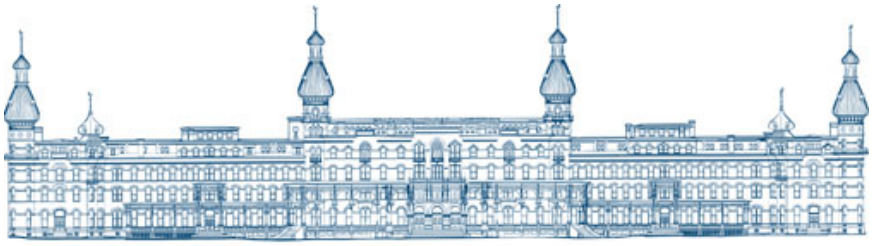
Chemical Hygiene Plan



The University Of

TAMPA

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Chemical Hygiene Plan
for The University of Tampa
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TABLE OF CONTENTS

1.0 Introduction 1

1.1. Purpose 1
1.2. Intent 1
1.3. Organization 1
1.4. Location 2
1.5. Chemical Safety Website 2

2.0 Responsibilities 2

2.1. President of the University 2
2.2. Chemical Hygiene & Biological Safety Officer 3
2.3. Principal Investigator 3
2.3.1 Chemical Hygiene Officers at UT 4
2.4. Laboratory and Studio Personnel (faculty, instructional staff and students) 5
2.5. Students Enrolled in Laboratory/Studio Courses 6
2.6. Facilities 6

3.0 Resources 6

3.1. UT's Chemical Safety Website 6
3.2. OSHA Regulations 6
3.3. Chemical Safety Information Sources 8
3.4. Material Safety Data Sheet 8
3.5. Container Labeling 8

4.0 Hazard Identification General Principles 9

4.1. Perform Hazard Assessment 10
4.2. Minimize Chemical Exposures 10
4.3. Avoid Underestimation of Risk 10
4.4. Provide Adequate Ventilation 10
4.5. Observe Established Standards 10
4.6. Follow the Chemical Hygiene Plan and Best Practices/Procedures. 11

5.0 Training 11

5.1. Chemical Safety Training 11
5.2. Student Training 12
5.3. Facilities Supervisors 12

6.0 Chemical Exposure Signs and Symptoms 13

6.1. Common Signs and Symptoms of Chemical Exposure 13
6.2. Exposure Monitoring 14

7.0 Medical Examination and Consultation 14

7.1. Determination 14
7.2. Exposure Information 15

7.3. Examination Criteria and Frequency 15
7.4. Physician's Written Opinion 15
7.5. Cost and Scheduling 16

8.0 Recordkeeping 16

8.1. Records 16
8.2. Retention and Storage 16
8.3. Custom Forms 17

9.0 Chemical Hygiene Plan Evaluation, Review and Update 17

9.1. Plan Evaluation and Inspections 17
9.2. Plan Review and Update 17
9.3. Hyperlinks Imbedded in Plan 17

10.0 Toxic Substances Control Act (TSCA) 17

10.1. Introduction 17
10.2. Research and Development (R&D) Exemption 18

11.0 Chemical Facility Antiterrorism Standard 20

12.0 Controlled Substances 20

13.0 Basic Rules and Procedures For Working With Chemicals 21

13.1. General Rules 21
13.2. Supervision 22
13.3. Personal Hygiene 22
13.4. Housekeeping 23
13.5. Unintended Experiment or Unusual Risk 23

14.0 Personal Protective Equipment 24

14.1. General Consideration 24
14.2. Protection of Skin and Body 24
14.2.1 Normal Clothing Acceptable in the Laboratory 25
14.2.2 Hand Protection 25
14.2.3 Eye Protection 27
14.2.4 Respiratory Protection 28

