safety. Students and employees will obtain access to pertinent safety information through their supervisory staff or the departmental Laboratory Safety Officer. When safety concerns arise, students are encouraged to contact their instructor. An important aspect of the Chemical Hygiene Plan is that once a person is given the basic training and information, they will take every effort to protect themselves.

The eventual success of this safety and health program is a result of the joint efforts and responsibility of the laboratory students, instructors and the administration of UNT. The University places a high priority on the establishment of safe and healthful learning environment through the

leadership and participation of all members of the organization.

Background

The Occupational Safety and Health Administration (OSHA) promulgated the Laboratory Standard, 29CFR 1910.1450, Occupational Exposures to Hazardous Chemicals in Laboratories. The standard mandates that any laboratory, or organization of laboratories, which handle hazardous chemicals will prepare and implement a chemical hygiene plan.

This Chemical Hygiene Plan meets the standards set by OSHA. This guide includes specific measures taken to ensure personal protection and includes the following elements:

1. Standard Operating Procedures relevant to safety and health considerations;
2. Provisions for hazard identification and evaluation, including the criteria used to determine and implement control measures such as engineering controls and personal protective equipment;
3. Requirements for the proper functioning of laboratory fume hoods and other protective equipment;
4. Provisions for training and information;
5. Provisions for medical consultation and examination;
6. Designation of personnel responsible for implementation;
7. Procedures for hazardous waste disposal;
8. Procedures for spills;
9. Procedures for record maintenance.

Laboratory Definition

In **29 CFR 1910.1450**, a laboratory is defined as:

> *Laboratory means a facility where the "laboratory use of hazardous chemicals" occurs. It is a workplace where relatively small quantities of hazardous chemicals are used on a non-production basis.*

For the purposes of this document, the following definition of laboratory will apply:

> A room or space (to include closets and support chaseways) provided for instructional, observation, measurement or other research activities that includes chemical, biological and/or radiological materials, or contains physical or mechanical equipment, in a non-production environment.

Categories of laboratories covered under this definition include:

- Art
- Biological
- Chemical
- Environmental
- Engineering
- Physical

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Hazard Identification and Evaluation

Criteria for Control Measures

> Proposals must be submitted to RMS for approval prior to starting any experiments using or producing highly toxic, flammable, explosive or otherwise potentially dangerous conditions.

Evaluating whether special handling precautions are warranted will require examination of a number of factors in order to formulate handling recommendations, including:

- Potential for routine airborne exposure.
- Potential for routine dermal exposure.
- Potential for accidental exposure.
- Quantities of chemicals processed.
- Composition of mixtures containing special hazards.
- Previous history of accidents or illnesses in the area.
- Physical and chemical properties of the chemical.

- Exposure controls currently utilized.
- Chemical stability of the chemical.
- Available toxicological and health effect data.

Based on the results of the hazard evaluation, recommendations for special handling requirements could include:

- Application of written standard operating procedures (required for especially hazardous substances, e.g., explosives, flammables, et al.);
- Training that must be completed prior to assigning any tasks.
- Establishment of designated handling areas.
- Posting of warning signage.
- Exposure monitoring requirements.
- Use of laboratory fume hoods or local exhaust.
- Prior fit testing and instruction in the proper use of respiratory protection equipment (contact Risk Management Services, (940) 565-2109 for more information).
- Special hygiene requirements.
- Use of protective clothing.
- Decontamination procedures.
- Procedures for removal of contaminated material.
- Proper method for hazardous waste removal. Contact Risk Management Services to request a hazardous waste pickup.

Chemical Inventory

A chemical inventory is conducted annually that lists all hazardous chemicals in laboratories. Chemicals listed are those classified as hazardous by:

- Department of Transportation (DOT);
- Environmental Protection Agency (EPA);
- Occupational Health and Safety Administration (OSHA); or
- displaying a 3 or greater number in any section of the National Fire Protection Association (NFPA) diamond; or
- listed in Schedules I through V in the DEA list of Controlled Substances (See Appendix F for the list of Controlled Chemicals).

DOT and EPA classifications as listed in their respective literature, or listed in Schedules I through V in the DEA list of Controlled Substances (See Appendix F for the list of Controlled Chemicals and Appendix G for the list of Glassware Used in Drug Making). The Standard recommends that reproductive toxins, highly toxic materials and carcinogens be identified and listed on an additional chemical inventory for highly toxic materials and carcinogens.

Chemicals are listed alphabetically, according to the product name. The chemical name, manufacturer, and amount in storage are listed. Appendix H includes chemicals of interest and screening threshold quantities (STQ) from Homeland Security Department. Any chemicals exceeding the STQ quantities must be reported for security issues.

Safety Data Sheets (SDS)

Safety Data Sheets (**SDS**s) are supplied by the chemical manufacturer and provide information regarding the product's physical, chemical and toxicological characteristics, methods for safe handling, storage and disposal, and personal protective measures for contact and spills.

Hazard evaluation relies on the chemical manufacturer's provided information to ascertain whether or not the chemical is hazardous. Orders for chemicals shall include a request for the product SDS.

> The master binders containing SDSs are kept in office **117 in the Risk Management Services (RMS) offices located at 700 North Texas Blvd., Denton, Tx 76201.** Individual departments may wish to maintain their own SDS collection.

Labeling

29 CFR 1910.1450 contains specific chemical labeling requirements. Labeling is required for all hazardous chemicals that are manufactured, shipped and used in the workplace. The manufacturer's labels must not be removed or defaced.

Chemical manufacturers, importers, and distributors are required to label each container of hazardous chemical leaving their facility with the following information:

1. Identity of the hazardous chemical
2. Appropriate hazard warnings
3. Name and address of the manufacturer

Each chemical transferred outside of the laboratory that is not in its original container must also be labeled. These workplace labels must contain SDS information as follows:

1. Identity of the hazardous chemical
2. Route of entry (e.g. eyes, nose, ingestion, or skin)
3. Health hazard
4. Physical hazard
5. Target organ affected

An example of an in-house label is shown below:

Acetic Acid	
Route of Entry	Eyes, Skin, Nose
Health Hazard	Poison
Physical Hazard	Corrosive
Target Organs	Skin and Lungs

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Standard Operating Procedures

Laboratory Safety Officers

Laboratory Safety Officers (LSOs) are department or area-specific resources who are qualified by training or experience to provide technical laboratory safety guidance in the school or unit assigned. LSOs are useful in helping to create and enhance a safe laboratory working environment.

Assignment of an LSO

Department chairs are responsible for assigning one or more LSOs for their department. Any department with active laboratories (instructional, research, and other types as identified) are required to have at least one LSO.

Duties of an LSO

The primary duty of an LSO is to act as a liaison on safety-related issues with RMS personnel as needed. Additionally, LSO's are to be familiar with and understand the Laboratory Safety Rules and Best Practices found in Appendix I of this plan.

Other duties of an LSO may include:

Laboratory Inspections

- Assisting in laboratory inspection process and complete inspection reports as needed
- Help resolve identified issues found in laboratories under area of responsibility

General Safety

- Respond to chemical or biochemical concerns as requested by RMS
- Knowledge resource for safety-related inquiries and RMS requests to disseminate information
- Assist in providing chemical inventory information to RMS from responsible parties within their area

Basic Rules for Non-Laboratory Personnel In Laboratories

Access to laboratories is restricted to instructors, authorized personnel, and students of the laboratory course that have been trained in proper laboratory techniques when performing work with hazardous chemicals, biologicals, radio nuclides and lasers. Students and instructors are required to enforce the restricted access rules.

Authorized visitors are to be accompanied by laboratory personnel. Authorized visitors in the laboratory shall be instructed in basic safety procedures and shall be provided with appropriate protective equipment such as safety glasses and gloves.

Laboratories utilizing highly toxic chemicals, carcinogens, infectious agents, or radiation hazards shall have emergency procedures posted

conspicuously in the laboratory. Restricted access signs along with basic safety rules shall be posted in a conspicuous space near the entrance of these laboratories.

General Laboratory Rules

Safe work habits and general guidelines that apply to various types of laboratories are included in this section. Instructors are encouraged to develop laboratory-specific rules from the general guidelines or the references that have been incorporated into this safety manual.

As few laboratory chemicals are without hazards, general precautions for handling all laboratory chemicals require minimizing exposure. Skin contact with chemicals should be avoided. Avoid underestimation of the risk even when working with substances of no known significant hazard. One should assume that any mixture of hazardous chemicals is more toxic than the most toxic component. Adequate ventilation provided by fume hoods is the best means of preventing exposure to airborne substances.

Prior to working with new chemicals, the Safety Data Sheet (SDS) must be read and the precautions for safe handling observed. The SDS provides laboratory personnel with the OSHA permissible Exposure Limits (PEL) and the ACGIH Threshold Limit Values (TLV). The PEL and TLV exposure limits shall not be exceeded.

Exposures to chemical substances above the PEL or TLV and regulated by a standard which requires monitoring, either initially or periodically, shall be monitored according to that standard. The standards require records of exposure, personal monitoring, and amounts of usage for highly toxic or carcinogenic chemicals. OSHA standards require maintaining for a period of time, generally 2, 20, or 30 years, records of personnel who were exposed to specific toxic chemicals.

A recommended procedure for laboratories to follow is to maintain an access log for these toxic chemicals in a bound book. The laboratory log should have entries for the following: date, type of work performed, chemicals utilized, monitoring equipment, procedures, results, and personnel in the laboratory. The laboratory log will become a part of the permanent record of the laboratory. The above procedures are only necessary if personnel are directly exposed at or above the PEL or TLV for the chemical substance regulated by a standard (see Appendix A - Definition of a Carcinogen and List of Known Human Carcinogens).

The general rules are directed primarily toward prevention of toxic exposure and do not include rules and procedures for prevention of physical injury. Safety in Academic Chemistry Laboratories, a reference included in the manual, contains recommended techniques for safety operation of equipment such as: electrical equipment, glassware, distillations, low and high temperature operations, vacuum and high pressure operations, emergency procedures, etc.

Any laboratory that desires to run experiments and/or equipment overnight unattended should fill out an "overnight experiment notice" form. These experiments include hazardous procedures, highly reactive chemicals, highly exothermic reactions, reactions that generate hazardous waste and equipment that generates high heat or pressure. The form (see Appendix B - Overnight Experiment Notice Form) should be posted on the door and the other copy should be submitted to Risk Management. Principal investigators (PI) must train all the laboratory personnel on the emergency call list how to shutdown the operation.

University laboratories will be inspected quarterly when in use. A formal inspection report for each laboratory will be submitted electronically to the PI, Lab Safety Officer, and Risk Management Services department within 30 days of any inspection. Significant findings that pose an immediate threat to life or property require re-inspection and shall be addressed, corrected or resolved by the responsible PI to sufficiently prevent, mitigate or limit the probability and/or severity of an occurrence. Laboratories with significant findings shall be re-inspected within 30 days of the notice to the PI. Uncorrected significant findings following re-inspection will be reported to the Provost according to the judgment of the Director of Risk Management Services.

All of the university laboratories will be inspected quarterly. A formal inspection report for each laboratory will be submitted to the PI, Lab Safety Officer, and Risk Management within 30 days of any inspection. Any violations should be promptly addressed and corrected by the PI. An unannounced re-inspection shall be performed after 30 days of inspection. Any uncorrected deficiencies will be reported to the Provost Office for enforcement.

The following procedures are used when working with chemicals:

Accidents and Spills

1. **Eye contact**
   Promptly flush eyes with water for 15 minutes, and seek medical attention.
2. **Ingestion**
   Consult the product SDS health and first aid section. Generally, the victim should be encouraged to drink large amounts of water.
3. **Skin contact**
   Promptly flush the affected area with copious amounts of water and remove any contaminated clothing; use a emergency shower when contact is extensive. If symptoms persist after washing, seek medical attention.
4. **Seek immediate medical attention**
   Encourage the injured person to go to the Student Health Center immediately.
5. **Clean-up**
   Promptly clean up spills, using appropriate protective clothing and equipment, along with proper disposal methods.
6. **Report**
   Accidents should be reported to the immediate supervisor who will fill out the proper forms. The supervisor should report the accident to Risk Management Services, (940) 565-2109, immediately for prompt reporting and investigation.

Spill Cleanup

Chemical spills are contained using the **Think C.L.E.A.N Plan**:

1. **C**ontain the spill
2. **L**eave the area
3. **E**mergency: eye wash, shower, medical care
4. **A**ccess SDS
5. **N**otify a supervisor

All spills are to be contained using appropriate absorbent or spill kits. When spills involving large quantities of hazardous material occur, contact the laboratory supervisor or Chemical Hygiene Officer who will direct clean-up or evacuation procedures. Spill kits will be provided upon request.

Rules for Safe Laboratory Work

Safe work habits

Procedures to avoid unnecessary exposure to chemicals:

- Laboratory management (PIs, professors and lab managers) are responsible for conducting weekly testing of eyewash fountains, and for the proper operation of all laboratory safety equipment, including fire extinguishers and emergency showers.
- Laboratory personnel shall be aware of the location and proper operating of laboratory safety equipment including fire extinguishers; emergency showers; and eyewash fountains.
- Visitors to the laboratory shall abide by all laboratory safety rules, including requirements for the use of eye protection.
- Eye protection should be worn at all times in the laboratory. Spectacles, safety glasses and other eye protection devices shall be kept clean at all times.
- Seek information (from SDS) and advice about hazards, plan appropriate protective procedures, and plan positioning of equipment before beginning any new operation.
- Use minimum amounts of chemicals to accomplish task.
- Substitute less hazardous materials whenever possible.
- Do not smell or taste chemicals. Avoid inhalation from apparatus that can discharge toxic chemicals such as vacuum pumps, distillation columns, reflux columns, etc., by venting the equipment into a local exhaust.
- Do not allow release of toxic substances in rooms which have contained re-circulating atmospheres.
- Use only those chemicals for which the quality of the available ventilation system is appropriate.
- Handle and store laboratory glassware with care to avoid damage; do not use damaged glassware. Use extra care with Dewar flasks and other evacuated glass apparatus; shield or wrap them to contain chemicals and fragments should implosion occur. Use equipment only for its designed purpose.
- Wash areas of exposed skin thoroughly before leaving the laboratory.
- Avoid behavior that might confuse, startle or distract another worker.
- Do not use mouth suction for pipetting or starting a siphon.
- Avoid working alone in a laboratory while hazardous procedures are being conducted.
- Warning signs with personnel contact information shall be posted on the door and on equipment where special or unusual hazards exist.
- Provide for the containment of toxic substances in the event of failure of utility service when operating unattended equipment. Also, ensure that the warning signs are in place.
- Work areas shall be maintained clean and uncluttered with chemicals and equipment properly labeled and stored; clean up the work area on completion of an operation and at the end of each day.
- Hood operations: Use a hood for operations that might result in release of toxic chemical vapors or dust. Use a fume hood or other local ventilation device when working with any volatile substance with a TLV of less than 50 ppm. (Confirm adequate hood performance before use. Keep hood closed when operations are not being performed in the hood. Do not allow materials to block vents or air-flow. Do not store materials in the hood.)
- Be aware of unsafe conditions and see that they are corrected when detected.
- All the laboratories should be inspected by the Lab Safety Officers once per semester unless they are inactive.

Personal Protective Equipment (PPE)

- A face shield of chemical goggles shall be worn when conducting operations utilizing glassware, distilling or refluxing; and transferring or mixing corrosives of toxic liquids.
- Confine long hair and loose clothing especially if working with moving machinery.
- The preferred footwear are shoes which completely encloses the foot.
- Wear appropriate impervious gloves when the potential for contact with toxic materials exists; inspect the gloves before each use, wash gloves prior to removal, and replace gloves that have deteriorated.
- Stop using the chemical when air contaminant concentrations are not sufficiently reduced by engineering controls. Inspect respirators prior to each use. Medical evaluations are required before the use of respiratory equipment.
- Use any protective and emergency apparel and equipment as appropriate.
- If contact lenses are worn in the laboratory, inform the supervisor so special precautions can be taken. We strongly recommend against the use of contact lenses in the lab. The potential for chemical buildup under them is too great.

- Remove laboratory coats or other clothing immediately upon significant contamination.
- Leave lab coats in the lab.
- Proper handling and disposal methods of hazardous waste and materials; contact Risk Management Services for a hazardous waste pickup.

Laboratory Hygiene Requirements

> Eating, drinking, smoking, gum chewing, or applying cosmetics is prohibited in the laboratories. Wash hands before conducting these activities.

> Storing, handling, or consuming food or beverages in laboratories and storage areas is prohibited.

Allergens and Embryo Toxins

Procedures and precautions

- Allergens such as diazomethane, isocyanates, and bichromates, require wearing suitable gloves to prevent hand contact with allergens or substances of unknown allergenic activity. Laboratory hoods or glove boxes are a preferred enclosure for allergen work.
- Embryo toxins such as organomercurials, lead compounds, and formamide require women of childbearing age to only work with these substances in a hood whose satisfactory performance has been confirmed. Appropriate protective clothing is required to prevent skin contact.
- Procedures for safe handling, use, and storage of allergens and embryo toxins shall be reviewed annually and prior to the introduction of any new material.
- Allergens and embryo toxins shall be properly labeled and stored in unbreakable secondary containers in adequately ventilated areas.
- Spills and incidents of exposure to these materials require immediate notification of supervisor and consultation of a qualified physician when appropriate.
- Chemicals of moderate chronic or high acute toxicity (Appendix E - Acutely Toxic Chemicals) may not exceed TLV50 ppm, e.g. hydrogen cyanide and hydrofluoric acid (NFPA 3 or 4).

Moderate chronic and high acute toxicity

Additional precautions are appropriate when working with chemicals of moderate chronic and high acute toxicity (see Appendix E - Acutely Toxic Chemicals).

- Minimize exposure to these toxic substances by any route using all reasonable precautions and appropriate protective equipment, including washing of hands and arms thoroughly after removal of protective equipment.
- Use and store these substances only in areas of restricted access. The storage area containers require special warning signs to alert users of the hazards and safe handling procedures.
- Use in hoods that have been previously evaluated to confirm adequate performance. Trap released vapors to prevent their discharge into the hood exhaust.
- Maintain records of the amounts of these materials on hand, amounts used, and names of personnel working with the materials.
- Accidents and spills are prevented by preparing the work area prior to chemical handling.
- Assure that at least two people are present at all times when working with highly toxic materials.
- Cover the work area with containment devices such as plastic sheeting and absorbent materials. Prepare a waste disposal receptacle for the waste chemicals and containment material.
- If a major spill occurs outside of the hood, evacuate the area. Assure that cleanup personnel wear suitable protective equipment.

Chemicals with High Chronic Toxicity

Organic mercury compounds and carcinogens; see Appendix E - Acutely Toxic Chemicals (NFPA 3 or 4).

> Carcinogens are those listed in the definition of a carcinogen in Appendix A - Definition of a Carcinogen and List of Known Human Carcinogens.

Procedures and Supplemental Rules

- Restrict all transfers and work with these substances to a "controlled area" such as a restricted access hood, glove box, or a portion of the laboratory designated for use of highly toxic substances. Personnel in the laboratory must be made aware of the substances being used and necessary precautions.

- Prior to introduction of highly toxic materials in the laboratory, prepare a plan for the use, disposal and decontamination of equipment. The controlled area must be decontaminated after using highly toxic materials.
- Personnel shall remove protective equipment and place it in an appropriate labeled container. Personnel will thoroughly wash hands, forearms, face, and neck after removing protective equipment.
- Laboratory personnel are responsible for cleaning the area when highly toxic materials are used. The area must be decontaminated prior to allowing Janitorial personnel to resume normal cleaning procedures.
- Medical surveillance is required if using significant quantities of a highly toxic material on a regular basis (three times per week). Consult a qualified physician concerning desirability of regular medical monitoring. Only if the SOP (Standard Operating Procedure) for the use of the chemical insures no exposure to personnel at or above the PEL and/or TLV can the material be used without medical monitoring.
- Maintain records of the amounts of these materials on hand, amounts used, and names of personnel working with the materials.
- Accidents and spills are prevented by preparing the work area prior to chemical handling.
- Assure that at least two people are present at all times when working with highly toxic materials.
- Cover the work area with containment devices such as plastic sheeting and absorbent. Prepare a waste disposal receptacle for the waste chemicals and containment material.
- If a major spill occurs outside of the hood, evacuate the area. Assure that cleanup personnel wear suitable protective equipment.

Explosive Chemical Management

An explosive chemical is a gas, solid or liquid chemical which is in itself capable by chemical reaction of producing gas at a temperature and pressure at a speed able to cause damage to the surroundings. This includes chemicals purchased from supplied by vendors or products and by-products generated from experiments or reactions. Examples of explosive chemicals are:

- organic peroxides
- oxidizers includes salts containing nitrates
- chlorates
- high concentration of perchloric acids

The following procedures must be followed to minimize the risk of explosion.