15.0 Engineering Controls 28

15.1. Chemical Hoods, Bio-Safety Cabinets and Local Exhaust Ventilation 28

16.0 Laboratory and Studio Emergency Equipment 31

16.1. Emergency Eyewashes and Safety Showers 31
16.2. Fire Extinguishing Equipment 31

17.0 Chemical Procurement, Distribution and Storage 31

17.1. Chemical Procurement 31
17.2. Distribution 32

17.3. Chemical Storage in the Laboratory 32
17.4. Chemical Stability or Reactivity 33
17.5. Incompatible Chemicals 34

18.0 Chemical Spills & Accidents 34

18.1. General Information 34
18.2. Sink Traps 35
18.3. Minor Chemical Spill 35
18.4. Major Chemical Spill 35
18.5. Acid/Base Spills 35
18.6. Mercury Spills 35
18.7. Alkali Metal Spills 36
18.8. White Phosphorus 36

19.0 Inclement Weather and Planned Power Outage Precautions 36

20.0 Personal Safety, Contamination and Injury 36

20.1. General Information 36
20.2. Chemicals Spills on the Body 37
20.3. Chemical Splash in the Eye 37
20.4. Ingestion of Hazardous Chemicals 37
20.5. Inhalation of Smoke, Vapors and Fumes 38
20.6. Burning Chemicals on Clothing 38
20.7. Actions to be Avoided During an Emergency 38

21.0 Fire And Fire Related Emergencies 38

22.0 Hazardous Waste Disposal Program 39

23.0 Flammable Liquids 40

23.1. General Information 40
23.2. Special Handling Procedures 41

24.0 Highly Reactive Chemicals & High Energy Oxidizers 42

24.1. General Information 42
24.2. Special Handling Procedures 43
24.3. List of Shock Sensitive Chemicals 44
24.4. List of High Energy Oxidizers 46
24.5. List of Peroxide Forming Chemicals 47

25.0 Use of Compressed Gases and Welding Activities 48

25.1. General Information 48
25.2. Special Handling Procedures 48
25.3. Special Precautions for Hydrogen 49
25.4. Special Precautions for Cryogens 49

26.0 Corrosive Chemicals 50

26.1. General Information 50
26.2. Special Handling Procedures.....50

27.0 Chemicals of High Acute & Chronic Toxicity.....51

27.1. General Information 51
27.2. Other Factors That Affect Toxicity 53
27.3. Special Handling Procedures.....53

28.0 UT Best Management Practices 55

29.0 Laboratory Specific Chemical Hygiene Plan Template 57

Appendix A - OSHA Lab Standard (29 CFR 1910.1450).....58
Appendix B – Copy of Training Record 58
Appendix C – Laboratory and Art Studio General Safety Summary.....58
Appendix D – Laboratory and Studio Self Audit.....58
Appendix E – Glossary of Terms 58
Appendix F – Laboratory Safety Reference Material 68

Acknowledgments - Sources of Information

The University of Tampa acknowledges that information/documents freely available on the web from Yale University, Harvard University, and Northeastern University were used in the creation of this document. Because this document was created specifically for UT site operations sections of text that are taken in whole or paraphrased are not individually cited. Rather, we acknowledge globally here the use of these sources in the creation of this document. This is also true of the National Research Council book "Prudent Practices in the Laboratory" (1995) published by the National Academy Press.

This information is for the public good at UT and any other organization that may find this document useful is welcome to borrow any of this material and adapt it to their institution. Please simply acknowledge having done so globally for the document as we have done here, if you choose to use any of this material, including referencing the aforementioned institutions in your acknowledgment section.

RECORD OF AMENDMENTS

Date	Section	Amendment	Initial
09/16/16	All	Changed references to MSDS, CEHSC, and Website for updates	LAKJ
08/01/17	All	Global review and update	LAKJ
08/11/18	All	Reviewed – No Changes Made	LAKJ
08/06/19	All	Reviewed – No Changes Made	LAKJ
08/14/20	All	Reviewed – No Changes Made	LAKJ
01/19/21	All	Updates for Accessibility	LAKJ

1.0 INTRODUCTION

1.1. Purpose

The purpose of this Chemical Hygiene Plan [CHP] is to comply with each element of the Occupational Safety and Health Administration's [OSHA's] Laboratory Standard 29 CFR 1910.1450: *Occupational Exposure to Hazardous Chemicals in the Laboratory*.