1. **Responsibility**
   The PI involved in using explosive chemicals must perform a Risk Assessment prior to submitting a research proposal to the Risk Management Services for approval. Detailed Standard Operating Procedures must be attached with the proposal.
2. **Purchasing**
   All chemicals must be purchased through EIS approval system.
3. **Chemical Register**
   A register of all used/stored chemicals on site shall be generated by the manager of the lab or PI. This list should submitted to Risk Management Services for review.
4. **Chemical User**
   A list of chemical users includes name, employment status, contact email address, phone number and training status must be submitted with Standard Operating procedures (SOP) to Risk Management Services .
5. **New chemical hazard identification and risk assessment**
   For all new chemicals, a hazard and risk assessment must be performed immediately.
6. **Training**
   Staff and workers must receive related training before handling the chemicals and doing any hands-on experiments.
7. **Labeling**
   The label must be specific and firmly secured on the container.
8. **Personal Protective Equipment**
   Appropriate Personal Protective Equipment must be worn during experiment.
9. **Handling and storage of chemicals**
   Proper procedures found in the SDS sheets must be used.
10. **Waste disposal**
    Chemical waste must not be mixed with other chemical waste unless the waste is the same type. Users must take “Hazardous Wastes” training prior to handling explosive waste,
11. **Updates and records**
    All SDS’s must be updated regularly. Risk Managements Services ensures that new chemicals are entered into the Database inventory.
12. **Signage**
    Warning signage must be posted on the wall or entrance to warn building occupants of any hazards.
13. **Emergency phone number**
    Emergency contact numbers of responsible lab persons, the PI(s), and the UNT Police department must be posted on the outside lab door.
14. **Overnight experiments**
    Describe how to stop the process(es) or turn off the equipment if an emergency happens; also attach a map showing all equipment locations in the lab. See Appendix B - Overnight Experiment Notice Form for details.
15. **Incident report**
    Principal Investigator or Lab Manager must report any incident to the Risk Management Services within 7 working days. Injuries involving employees require separate report to Risk Management Services Insurance and Claims, (940) 565-2109.

Lasers

No person may use a laser of any type prior to training in laser safety. Contact the Radiation Safety Officer at 940-565-3282 to obtain this training.

Procedures

- The type and intensity of radiation from lasers varies widely with the instrument design. Prior to working with an instrument, the specifications for operation and protection must be consulted.
- Always wear goggles that offer protection against the specific wavelength of laser in use. If more than one wavelength is being used, additional goggles specific for each wavelength are required. No available spectacles protect against all laser wavelengths.
- Never look directly at the beam or pump source.
- Never view the beam pattern directly; use an image converter or other safe, indirect means. To decrease reflecting hazards, do not aim by looking along the beam.
- Do not allow any objects that cause reflections to be present in or along the beam. Even buttons on clothing and polished screw heads can be dangerous.
- Keep a high general illumination level in areas where lasers are in operation. Low light levels cause dilation of the pupils, thereby increasing the hazard.
- Display warning signs in laser areas.

Laboratory Use of Carcinogens

When carcinogens are used in a laboratory, access to the laboratory will be clearly restricted to personnel trained in safe handling of highly toxic material. See Appendix A for the criteria for a chemical being listed as a carcinogen and for listed carcinogens and suspected carcinogens. Anything categorized by IARC as Groups I and II is covered by the Hazard Communication Standard and the Laboratory Standard.

Group I	known human carcinogens
Groups IIA and IIB	probable human carcinogens
Group III	substances evaluated, but no human carcinogenicity classification could be made

Access and use of highly toxic substances and carcinogens shall be controlled and monitored. Instructors and graduate students using these materials shall record the amounts used, date and persons working with the materials. A separate inventory list of carcinogens, suspected carcinogens, reproductive toxins and highly toxic substances is recommended.

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Control Measures Implementation

Chemical Storage

Chemicals are stored according to segregation systems that separate incompatible classes of chemicals. Flammables, acids, bases, oxidizers, water reactives, and peroxides require special attention for proper storage. A list of incompatible chemicals which require special precautions for safe storage is provided in Appendix C - List of Incompatible Chemicals. Appendix C lists the maximum allowable container capacity for containers such as: glass bottles, metal cans, plastic bottles or pails, safety cans and metal drums. Certain chemical manufacturers and suppliers provide additional storage and segregation information on the product label or SDS.

Storage of laboratory chemicals presents an ongoing safety problem. Amounts of chemicals in storage should be as small as practical. Storage on bench tops and in fume hoods is prohibited due to the potential for fire and spills. Certain reactive or unstable chemicals are stores in specially designed refrigerators. Flammable liquids are stored in an approved flammable storage cabinet.

Safety cans with a spring loaded spout are preferred for transporting flammable liquids. Alternatively, when chemicals are hand carried, the container may be placed in an outside container or a plastic pail.

Stored chemicals shall be periodically inspected for deterioration and container integrity. Chemicals which are no longer used in the laboratory shall be discarded by labeling it with a chemical waste tag. Contact Risk Management Services to request a hazardous waste pickup.

Cylinders of compressed gases are to be strapped or chained to a wall or bench top and are capped when not in use.

Engineering Controls

Air flow through the laboratory should be relatively uniform and be exhausted to the exterior of the building.

All laboratory fume hoods are inspected annually and certified by the Chemical Hygienist. Any hood not passing inspection should be taken out of

service immediately and not used until it has been repaired. Repair should be in a timely manner so as not to endanger the health and well-being of students and employees or place the facility at risk.

Ventilated storage cabinets for chemicals are provided as needed. The Chemical Hygienist shall maintain inspection and repair records for laboratory safety equipment. Annual inspections and/or testing are required for the following: eyewash fountains; emergency showers; and fire extinguishers.

Personal Protective Equipment

Safety glasses are recommended for all laboratory work. Chemical goggles shall be worn when performing potentially hazardous operations.

Face shields and chemical goggles are worn to prevent injury from splashes or sprays of hazardous chemicals or biohazards if there is a potential for eye, nose, or mouth contamination. This equipment is located in the laboratories when there is a need for the equipment.

Laboratory personnel are required to wear appropriate impervious gloves when there is a potential for direct skin contact with hazardous chemicals or blood bome pathogens.

When the probability of chemical splashes is great, an impervious apron appropriate for the task is worn.

All personal protective equipment shall be removed immediately upon leaving the work area; cleaned, and placed in an appropriate area.

Exposure Levels and Medical Monitoring

Exposure to chemical substances regulated by a standard which requires monitoring, either initially or periodically, shall be monitored according to the standard. If the initial monitoring discloses exposure over the PEL, then immediate compliance with the exposure and medical monitoring provisions of the relevant standard is required. Compliance with the standard may include more frequent monitoring and implementation of additional control measures.

Personnel shall be notified in writing of monitoring data within 15 days of receipt of those monitoring results.
Exposure records will be maintained for personnel exposed above the TLV and/or PEL of the following chemicals: chemicals covered by a standard; carcinogens; and highly toxic materials. Exposure, medical, and personnel monitoring records will be maintained for thirty years.

Monitoring is required in laboratories where chemicals specifically regulated by OSHA CFR 1910 subpart Z are used. See Appendix A - Definition of a Carcinogen and List of Known Human Carcinogens for the OSHA Carcinogens.

If any of the above described chemicals are to be used in the laboratory, a work procedure which identifies each workstation/task in the laboratory and the required controls and equipments will need to be included in the Laboratory Safety Manual.

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Nanoparticles

Nanotechnology is the use and control of particulates of roughly 1 to 100 nanometers. Nanoparticles can cross an alveolar wall into bloodstream. It also can spread to other organs, tissues and brain. Potential nanomaterial exposure routes include inhalation, dermal contact, and ingestion. To prevent the exposure, always maintain good work practices like clean work areas, hand washing, and shower use /change of clothes).

Use engineering controls like source enclosure, local exhaust ventilation, and HEPA filters. During any experiment, wear NIOSH-approved personal protective equipment and respirator. Cleanup any spill immediately and properly dispose of any Nanomaterials. Report any accidents or near-miss accidents to your supervisor.

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Training

Effective training is crucial to a successful laboratory safety program. Laboratory Supervisors must actively participate in the training process to ensure that all lab employees are effectively trained before any work with hazardous materials occurs. It should be noted that depending on the type of research being conducted and associated hazards, there may be additional training requirements. For more information, contact RMS at (940)565-2109 or visit the RMS Training webpage.

(http://riskmanagement.unt.edu/training/environmental-services-training)

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Contaminated Waste Removal/Disposal

General Methods for Segregation and Disposal

To assure that minimal harm to people and the environment will result from the disposal of waste laboratory chemicals, segregation and disposal shall be in accordance with to provisions of the following:

1. Code of Federal Regulations, Title 49, Parts 172-173, Department of Transportation
2. Code of Federal Regulations, Title 40, Parts 261-262, Environmental Protection Agency

Certain non-hazardous chemicals are permissible for sanitary sewer disposal. In general, only those solutions from routine titrations and tests which do not contain any hazardous chemical will be allowed to be put into the sanitary sewer system.

The following types of hazardous materials must be segregated for disposal:

1. Non-flammable organic liquids or solids.
2. Solutions of heavy metals.
3. Hydrocarbons, halogenated hydrocarbons, nitro compounds, mercaptans, and most oxygenated compounds.
4. Organics that are explosive such as azides and peroxides.
5. Concentrated acids or bases (6 molar or higher).
6. Highly toxic, malodorous, or lachrymatory substances (such as cyanides or carcinogens; see Appendix A - Definition of a Carcinogen and List of Known Human Carcinogens).

Indiscriminate disposal by pouring waste down the drain or adding them to mixed refuse for landfill burial in unacceptable. Hoods are not to be used as a means of disposal for volatile chemicals.

Hazardous Waste

Reference the Hazardous Waste Management Guide for information on hazardous waste management. Waste in need of disposal is required to be tagged with a hazardous waste tag, with the contents listed on this tag. Complete a Hazardous Materials Pickup Request form to have the material picked up.

Radioactive Waste

See the Radiation Waste Handling SOP located on the RMS website.

RMS Standard Operating Procedures (SOP)

All SOPs related to the chemical hygiene plan can be found at the RMS website (www.rms.unt.edu).