1.2. Intent

The intent of this CHP is to convey chemical health and safety information to University of Tampa [UT] laboratory and/or studio employees working with hazardous materials and to ensure appropriate work practices, procedures and controls are in place to protect laboratory and/or studio employees from chemical health and safety exposure hazards. The key requirements of the OSHA Standard are as follows:

- You must have access to the Chemical Hygiene Plan.
- Safety Data Sheets (SDS) must be available to you.
- You must be informed of the hazardous chemicals present in your laboratory and/or studio and the operations in which they are involved.
- You must receive adequate training in working with hazardous chemicals.
- Chemical containers and chemical waste must be labeled properly.
- You must know how to detect the presence or release of a hazardous chemical.
- You must be provided with personal protective equipment (safety glasses, gloves, lab coat, for example).
- You must be provided with engineering controls (fume hood, for example).
- You must receive training in the proper procedures for responding to emergencies.
- You are entitled to a medical consultation, whenever there is an event, such as a spill or leak that result in suspected chemical exposure.
- If there is reason to believe that the airborne concentration of a hazardous chemical may exceed established exposure limits, air monitoring may be required.
- You must be notified of the results of any air monitoring conducted.
- You are entitled to a copy of established exposure limits for hazardous chemicals.
- You are entitled to a complete copy of the OSHA Lab Standard as provided in Appendix A of this document.

1.3. Organization

The CHP is organized into five sections. **Section I** contains general administrative components of the CHP which includes responsibilities, hazard identification, training, recordkeeping, medical surveillance, exposure monitoring, and annual plan evaluation.

Section II contains recommended general precautions for working with laboratory chemicals. These precautions address broad classes of chemicals and include information and guidance in the following areas:

- Common hazards
- General safe work practices
- Chemical storage
- Personal protective equipment
- Other safety equipment and engineering controls
- Work practices for particularly hazardous substances
- Chemical waste management
- Emergency procedures

Section III contains specific detailed information regarding chemical use and exposures.

Section IV is a summary page of UT site specific policies that are best management practice protocols for all areas of campus.

Section V is provided as a template for each individual laboratory to customize this Chemical Hygiene Plan for their operations. A template is contained in this section to provide assistance to laboratory and/or studio personnel generating specific safety procedures.

1.4. Location

The University of Tampa's CHP is located online at http://utweb.ut.edu/ehs/ and a written copy is located in the College of Natural and Health Sciences, Plant Hall Science Wing, Room 215.

1.5. Chemical Safety Website

This plan references the UT chemical safety website throughout this document.

http://utweb.ut.edu/ehs

2.0 RESPONSIBILITIES

Chemical health and safety on the University of Tampa campus is shared by all participants in the laboratory and/or studio environment, but also includes support from senior administration. The following summarizes the principal roles in this effort:

2.1. President of the University

The President has the senior-most authority over the CHP and provides resources and support for encouraging chemical safety on property controlled by the University of

Tampa through the Chemical Hygiene budget and his commitment to help foster a safe working environment.

2.2. Chemical Hygiene & Biological Safety Officer

The Chemical Hygiene & Biological Safety Officer [CHBO] oversees and manages chemical hygiene for the entire University. These duties are minimally described as follows:

- Annually Review and Update the Chemical Hygiene Plan;
- Work with the laboratory community, administrators and other employees to develop and implement appropriate chemical hygiene policies and practices;
- Provide technical assistance for complying with the Chemical Hygiene Plan, and answer chemical safety questions for employees;
- Provide advice and guidance regarding the procurement, use, and disposal of chemical wastes used in the laboratories;
- Provide technical assistance to laboratory and/or studio supervisors and workers concerning appropriate storage, handling, and disposal of hazardous chemicals;
- Develop and implement University wide chemical safety inspection and training programs;
- Assist Principal Investigators in the selection of appropriate laboratory safety practices and engineering controls for new and existing projects and procedures;
- Determine when an exposure assessment is appropriate and conduct exposure assessments;
- Know the current legal requirements concerning regulated substances;
- Investigate and ensure documentation is made of all reported accidents which result in the exposure of personnel or the environment to hazardous chemicals;
- Provide or coordinate emergency response for chemical spills;
- Supervise decontamination operations where accidents have resulted in significant contamination of laboratory areas; and
- Make budget arrangements for health and safety improvements.