These include:

- Arts and Crafts Safety SOP
- Chemical Materials Purchase Review SOP
- Controlled Substance SOP
- Eye Wash Station Inspection SOP
- Laboratory Safety SOP
- Laser Safety SOP
- Minors in Labs SOP
- Nano-Particle SOP
- Refrigerant SOP

Revision

Last approved revision: 2/2016

Appendix A - Definition of a Carcinogen and List of Known Human Carcinogens

Select Carcinogens

A carcinogen is a substance or chemical that after chronic exposure will cause some part or parts of the body to begin cancerous growth leading to harmful effects on the affected organ(s).

All of these materials require special handling, and are usually used only under a hood with full PPE protection (gloves, goggles, apron, et al.). Most have very low TLV and/or PEL values indicating the harmfulness of the compound. Since these are known human carcinogens, all require specific standard operating procedures (SOPs) to be written when used in any UNT laboratory.

Many times, it is much easier to find a replacement chemical than to set up the engineered environmental controls and operating procedures required to maintain safe use of these chemicals. If electing to use any of these chemicals, a Principal Investigator or laboratory manager must publish an SOP and ensure that engineering controls always keep the chemical below the PEL and/or TLV when laboratory personnel are exposed to a listed material.

The following list of known human carcinogens fall under the Substance Specific Standards for each chemical:

Aflatoxins	Alcoholic Bevarage Consumption	4-aminodiphenyl
Analgesic Mixtures Containing Phenacetin	Aristolochic Acids	Arsenic and Inorganic Arsenic Compounds
Asbestos	Azathioprine	benzene
benzidine	Beryllium and Beryllium Compounds	Bis(chloromethyl)Ether and Technical-Grade Chloromethyl Methyl Ether
1,3-Butadiene	Cadmium and Cadmium Compunds	Chlorambucil
1-(2-Chloroethyl)-3-(4-methylcyclohexyl)-1-nitrosourea	Chromium Hexavalent Compounds	Coal Tars and Coal-Tar Pitches
Coke-Oven Emissions	Cyclophosphamide	Cyclosporin A
Diethylstibestrol	Dyes Metabolized to Benzidine	Erionite
Estrogens, Steroidal	Ethylene Oxide	Formaldehyde
Hepatitis B Virus	Hepatitis C Virus	Human Papillomaviruses: Some Genital-Mucosal Types
Melphalan	Methoxalen with Ultraviolet A Therapy	Mineral Oils: Untreated and Mildly Treated
Mustard Gas	2-Naphthylamine	Neutrons
Nickel Compounds	Radon	Silica, Crystalline(Respirable Size)
Solar Radiation	Soots	Strong Inorganic Acid Mists Containing Sulfuric Acid
Sunlamps or Sunbeds, Exposure to	Tamoxifen	2,3,7,8-Tetrachlorodibenzo-p-dioxin
Thiotepa	Thorium Dioxide	Tobacco Smoke, Environmental
Tobacco Smoke	Tobacco, Smokeless	Ultraviolet Radiation, Broad-Spectrum
Vinyl Chloride	Wood Dust	X-Radiation and Gamma Radiation

Reasonably Anticipated to be Human Carcinogens

All of the following chemicals are expected to follow the same precautions as those described in the *Select Carcinogens* section above.

Acetaldehyde	2-Acetylaminofluorene	Acrylamide
Adriamycin	2-Aminoanthraquinone	o-Aminoazotoluene
1-Amino-2,4-dibromoanthraquinone	2-Amino-3,4-dimethylimidazo[4,5-f]quinoline	2-Amino-3,8-dimethylimidazo[4,5-f]quinoxaline
1-Amino-2-methylanthraquinone	2-Amino-3-methylimidazo[4,5-f]quinoline	2-Amino-1-methyl-6-phenylimidazo[4,5-b]pyridine
Amitrole	o-Anisidine and its Hydrochloride	Azacitidine
Basic Red 9 Monohydrochloride	Benz[a]anthracene	Benzo[b]fluoranthene
Benzo[j]fluoranthene	Benzo[k]fluoranthene	Benzo[a]pyrene
Benzotrichloride	2,2-Bis(bromomethyl)-1,3-propanediol	Bis(chloroethyl) Nitrosourea
Bromodichloromethane	1,4-Butanediol Dimethanesulfonate	Butylated Hydroxyanisole
Captafol	Carbon Tetrachloride	Ceramic Fibers(Respirable Size)
Chloramphenicol	Chlorendic Acid	Chlorinated Paraffins(C_{12}, 60% Chlorine)
Chloroform	1-(2-Chloroethyl)-3-cyclohexyl-1-nitrosourea	3-Chloro-2-methylpropene
4-Chloro-o-phenylenediamine	Chloroprene	p-Chloro-o-toluidine and its Hydrochloride
Chlorozotocin	Cisplatin	Cobalt Sulfate
Cobalt-Tungsten Carbide: Powders and Hard Metals	p-Cresidine	Cupferron
Dacarbazine	Danthron	2,4-Diaminoanisole Sulfate
2,4-Diaminotoluene	Diazoaminobenzene	Dibenz[a,h]acridine
Dibenz[a,f]acridine	Dibenz[a,h]anthracene	7H-Dibenzo[c,g]carbazole
Dibenzo[a,e]pyrene	Dibenzo[a,h]pyrene	Dibenzo[a,i]pyrene
Dibenzo[a,f]pyrene	1,2-Dibromo-3-chloropropane	1,2-Dibromoethane
2,3-Dibromo-1-propanol	1,4-Dichlorobenzene	3,3’-Dichlorobenzidine and its Dihydrochloride
Dichlorodiphenyltrichloroethane	1,2-Dichloroethane	Dichloromethane
1,3-Dichloropropene	Diepoxybutane	Diesel Exhaust Particulates
Di(2-ethylhexyl) Phthalate	Diethyl Sulfate	Diglycidyl Resorcinol Ether
3,3’-Dimethoxybenzidine	4-Dimethylaminoazobenzene	3,3’-Dimethylbenzidine
Dimethylcarbamoyl Chloride	1,1-Dimethylhydrazine	Dimethyl Sulfate
Dimethylvinyl Chloride	1,6-Dinitropyrene	1,8-Dinitropyrene
1,4-Dioxane	Disperse Blue 1	Dyes Metabolized to 3,3’-Dimethoxybenzidine
Dyes Metabolized to 3,3’-Dimethylbenzidine	Epichlorohydrin	Ethylene Thiourea
Ethyl Methanesulfonate	Furan	Glass Wool Fibers(Inhalable)
Glycidol	Hexachlorobenzene	Hexachloroethane
Hexamethylphosphoramide	Hydrazine and Hydrazine Sulfate	Hydrazobenzene
Indeno[1,2,3-cd]pyrene	Iron Dextran Complex	Isoprene
Kepone	Lead and Lead Compounds	Lindane, Hexachlorocyclohexane, and other Hexachlorocyclohexane Isomers
2-Methylaziridine	5-Methylchrysene	4,4’-Methylenebis

4,4’-Methylenebis benzenamine	4,4’-Methylenedianiline and its Dihydrochloride	Methyleugenol
Methyl Methanesulfonate	N-Methyl-N’-Nitro-N-Nitrosoguanidine	Metronidazole
Michler’s Ketone	Mirex	Naphthalene
Nickel, Metallic	Nitrilotriacetic Acid	o-Nitroanisole
Nitrobenzene	6-Nitrochrysene	Nitrofen
Nitrogen Mustard Hydrochloride	Nitromethane	2-Nitropropane
1-Nitropyrene	4-Nitropyrene	N-Nitrosodi-n-butylamine
N-Nitrosodiethanolamine	N-Nitrosodiethylamine	N-Nitrosodimethylamine
N-Nitrosodi-n-propylamine	N-Nitroso-N-ethylurea	4-(N-Nitrosomethylamino)-1-(3-pyridyl)-1-butanone
N-Nitroso-N-methylurea	N-Nitrosomethylvinylamine	N-Nitrosomorpholine
N-Nitrosonornicotine	N-Nitrosopiperidine	N-Nitrosopyrrolidine
N-Nitrososarcosine	o-Nitrotoluene	Norethisterone
Ochratoxin A	4,4’-Oxydianiline	Oxymetholone
Phenacetin	Phenazopyridine Hydrochloride	Phenolphthalein
Phenoxybenzamine Hydrochloride	Phenytoin and Phenytoin Sodium	Polybrominated Biphenyls
Polychlorinated Biphenyls	Procarbazine and Its hydrochloride	Progesterone
1,3-Propane Sultone	-Propiolactone	Propylene Oxide
Propylthiouracil	Reserpine	Riddelliine
Safrole	Selenium Sulfide	Streptozotocin
Styrene	Styrene-7,8-oxide	Sulfallate
Tetrachloroethylene	Tetrafluoroethylene	Tetranitromethane
Thioacetamide	4,4’-Thiodianiline	Thiourea
Toluene Diisocyanates	0-Toluidine and its Hydrochloride	Toxaphene
Trichloroethylene	2,4,6-Trichlorophenol	1,2,3-Trichloropropane
Tris(2,3-dibromopropyl)Phosphate	Ultraviolet Radiation A	Ultraviolet Radiation B
Ultraviolet Radiation B	Ultraviolet Radiation C	Urethane
Vinyl Bromide	4-Vinyl-1-cyclohexene Diepoxide	Vinyl Fluoride

Appendix B - Overnight Experiment Notice Form

Procedures

The overnight experiment notice form is to be used by persons with laboratory experiments that take place overnight. Fill out the form, provide a copy to the Risk Management Services department (565-2109), and post on door(s) where experiment will be performed.

Download Form

Download RMS Overnight Experiment Notice Form.

Appendix C - List of Incompatible Chemicals

The most complete and reliable reference on chemical reactivity is found in the current edition of "Handbook of Reactive Chemical Hazards" by L. Bretherick, published by Butterworths. Reactivity information is sometimes given in manufacturer's MSDSs and on labels. Also, guidelines on which chemicals are reactive can be found in regulations promulgated by the Department of Transportation (DOT) in 49 CFR and by the Environmental Protection Agency (EPA) in 40 CFR. Also see NFPA Manual 325 M--"Fire Hazard Properties of Flammable Liquids, Gases, Volatile Solids", Manual 49 "Hazardous Chemicals Data", and Manual 491M "Manual of Hazardous Chemical Reactions".

Examples of Incompatible Chemicals

From: "Safety in Academic Chemistry Laboratories", American Chemical Society

CHEMICAL	***... is incompatible with ...***
Acetic acid	Chromic acid, nitric acid, hydroxyl compds, ethylene glycol, perchloric acid, peroxides, permanganates
Acetylene	Chlorine, bromine, copper, fluorine, silver, mercury
Acetone	Nitric acid and sulfuric acid mixtures
Ammonia (anhydrous)	Mercury,chlorine, calcium hypochloride, iodine, bromine, hydrofluoric acid
Ammonium nitrate	Acids, powdered metals, flammable liquids, chlorates, nitrites, sulfur, finely divided organic combustible materials
Aniline	Nitric acid, hydrogen peroxide
Arsenical materials	Any reducing agent
Azides	Acids
Bromine	See chlorine
Calcium oxide	Water
Carbon (activated)	Calcium hypochlorite, all oxidizing agents
Carbon tetrachloride	Sodium
Chlorates	Ammonium salts, acids, powdered metals, sulfur, finely divided organic combustible materials
Chromic acid and chromium	Acetic acid, naphthalene, camphor, glycerol, alcohol, flammable liquids
Chlorine	Ammonia, acetylene, butadiene, butane, methane, propane(or other petroleum gases), hydrogen, sodium carbide, benzene, finely divided metals, turpentine
Chlorine dioxide	Ammonia, methane, phosphine, hydrogen sulfide
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
Fluorine	All other chemicals
Hydrocarbons (such as butane, propane, benzene)	Fluorine, chlorine, bromine, chromic acid, sodium peroxide
Hydrocyanic acid	Nitric acid, alkali
Hydrofluoric acid (anhydrous)	Ammonia (aqueous or anhydrous)
Hydrogen peroxide	Copper, chromium iron, most metals or their salts, alcohols, acetone, organic materials, aniline, nitromethane, combustible materials
Hydrogen sulfide	Fuming nitric acid, oxidizing gases
Hypochlorites	Acids, activated carbon
Iodine	Acetylene, ammonia (aqueous or anhydrous), hydrogen
Mercury	Acetylene, fulminic acid, ammonia
Nitrates	Sulfuric acid
Nitric acid (concentrated)	Acetic acid, sulfuric acid, aniline, chromic acid, hydrocyanic acid, hydrogen sulfide, flammable liquids, flammable gases, copper, brass, any heavy metals

Nitrites	Acids
Nitroparaffins	Inorganic bases, amines
Oxalic acid	Silver, mercury
Oxygen	Oils, grease, hydrogen, flammable liquids, solids or gases
Perchloric acid	Acetic anhydride, bismuth and its alloys, alcohol, paper, wood, grease, oils
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
Potassium perchlorate	Sulfuric and other acids
Potassium permanganate	Glycerol, ethylene glycol, benzaldehyde, sulfuric acid
Selenides	Reducing agents
Silver	Acetylene, oxalic acid, tartartic acid, ammonium compounds, fulminic acid
Sodium	Carbon tetrachloride, carbon dioxide, water
Sodium nitrite	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	Potassium chlorate, potassium perchlorate, potassium permanganate (similar compounds of light metals, such as sodium, lithium)
Tellurides	Reducing agents

Appendix D - Maximum Allowable Container Capacities Stored Outside a Flammable Cabinet

- Glass bottles: maximum of one quart (1 liter) of any flammable liquid stored outside a flammable cabinet. Use safety cans for larger volumes than this.
- Metal cans: maximum of one gallon (4 liter can) of any flammable liquid stored outside a flammable cabinet. Use safety cans for larger volumes than this. A 5 gallon (20 liters) can may be used if a flame arrestor is present in the dispenser nozzle.
- Plastic bottles: maximum of one quart (1 liter) of any flammable liquid stored outside a flammable cabinet. Use safety cans for larger volumes than this.
- Plastic pails: if flame arresters are present in the nozzle, then 5 gallon pails can be used to dispense flammable liquids.
- Safety cans: up to 5 gallons of a flammable liquid may be dispensed from safety cans having a self-closing lid and flame arrester.
- Metal drums: dispensing flammable liquids from metal drums requires grounding of the nozzle to a good ground and grounding of the receiving vessel during transfer of the liquid.

Appendix E - Acutely Toxic Chemicals

Based on OSHA Standard 29 CFR, 1910.119, Appendix A.

CHEMICAL LOOKUP #	CHEMICAL NAMES
75-07-0	Acetaldehyde
107-02-8	Acrolein (2-Propenal)
814-68-6	Acrylyl Chloride
107-05-1	Allyl Chloride
107-11-9	Allylamine
Varies	Alkylaluminums
7664-41-7	Ammonia, Anhydrous
7664-41-7	Ammonia solutions (greater than 44% ammonia by weight)
7790-98-9	Ammonium Perchlorate
7787-36-2	Ammonium Permanganate
7784-42-1	Arsine (also called Arsenic Hydride)
542-88-1	Bis(Chloromethyl) Ether
10294-34-5	Boron Trichloride
7637-07-2	Boron Trifluoride
7726-95-6	Bromine
13863-41-7	Bromine Chloride
7789-30-2	Bromine Pentafluoride
7787-71-5	Bromine Trifluoride
106-96-7	3-Bromopropyne (also called Propargyl Bromide)
75-91-2	Butyl Hydroperoxide (Tertiary)
614-45-9	Butyl Perbenzoate (Tertiary)
75-44-5	Carbonyl Chloride (see Phosgene)
353-50-4	Carbonyl Fluoride
9004-70-0	Cellulose Nitrate (Concentration greater than 12.6% nitrogen)
7782-50-5	Chlorine
10049-04-4	Chlorine Dioxide
13637-63-3	Chlorine Pentrafluoride
7790-91-2	Chlorine Trifluoride
96-10-6	Chlorodiethylaluminum (also called Diethylaluminum Chloride)
97-00-7	1-Chloro-2,4-Dinitrobenzene
107-30-2	Chloromethyl Methyl Ether
76-06-2	Chloropicrin
None	Chloropicrin and Methylbromide Mixt.
None	Chloropicrin and Methylchloride Mixt.
80-15-9	Commune Hydroperoxide
460-19-5	Cyanogen
506-77-4	Cyanogen Chloride
675-14-9	Cyanuric Fluoride
110-22-5	Diacetyl Peroxide (concentration greater than 70%)

334-88-3	Diazomethane
94-36-0	Dibenzoyl Peroxide
19287-45-7	Diborane
110-05-4	Dibutyl Peroxide (Tertiary)
7572-29-4	Dichloro Acetylene
4109-96-0	Dichlorosilane
557-20-0	Diethylzinc
105-64-6	Diisopropyl Peroxydicarbonate
105-74-8	Dilauroyl Peroxide
75-78-5	Dimethyldichlorosilane
57-14-7	Dimethylhydrazine, 1,1-
124-40-3	Dimethylamine, Anhydrous
97-02-9	Dinitroaniline-2,4
1338-23-4	Ethyl Methyl Ketone Peroxide (also Methyl Ethyl Ketone Peroxide; concentration > 60%)
109-95-5	Ethyl Nitrite
75-04-7	Ethylamine
371-62-0	Ethylene Fluorohydrin
75-21-8	Ethylene oxide
151-56-4	Ethyleneimine
7782-41-4	Fluorine
50-00-0	Formaldehyde (Formalin)
110-00-9	Furan
684-16-2	Hexafluoroacetone
7647-01-0	Hydrochloric Acid, Anhydrous
7664-39-3	Hydrofluoric Acid, Anhydrous
10035-10-6	Hydrogen Bromide
7647-01-0	Hydrogen Chloride
74-90-8	Hydrogen Cyanide, Anhydrous
7664-39-3	Hydrogen Fluoride
7722-84-1	Hydrogen Peroxide (52% by wt or >)
7783-07-5	Hydrogen Selenide
7783-06-4	Hydrogen Sulfide
7803-49-8	Hydroxylamine
13463-40-6	Iron, Pentacarbonyl
75-31-0	Isopropylamine
463-51-4	Ketene
78-85-3	Methacrylaldehyde
920-46-7	Methacryloyl Chloride
30674-80-7	Methacryloyloxyethyl Isocyanate
126-98-7	Methyl Acrylonitrile
74-89-5	Methylamine, Anhydrous
74-83-9	Methyl Bromide
74-87-3	Methyl Chloride

79-22-1	Methyl Chloroformate
1338-23-4	Methyl Ethyl Ketone Peroxide (concentration > 60%)
453-18-9	Methyl Fluoroacetate
421-20-5	Methyl Fluorosulfate
60-34-4	Methyl Hydrazine
74-88-4	Methyl Iodide
624-83-9	Methyl Isocyanate
74-93-1	Methyl Mercaptan
79-84-4	Methyl Vinyl Ketone
75-79-6	Methyltrichlorosilane
13463-39-3	Nickel Carbonly (Nickel tetracarbonyl)
7697-37-2	Nitric Acid (94.5% by wt. Or >)
10102-43-9	Nitric Oxide
100-01-6	Nitroaniline (paranitroaniline)
75-52-5	Nitromethane
10102-44-0	Nitrogen Dioxide
10102-44-0	Nitrogen Oxides (NO; NO(2); N204; N203)
10544-72-6	Nitrogen Tetroxide (also called Nitrogen Peroxide)
7783-54-2	Nitrogen Trifluoride
10544-73-7	Nitrogen Trioxide
8014-94-7	Oleum (65% to 80% by weight; also called Fuming Sulfuric acid)
20816-12-0	osmium Tetroxide
7783-41-7	oxygen Difluoride (Fluorine Monoxide)
10028-15-6	Ozone
19624-22-7	Pentaborane
79-21-0	Peracetic Acid (concentration >60% Acetic Acid; also called Peroxyacetic Acid)
7601-90-3	Perchloric Acid (concentration >60%)
594-42-3	Perchloromethyl Mercaptan
7616-94-6	Perchloryl Fluoride
79-21-0	Peroxyacetic Acid (concentration >60% Acetic Acid; also called Peracetic Acid)
75-44-5	Phosgene (also called Carbonyl chloride)
7803-51-2	Phosphine (Hydrogen phosphide)
10025-87-3	Phosphorus Oxychloride (also called Phosphoryl Chloride)
7719-12-2	Phosphorus Trichloride
10025-87-3	Phosphoryl Chloride (also called Phosphorus Oxychloride)
106-96-7	Propargyl Bromide
627-3-4	Propyl Nitrate
107-44-8	Sarin
7783-79-1	Selenium Hexafluoride
7803-52-3	Stibine (Antimony Hydride)
7446-09-5	Sulfur Dioxide (liquid)
5714-22-7	Sulfur Pentafluoride
7783-60-0	Sulfur Tetrafluoride