2.3. Principal Investigator

A principal investigator (PI) is a generic term for UT personnel (faculty and/or staff) who have primary responsibility, either solely or collaboratively, for the safe and proper usage of chemicals and hazardous wastes in the space(s) assigned to them. Each principal investigator plays a critical role in the development, updating and continuous implementation of the Chemical Hygiene Plan in her/his laboratory and/or studio, which will be pursued at the onset of each academic year. These responsibilities include:

- Whenever necessary, acquiring the knowledge and information needed to recognize and control chemical hazards in the laboratory and/or studio;
- Conduct workplace hazard assessment and filing a timely written report to the CHBO when specific actions are requested or required to address an identified hazard in order to mitigate risk as effectively as possible;

- Selecting and employing laboratory and/or studio practices and controls that reduce the potential for exposure to hazardous chemicals to yourself and others in the space;
- Informing students and employees working in his/her laboratory and/or studio of the potential hazards associated with the use of chemicals in the laboratory and/or studio and instructing them in the safe laboratory and/or studio practices, adequate controls, and procedures for dealing with accidents involving hazardous chemicals;
- Training her/his colleagues and students in order to ensure the required chemical hygiene rules are adhered to in the laboratory and/or studio and serving as a supervisor of chemical related activities in the laboratory authorized by the PI;
- Ensuring appropriate controls (engineering and personal protective equipment) are used and are in good working order, as can be ascertained from their experience, training and personal awareness. If in doubt, ask the CHBO for assistance in ensuring this condition is met;
- The PI decides what chemicals will be brought into their lab, either through procurement by UT purchasing processes or importing a chemical from another source (e.g. another lab). This responsibility includes notifying the CHBO prior to ordering/importing and using particularly hazardous substances (p-listed substances) on University property. The most current p-listed compounds are available on the chemical safety website for easy review; and
- Developing an understanding of the regulatory requirements and standards regulating hazardous substances used in her/his laboratory and/or studio and including this understanding in the training of colleagues working in the laboratory and/or studio.
- The University does not have protocols for the use of radioactive chemicals and does not allow their procurement, importation or storage on University property. Should a PI wish to use radioactive materials, this will be discussed with their respective Dean, Chair and CHBO so that protocols can be established and followed.
- A manufactured instrument containing a radiation source is permitted. The State of Florida requires a license for the instrument. The PI(s) responsible for procuring or importing the equipment shall notify the CHBO and work collaboratively to secure a license upon acquiring the instrument, as well as meet annual reporting obligations for the renewal of the license.

2.3.1 Chemical Hygiene Officers at UT

These persons oversee the adaptation and implementation of this CHP into her/his laboratory and/or studio to help maintain a safe working environment. The chemical hygiene officer for a laboratory serves as a resource for all persons who utilize the space under her/his direction so as to provide professional guidance on the safe and proper use of chemicals in the laboratory, safety equipment, and the appropriate handling and labeling of chemical hazardous wastes generated therein.

The PI assigned, as a matter of record kept by the appropriate Dean's office and the CHBO, to a teaching, research, and/or preparatory laboratory space, by definition, serves as the chemical hygiene officer for that space. For shared laboratories/studios, all faculty and/or instructional staff who are assigned to a space serve in this capacity, unless the Dean, Department Chair and/or faculty and/or instructional staff member mutually agree upon the designation of a single individual to serve in this capacity for this space. In such instances, the CHBO will be notified of this designee.

For Sodexo facilities at UT, the supervisor of an area where chemicals are stored serves in this capacity.

The duties of an acting Chemical Hygiene Officer [CHO] may comprise:

- Ensure appropriate training is provided to new and current workers;
- Confirm workers know and follow established safe work procedures and emergency procedures;
- Ensure safety equipment and engineering controls are utilized;
- Confirm appropriate personal protective equipment is utilized;
- Routinely inspect safety equipment in the laboratory and report any noticeable deficiencies to the CHBO in writing;
- Make persons working in the lab aware of the locations of the University CHP, SDS and other important chemical safety policies/procedures/information on the chemical safety website (http://utweb.ut.edu/ehs) and the lab specific CHP.
- Develop safety procedures for new or particularly hazardous chemicals or operations when introduced to the laboratory and/or studio in consultation with the CHBO;
- Report, in writing and within 48 hours, accidents and other potential exposure conditions to the CHBO; and
- Recommend actions in writing to the CHBO to correct any unsafe condition.