7446-11-9	Sulfur Trioxide (also called Sulfuric Anhydride)
7446-11-9	Sulfuric Anhydride (also called Sulfur Trioxide)
7783-80-4	Tellurium Hexafluoride
116-14-3	Tetrafluoroethylene
10036-47-2	Tetrafluorohydrazine
75-74-1	Tetramethyl Lead
7719-09-7	Thionyl Chloride
1558-25-4	Trichloro (chloromethyl) Silane
27137-85-5	Trichloro (dichlorophenyl) Silane
10025-78-2	Trichlorosilane
79-38-9	Trifluorochloroethylene
407-25-0	Trifluoroacetic anhydride
2487-90-3	Trimethoxysilane

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614-45-9	Butyl Perbenzoate (Tertiary)
75-44-5	Carbonyl Chloride (see Phosgene)
353-50-4	Carbonyl Fluoride
9004-70-0	Cellulose Nitrate (Concentration greater than 12.6% nitrogen)
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10049-04-4	Chlorine Dioxide
13637-63-3	Chlorine Pentrafluoride
7790-91-2	Chlorine Trifluoride
96-10-6	Chlorodiethylaluminum (also called Diethylaluminum Chloride)
97-00-7	1-Chloro-2,4-Dinitrobenzene
107-30-2	Chloromethyl Methyl Ether
76-06-2	Chloropicrin
None	Chloropicrin and Methylbromide Mixt.
None	Chloropicrin and Methylchloride Mixt.
80-15-9	Commune Hydroperoxide
460-19-5	Cyanogen
506-77-4	Cyanogen Chloride
675-14-9	Cyanuric Fluoride
110-22-5	Diacetyl Peroxide (concentration greater than 70%)

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7616-94-6	Perchloryl Fluoride
79-21-0	Peroxyacetic Acid (concentration >60% Acetic Acid; also called Peracetic Acid)
75-44-5	Phosgene (also called Carbonyl chloride)
7803-51-2	Phosphine (Hydrogen phosphide)
10025-87-3	Phosphorus Oxychloride (also called Phosphoryl Chloride)
7719-12-2	Phosphorus Trichloride
10025-87-3	Phosphoryl Chloride (also called Phosphorus Oxychloride)
106-96-7	Propargyl Bromide
627-3-4	Propyl Nitrate
107-44-8	Sarin
7783-79-1	Selenium Hexafluoride
7803-52-3	Stibine (Antimony Hydride)
7446-09-5	Sulfur Dioxide (liquid)
5714-22-7	Sulfur Pentafluoride
7783-60-0	Sulfur Tetrafluoride

7446-11-9	Sulfur Trioxide (also called Sulfuric Anhydride)
7446-11-9	Sulfuric Anhydride (also called Sulfur Trioxide)
7783-80-4	Tellurium Hexafluoride
116-14-3	Tetrafluoroethylene
10036-47-2	Tetrafluorohydrazine
75-74-1	Tetramethyl Lead
7719-09-7	Thionyl Chloride
1558-25-4	Trichloro (chloromethyl) Silane
27137-85-5	Trichloro (dichlorophenyl) Silane
10025-78-2	Trichlorosilane
79-38-9	Trifluorochloroethylene
407-25-0	Trifluoroacetic anhydride
2487-90-3	Trimethoxysilane

Appendix G - Glassware Used For Drug Making

"Chemical laboratory apparatus" means any item of equipment designed, made, or adapted to manufacture a controlled substance or a controlled substance analogue, including:

- a condenser;
- a distilling apparatus;
- a vacuum drier;
- a three-neck or distilling flask;
- a tableting machine;
- an encapsulating machine;
- a filter, Buchner, or separatory funnel;
- an Erlenmeyer, two-neck, or single-neck flask;
- a round-bottom, Florence, thermometer, or filtering flask;
- a Soxhlet extractor;
- a transformer;
- a flask heater;
- a heating mantel; or
- an adaptor tube.

Notes

Appendices A and D list the known carcinogens and the acute toxic chemicals as per OSHA regulations. These materials must be inventoried and proper SOP (standard operating procedures) developed to insure that they are being properly handled and that the environmental controls are working correctly.
Please contact the Chemical Hygiene Officer (x4429) if any of the above chemicals are in your laboratories. An inventory form will be available from the Risk Management Services group as well as on our WEBSITE (http://www.web2.edu/riskman). Please fill out the form, inputting all of the chemicals that are either known carcinogens or are on the acute toxic chemical list (Appendix D).

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Appendix I - Laboratory Safety Rules and Best Practices

Navigation

Introduction

Laboratory safety is critically important to all who are responsible for or who work in and around laboratories. Although laboratory types and functions can differ, there are basic rules and best practices that can be implemented and observed in all laboratories, helping to improve overall laboratory performance, while protecting the health and safety of all involved.

> **Fact**
> Human error, poor laboratory techniques and misuse of equipment cause the majority of laboratory injuries and work related infections.

Objective

The objective of these rules and practices is to promote a basic level of safety awareness and to encourage proper work practices in laboratories. These practices apply to all types of laboratories; however, many laboratories require additional rules and procedures specific to the risks and activities undertaken and the particular material(s) and equipment in use.

Contact the Principal Investigator, Laboratory Supervisor or Laboratory Safety Officer responsible for your laboratory if you have additional questions or concerns, or Risk Management Services (RMS) at 940-565-4919.

Unsafe or Harmful Acts and Conditions

Safety is an important aspect of any properly functioning laboratory. Protecting those in and around a laboratory, laboratory equipment, and the surrounding environment are critical components to effective prevention programs.

The rules and best practices contained in this document serve to demonstrate only the basic levels of safety required to ensure safe laboratory activities. All laboratory personnel are to be mindful of the ramifications of their actions, and work carefully and particularly to avoid, minimize or mitigate negative outcomes that may cause injury, death, property damage, and/or harm the environment.

In light of the impossibility to cover any and all hazards and exposures arising from laboratory materials and activities with this and other safety manuals, it is **strongly recommended**, when not required by the type of chemical (such as carcinogens and extremely hazardous materials), that laboratories develop standard operating procedures and written protocols to guide workers in safely working with materials, equipment and conditions within the laboratory.

In addition, at times during inspections or otherwise, unsafe acts or conditions observed by or reported to Risk Management Services may be investigated, and remediation shall be required, with steps implemented to prevent unnecessary risks to life, property, and the environment. To this end, unsafe acts and conditions not explicitly covered by these rules and best practices, or contained within the Chemical Hygiene Plan or other safety manuals, are to be considered issues requiring a response following an inspection and/or report.

Best Practices

The best practices contained in this guide are broken into the following key areas:

- Incident Reporting and General Compliance

Incident Reporting and General Compliance

1. Within 24 hours (unless otherwise noted in list) all incidents listed below must be reported to the Chemical Hygiene/Biosafety Officer (peter.tay@unt.edu):
    - hazardous materials or related reagents
    - unsafe act or condition that may cause injury, death, property damage, or environmental harm
    - injuries and/or cuts
    - missing or stolen materials (non-hazardous and uncontrolled substances, one week)
    - misuse or abuse of chemicals and/or materials, including Personal Protective Equipment (next business day)
    - use of spill kit, to request resupply (next business day)
2. Report changes in laboratory contact information to RMS by next business day (940-565-4919).
3. Overnight experiments are required to inform Principal Investigator (PI) responsible for laboratory, post notice form on main entry to lab, and email completed form to the Chemical Hygiene Officer (peter.tay@unt.edu).
4. Annual laboratory chemical inventories are recommended.

General Housekeeping

1. Aisles and walkways are to be kept clear and free of all tripping hazards at all times.
2. High shelves, when in use, should never store items which might fall and injure, or are difficult to move or carry.
3. Storage on high shelves cannot be closer than 24" to the ceiling in non-sprinkled buildings (18" in sprinkled buildings).
4. Where floors are subject to wet conditions, proper precautions and safeguards (mats, drains, etc...) are required to prevent slip hazards.
5. Empty containers, boxes, and broken equipment are to be promptly removed and discarded.
6. Emergency exits are never to be blocked or poorly accessible.

Personal Protection

1. Personal Protection Equipment (PPE) appropriate for experiments should be worn at all times in the laboratory.
2. PPE is required to be worn by personnel while working with hazardous materials.
3. Reusable PPE is to be kept in good condition and discarded when cracked, torn, or otherwise damaged in such a way as to compromise protection.
4. Disposable PPE should always be available in sufficient quantities for daily use by personnel.
5. Laboratory personnel are required to wear closed-toed shoes and dress sufficient to cover legs (no shorts, skirts, etc...).

Lab Practices

1. Gloves should always be disposed of promptly in a manner according to use (biological, chemical, etc...).
2. Laboratory personnel are not to eat or drink in the laboratory.
3. Fume hoods are required to be used when handling hazardous materials.
4. Maintenance and recordkeeping of controlled substances is to be observed at all times.

Safety Equipment

1. Eye wash stations are to be accessible and clear of obstructions.
2. Eye wash stations are to be inspected, maintained and tested regularly, including testing for sufficient pressure to effect operation.
3. Safety showers are to be accessible and clear of obstructions.
4. Safety showers are to be inspected, maintained, and tested regularly.
5. Chemical spill response supplies are to be available and replaced promptly when consumed.
6. Care should be taken not to compromise the performance of the fume hood through improper use; for more information, see Chemical Fume Hood Safety.

Hazardous Materials

1. Hazardous materials are required to be disposed of properly; for inquiries, contact RMS at 940-565-4919, or to request a pickup go to http://rms.unt.edu.

2. Hazardous waste is to be removed as promptly as possible and never accumulated beyond what is necessary.
3. Hazardous materials are required to be properly labeled.
4. Sharps containers are provided for use and required for sharps materials.
5. Broken glass is required to be placed into an appropriate broken glass receptacle.

Chemical Use and Storage

1. Incompatible materials and substances are always to be properly segregated.
2. Hazardous materials are never be stored with materials meant to be eaten; refrigerators are not to be used dually to store chemicals and materials with food or drink.
3. All high-pressure cylinders are to be securely fastened and with appropriate safety precautions at all times; transport of cylinders is to be accomplished with the use of an appropriate dolly or device designed to transport the type of cylinder to be moved.
4. Cylinders not in use are to be capped.
5. Fume hoods are only to be used to keep chemicals in use during an experiment, and not for storage reasons.
6. Hazardous materials are only to be available in the quantity needed for the experiment in process; quantities in excess of one quart/pint (depending on type) are not to be stored on the laboratory bench.
7. Hazardous materials and reagents are never to be stored on the floor.
8. Chemicals are required to be labeled with the full name and target organs of the chemical.

Flammable Materials

1. Flammable materials are only to be kept in the quantity required for the experiment.
2. Flammable materials storage cabinets are required when storing flammable materials, except flammable liquids, which are required to be stored in an explosion-proof refrigerator.
3. Flammable material quantities in excess of one quart are not allowed.
4. Flammable materials are always to be kept sufficiently far enough away from an ignition source so as not to introduce an explosion hazard.

Infectious or Potentially Infectious Materials

1. Biohazards are allowed to be used only after a written protocol has been developed.
2. With a written protocol, all biohazard use is to strictly follow that written protocol.
3. Sterilized biohazard bags are to be disposed of properly according to the written protocol, and never by placing in unmarked bags or by removing/obscuring biohazard labeling.
4. Proper biohazard warning labels identifying biohazardous agents or biohazard areas are required.

Signs and Labeling

1. Clean areas are to be clearly marked and identified.
2. Emergency call lists are to be posted at all doors to laboratory.
3. Laboratory refrigerators, freezers, and/or microwaves are to be labeled 'Not for Food Use/Flammable Liquids'.
4. Restricted areas, when required, are to be properly identified and secured.

Training, Records and Access to Safety Manuals

1. Personnel training sign off sheets are to be kept on file.
2. Regular training (DVD, tape, online) is to be performed as needed/required.
3. Chemical Hygiene and Biosafety Plans are available and personnel are to be made aware of how to access (online).

Appendix J - Self-Assessment Training

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Introduction

The following guide lists training requirements associated with related activities. Participant must identify any special training related to their activities. The training courses listed are mandatory lab/workplace safety training for all the UNT employees, scientists, researchers, TA's, and RA's.

Safety Training Course

Art Safety

https://riskmanagement.unt.edu/riskman/index.php?section=onlinetraining&group=artsafety

Frequency of training	Biennial

If you...

1. Use art materials, paints, solvents, woodwork, sculptures, metals, etc., or major in Art.

Biological Safety

https://riskmanagement.unt.edu/riskman/index.php?section=onlinetraining&group=biosafety

Frequency of training	Biennial

If you...

1. Use biological materials, recombinant DNA, or toxins requiring BSL1 or BSL2 containment.
2. Supervise a laboratory that uses biological or recombinant DNA, or toxins requiring BSL1 or BSL2 containment.

Blood-borne Pathogens

https://riskmanagement.unt.edu/riskman/index.php?section=onlinetraining&group=bloodborne

Frequency of training	Annual

If you...

1. Perform research with HIV or HBV, use human blood, cadaver, body fluids, human cells, human cell lines, work with patients, or handle patient samples.

2. Ship or prepare to ship infectious agents (human, animal or plant), genetically modified organisms, human specimens.
3. Enter biological research labs to provide maintenance or service
4. Repair equipment from biological research labs as a non-researcher providing a service.

BSL2 Safety

https://riskmanagement.unt.edu/riskman/index.2.php?section=onlinetraining&group=biosafetyleveltwo

Frequency of training	Annual

If you...

1. Use biological materials, recombinant DNA, human blood, tissues, body fluids, infectious agents, or toxins requiring BSL2 containment.
2. Supervise a laboratory that uses biological or recombinant DNA, human blood, tissues, body fluids, infectious agents, or toxins requiring BSL2 containment.

Chemical Fume Hood

https://riskmanagement.unt.edu/riskman/index.php?section=onlinetraining&group=chemicalfumehood

Frequency of training	Biennial

If you...

1. Use hazardous chemicals in a laboratory or workplace.

Chemical Safety

https://riskmanagement.unt.edu/riskman/index.php?section=onlinetraining&group=labsafetyv

Frequency of training	Biennial

If you...

1. Use potentially hazardous chemicals or nonhazardous chemicals in a laboratory.
2. Supervise students/employees using potentially hazardous chemicals in a laboratory, i.e. PI/manager, RA, TA, supervisor.
3. Use potentially hazardous chemicals in a work place other than a laboratory.
4. Supervise workers in the workplace, i.e. PI/supervisor.

Cleanroom Safety

Users or cleanrooms should also see the Chemical Safety and Hydrofluoric Safety training sections.

Frequency of Training	Annual

If you...

1. Use a cleanroom (take training before initial use)

Ethidium Bromide

https://riskmanagement.unt.edu/riskman/index.php?section=onlinetraining&group=ethidiumbromide

Frequency of training	Biennial

If you...

1. Use Ethidium Bromide for staining DNA/RNA, or cell biology in a laboratory.

Laboratory Waste

https://riskmanagement.unt.edu/riskman/index.2.php?section=onlinetraining&group=laboratorywaste

Frequency of training	Biennial

If you...

1. Handle hazardous chemicals and infectious agents in the laboratory.
2. Are laboratory personnel handling hazardous wastes daily.

Hydrofluoric Acid Safety

https://riskmanagement.unt.edu/riskman/index.php?section=onlinetraining&group=hydrofluoricacid

Frequency of training	Annual

If you...

1. Use hydrofluoric acid in a laboratory or work place.

Pyrophoric Safety

https://riskmanagement.unt.edu/riskman/index.php?section=onlinetraining&group=pyrophoricsafety

Frequency of training	Annual

If you...

1. Use pyrophoric chemicals in a laboratory.

Hazmat Transportation Safety

https://riskmanagement.unt.edu/riskman/index.2.php?section=onlinetraining&group=hazmattransportation

Frequency of training	Biennial

If you...

1. Ship or prepare to ship infectious agents (human, animal or plant), genetically modified organisms, human specimens, or hazardous chemicals.

Appendix K - Use and Storage of Laboratory Cylinders

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Purpose

The proper use and storage of liquefied and gas cylinders are a critical safety measure for all laboratories to observe. Although cylinders are routinely used without incident, cylinders have the potential to cause serious harm to people, the environment and the property of the university, and due care must always be observed when handling, using and storing cylinders.

The following protocol and procedures have been developed to enumerate requirements that all laboratories shall follow in the safe handling of compressed or liquefied gas cylinders. No exceptions to this protocol will be allowed.

Definitions

Cylinder – A tank or pressure vessel used to store liquefied or gas cylinders at or above atmospheric pressure.

Bottle – A cylinder containing high pressure gas.

Lecture bottle – A small compressed or liquefied gas cylinder, 12-18 inches long and 2-3 inches in diameter.

Non-lecture bottle – A cylinder of varying size, greater than a lecture bottle, containing compressed or liquefied gas at high compression.

Hazardous cylinder – A cylinder exhibiting a characteristic that is considered to be a “hazardous” cylinder will have at least one of the following characteristics:

1. A health hazard rating of 3 or 4
2. A health hazard rating of 2 without physiological warning properties
3. Any pyrophoric gas
4. Any explosive gas

“In use” – A cylinder connected through a regulator or to a manifold to deliver gas to a laboratory operation.

Reserve cylinders – A single cylinder secured alongside another, “in use” cylinder, to be used as a reserve for that cylinder.

Laboratory – A room or space provided for instructional, observation, measurement or other research activities in a non-production environment. For the purposes of this document, closets, chaseways and other service areas are not included in the definition of a laboratory (see “service area” definition below). This definition is based on the Chemical Hygiene Plan laboratory definition.

Service area – A closet, chase way or other designated area used to wholly or partially support a laboratory as defined in this document.

Responsibilities

Principal Investigators and laboratory staff/supervisors – Responsible for overseeing or performing proper installation of a gas cylinder into a regulator or manifold, for overseeing or performing proper and safe storage and transport of gas cylinders while in possession of a gas cylinder, and for training responsible laboratory staff and students in the proper handling, transport and storage of cylinders.

Laboratory staff – Employees, to include graduate students and teaching assistants, are to observe all rules and requirements for the handling, transport and storage of cylinders according to the safety rules enumerated in this document. Laboratory staff shall participate in required training provided by laboratory management, and report issues and incidents concerning gas cylinders immediately to supervisors.

Laboratory inspectors – During all inspections, cylinders are to be reviewed for all conditions and requirements given within this protocol. Any infractions or concerns shall be recorded and followed up with a timely re-inspection. At no time is an infraction or unsafe condition to be undocumented due to immediate remediation of the concern by laboratory staff.

Risk Management Services – RMS laboratory safety staff are to monitor all inspections and provide follow-up inspections of laboratories with documented unsafe cylinder conditions or usage as given in this document. When necessary, RMS may perform training or require training on this protocol to laboratories that exhibit a high degree of unsafe conditions or exhibit continuous problems over a period of inspections.

Cylinders with Special Requirements

Special requirements must be followed when storing a cylinder that contains a hazardous material.

Lecture bottle – A hazardous lecture bottle not “in use” (e.g., connected into a regulator or manifold) must be stored in a continuously mechanically ventilated enclosure. A properly maintained and functioning fume hood meets this requirement. A bracket or clamp must be used to secure the lecture bottle and keep tubing and piping from supporting the cylinder’s weight.

Non-lecture bottle – A hazardous cylinder greater than lecture bottle size may not be installed or stored anywhere but in a gas cabinet or approved gas cylinder storage area, prohibiting covered cylinders of these types from being stored as reserve cylinders in a laboratory, closet or other service area. In addition, hazardous cylinders in this category containing pyrophoric gases are required to have sprinkled gas cabinets.

General Protocols and Procedures

Laboratory Inspections

This protocol will be used during the laboratory inspection process to identify labs or service area (such gas supply closets) with improper cylinder storage. Any non-reserve cylinders found in a laboratory will be required to be moved immediately to an approved gas storage area, with a follow-up inspection to determine compliance.

“In Use” Cylinder Requirements

Cylinders must be secured at all times from tipping, rolling or falling, by devices or means designed for the specific cylinder. Straps and chains must be affixed to the upper third of the bottle. Lecture bottles, when in use, must be immobilized either bracket, clamp. A flexible hose cannot be used as a fall prevention device.

Means of egress shall not be obstructed or impeded by a gas cylinder, and hazardous cylinders shall not be installed in such a way as to endanger exit pathways from a laboratory area.

Before transporting or storing any cylinder (including empties), always check that the valve is closed and tightened before removing from the regulator or manifold fitting. Do not attempt to over tighten a cylinder valve with an unapproved device. Be extremely cautious not to open a valve accidentally, when it is not connected into a regulator or manifold, which could lead to gas leaking, rapid gas release, or other dangerous conditions that may lead to injury or property damage.

In laboratories – Non-lecture bottle cylinders in laboratories shall always be equipped with regulators designed for the gas contained in the cylinder and marked with a maximum cylinder pressure on the gauge. A regulator is required to show both cylinder and outlet pressure (two gauges).

In service areas – Non-lecture bottle cylinders must be secured at all times from tipping by devices or means designed for the specific cylinder. A station regulator and gauge is required to be equipped at the point of use.

Cylinder Delivery and Pickup

Cylinders when delivered should always be checked that proper and accurate labels and tags are affixed. Cylinder labeling and tags shall not be removed. Cylinders should only be delivered between areas on a suitable hand truck designed for cylinder transport, equipped with strapping or other means to prevent the cylinder from unexpected separation from the hand truck while in transit. Cylinders shall never be rolled or dropped.

When delivered, any cylinders equipped to accept screw-on caps shall only be accepted for delivery if equipped with a screwed-on cap or a screwed-on cap is provided. Any cylinders not in use are required to be capped for pickup. It is very important never to lose caps; when necessary, an order for additional cylinders should request caps be provided by the cylinder supplier in the event a cap cannot be located.

Cylinder Installation

Any special precautions for a type or use of a gas, cylinder or gas delivery system shall always be observed by the installer and laboratory management and staff. When installing a cylinder,

1. ensure cylinder is properly and secured;
2. use protective gloves and eye wear if necessary (ex.: cryogenic gases);
3. clear cylinder valves of dust, dirt or other debris before attaching regulators or connecting to manifolds;
4. check that the regulator being attached is for the specific gas, and do not interchange regulators not designed for a specific gas or cylinder;
5. do not force connection fittings and never tamper with safety devices on the cylinder, regulator, manifold or piping system;
6. release adjusting handle/screw on regulator before opening cylinder valve;
7. stand to the side of the regulator when opening;
8. slowly open cylinder valve.

Cylinder Storage

Approved Cylinder Storage Area

An approved cylinder storage area shall be:

- Located away from all sources of heat, flame or ignition
- Equipped with a concrete or other solid, permanent and flat surface strong enough to support the weight of a full complement of cylinders (earthen floors are not allowed)
- Equipped with strap or chain tie downs suitable to secure cylinders of the sizes to be stored in the area
- Well ventilated; if located internally in a building for storage of hazardous cylinders, must be equipped with a vent directly to the outside of the building, with a negative pressure to the internal building, and located suitably away from air returns for the building
- Preferably equipped with a locking door or locking heavy duty cage
- Preferably constructed with walls made of concrete or brick

Segregation

Cylinders in storage shall be segregated according to the same rules of segregation in laboratories. For example, flammable gases shall not be stored next to oxygen cylinders. Additionally, explosive and pyrophoric gas cylinders should not be stored at the entrance/exit doors of a gas cylinder storage area.

Reserve Cylinders

Only one non-lecture reserve gas cylinder for each gas type is allowed to be secured next to a cylinder in use. All other extra cylinders must be stored in an approved gas cylinder storage area.

Reserve cylinders must be capped, with the cap screwed tightly onto the cylinder. No regulator or connective fitting may be left on a reserve or stored cylinder. Both in use and reserve cylinders must be secured. For hazardous gases that must be in a vented cabinet during use, no straps or chains are required while a cylinder is in the cabinet.

Special Uses and Storage

Cylinders for specials uses may be stored in a laboratory only if a suitable and secure storage area cannot be provided and those cylinders fit under certain a condition enumerated below.

All cylinders are required to be stored according to the stipulations of an in-use cylinder (and hazardous cylinder stipulations where applicable), without the requirement to be connected to a regulator. RMS reserves the authority to deem a cylinder storage situation as inappropriate if necessary, including in situations of life and fire safety, or when the volume or combination of cylinders is deemed dangerous by RMS.

Conditions which fall under the “Special Uses and Storage” fit one of the following criteria:

- Lecture bottles.
- Cylinders used for continuing operations (such as a supply cylinder filled by a vendor) that is properly installed, secured and well-ventilated.
- Cylinders in sizes dimensionally smaller than a D cylinder of specialty gases (maximum, two).
- Situationally inactive cylinder(s) required for an ongoing experiment, with storage of a cylinder to last no longer than the duration of the experiment.

Nitrogen/Argon Large Volume Uses

Processes which require a large volume of nitrogen or argon (example: glove box purging) may keep two total reserve cylinders for the duration of the process. All other requirements for reserve and empty cylinders must be observed.

“Empty” Cylinders

Cylinders, although unable to provide product, are never completely empty and may have significant amounts of product left. All “empty” cylinders shall be…

- marked “EMPTY” immediately upon determining the cylinder is no longer usable,
- completely capped (cap fully screwed onto the cylinder), and
- moved by the end of the business day or (after hours or on weekend and holiday periods), by the next business day.

Empty cylinders may only be stored in an approved storage area and are required to be chained while awaiting pickup. While in storage, empty and full cylinders should be segregated.

References

For more information on laboratory and life safety codes, see:

NFPA 45, Standard on Laboratories Using Chemicals, Chapter 11, “Compressed and Liquefied Gases”
NFPA 101, Life Safety Code, Chapters 39.3.2, 8.7.4.1, 7.1.10

Appendix L - Laboratory Incident Reporting Procedures

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Purpose

Incident reports help protect the health and safety of researchers, lab staff, university employees and the general public, and are essential to assess required training and resource needs of the university. The following procedures were developed to assist employees, and students in following university policies and regulatory requirements (chemical hygiene plan) related to the reporting, investigation and correction of laboratory incidents.

Definitions

Biohazard exposure – The inhalation, ingestion, absorption or injection of a biohazardous agent.

Biohazardous agent – An agent of biological origin that has the capacity to produce deleterious effects on humans.

Chemical exposure – The inhalation, ingestion, absorption or injection of harmful chemicals.

Chemical spill – An uncontrolled release of a hazardous chemical, either in the form of a gas, liquid, or solid.

Emergency – The potential or immediate threat to life, health, or property.

Incident – Any activity in a laboratory or service area that causes human injury, property damage or a release of a hazardous material. Types of incidents include, but are not limited to:

- Chemical spills
- Damage to property, including personal or privately owned
- Exposure or release of hazardous or biohazardous materials
- Injury (e.g., needle stick or eye splash), or illness resulting from the laboratory

Laboratory – A room or space provided for instructional, observation, measurement or other research activities in a non-production environment.

Near miss – An event that did not result in injury, illness, or damage, but where, given a slight shift in time or position, damage or injury easily could have occurred. Other familiar terms for these events is a "close call", or in the case of moving objects, "near collision".

Service area – A closet, chaseway or other designated area used to wholly or partially support a laboratory as defined in this document.

Responsibilities

Employee, Students and Lab Workers

The employee, student and lab worker must report all incidents to their supervisor or department designee as soon as reasonably possible (no exceptions) and are encouraged to report any near misses or unsafe working conditions whenever possible.

Laboratory Supervisors and Managers

Laboratory supervisors or managers are responsible for contacting the Lab Safety Manager within 24 hours of an incident.

The supervisor or manager must thoroughly investigate, complete and submit the Laboratory Incident Report Form within seven business days to the Lab Safety Manager at Risk Management Services.

Once the Lab Safety Manager completes an assessment and if applicable provides recommendations, the laboratory supervisors or manager is responsible to review the incident report and any recommendations or additional controls as provided by the RMS Lab Safety Manager and take the appropriate action where necessary to correct the issues.

Risk Management Services

Risk Management Services is responsible to:

- Review and assess the incident report.
- Notify appropriate departments within UNT as applicable.
- Perform a follow-up investigation if necessary, including inspection of the laboratory or affected environment, to include observing work processes and risk controls.
- If applicable, provide recommendations to the corresponding lab supervisor or manager.
- Report any regulatory-related information to the appropriate authority as applicable.

Incident Reporting Procedures

First Response

Follow standard procedures for treating injuries. Depending upon the severity of the injury, employees, students, and visitors may need to seek immediate medical attention. In these cases, the injured employee's supervisor must be contacted immediately.

Immediately contact RMS Environmental Services at (940) 565-2109 or UNT Police at (940) 565-3000 after hours if the incident involves:

- Injury or death of a person
- Chemical exposure or spill
- Radiation
- Biohazard exposure
- Laser exposure

Recording Details of the Incident

Once informed of an incident or near miss, the lab supervisor or manager must:

1. Contact the Lab Safety Manager within 24 hours of the incident.
2. Thoroughly investigate the incident or near miss.
3. Complete a Laboratory Incident Report form, which may be obtained from the RMS website (http://rms.unt.edu/).
4. Return the completed form to the Lab Safety Manager at Risk Management Services within seven business days.

Contact the Lab Safety Manager at (940) 369-8055 if you have any questions.

Completing the Laboratory Incident Report Form

Complete all applicable fields in the Laboratory Incident Report form. Attach additional pages as needed. The following information is to be included if applicable:

- Any persons involved in the incident, including witnesses with contact information.
- Any hazardous materials involved.
- Were the laboratory standard operating procedures (SOPS) effective at the time of the incident or near miss effective? Were there any deviations from the SOPS?
- Personal protective equipment (PPE) in use at the time of the incident or near miss.
- If there was any equipment failures involved (including PPE).
- Any injury or illness associated with the incident.

Risk Management Services

Once the Laboratory Incident Report is received, the Lab Safety Manager will:

1. Perform an assessment of the incident report.
2. Notify appropriate departments.
3. Follow-up with interviews, inspections and observation of the affected process(es) if necessary.
4. Review and determine if the risk may be avoided or mitigated through avoidance, segregation, alternate processes with lesser severity or likelihood, or with additional controls such as training, engineering controls, greater supervision, or other means as necessary.

Insurance and Claims

The Lab Safety Manager will notify Insurance and Claims by email as soon as possible when a lab incident occurs involving an injury or illness to an employee (including part-time employees and student employee) or when a claim resulting from an incident against the university is possible.

Emergency Management

Emergency management will be notified immediately when an emergency occurs in a laboratory.

Forms and Tools

Laboratory Incident Report Form

References

OSHA Accident/Incident Investigation