2.4. Laboratory and Studio Personnel (faculty, instructional staff and students)

Laboratory and/or Studio personnel are responsible for:

- Participating in Laboratory and/or Studio safety training programs;
- Being aware of the hazards of the materials she/he is around or working with, and handling those chemicals in a safe manner;
- Planning and conducting each operation in accordance with the chemical hygiene procedures;
- Implementing and staying current good chemical hygiene habits (chemical safety practices and procedures);
- Written reporting of concern about possible unsafe conditions to the principal investigator who then notifies the CHBO; and

- The Principal Investigator and Laboratory and/or Studio personnel share responsibility for collecting, labeling and storing chemical hazardous waste properly, as well as informing students or visitors entering their Laboratory and/or Studio of the potential hazards and safety rules/precautions.

2.5. Students Enrolled in Laboratory/Studio Courses

Students shall be provided with initial safety training prior to conducting any activities involving chemicals by their instructor. The instructor shall encourage students to review all safety information and equipment where available and inform the students of the evacuation route from the building. Students are responsible for engaging in safe work practices when handling any chemical agent.

2.6. Facilities

The onsite facilities and maintenance contractor [Sodexo] is directly responsible for the repair, inspection and maintenance records of the following key safety equipment:

- Fume Hoods and Biological Safety Cabinets;
- Local Exhaust Ventilation;
- Eyewash stations;
- Safety showers;
- First aid kits; and
- Fire extinguishers

Note – Sodexo may contract with outside vendors to perform repair and maintenance functions.

3.0 RESOURCES

3.1. UT's Chemical Safety Website

http://utweb.ut.edu/ehs

3.2. OSHA Regulations

The OSHA regulation for Occupational Exposure to Hazardous Chemicals in Laboratories and other pertinent standards can be found on the government website:

http://www.osha.gov/SLTC/laboratories/standards.html

The OSHA Laboratory Health Standard defines a hazardous chemical as any element, chemical compound, or mixture of elements and/or compounds which is a physical or a health hazard. The standard applies to all hazardous chemicals regardless of the quantity.

A chemical is a physical hazard if there is scientifically valid evidence that it is a combustible liquid, a compressed gas, an explosive, an organic peroxide, an oxidizer or pyrophoric, flammable, or reactive.

A chemical is a health hazard if there is statistically significant evidence, based on at least one study conducted in accordance with established scientific principles, that acute or chronic health effects may occur in exposed individuals. General classes of health hazards include:

Carcinogens	Irritants
Reproductive Toxins	Corrosives
Sensitizers	Neurotoxins (nerve)
Hepatotoxins	Nephrotoxins
Hematopoietic Agents	Agents that target damage to the Lungs, Skin, Eyes or Mucus Membranes

A chemical is considered a carcinogen or potential carcinogen if it is listed in any of the following publications:

- National Toxicology Program, Annual Report on Carcinogens (latest edition)
- International Agency for Research on Cancer, Monographs (latest edition)
- OSHA, 29 CFR 1910.1001 to 1910.1101, Toxic and Hazardous Substances
- OSHA, 29 CFR 1910.1003, 13 Carcinogens (see list below)

Chemical Abstracts Service [CAS] Register Number	Chemical Common Name
92-93-3	4-Nitrobiphenyl
134-32-7	alpha-Naphthylamine
107-30-2	methyl Chloromethyl ether
91-94-1	3,3'-Dichlorobenzidine (and its salts)
542-88-1	bis-Chloromethyl ether
91-59-8	beta-Naphthylamine
92-87-5	Benzidine
92-67-1	4-Aminodiphenyl
151-56-4	Ethyleneimine
57-57-8	beta-Propiolactone

53-96-3	2-Acetylaminofluorene
60-11-7	4-Dimethylaminoazo-benzene
62-75-9	N-Nitrosodimethylamine

A chemical is considered hazardous, according to the OSHA standard, if it is listed in any of the following:

- OSHA, 29 CFR 1910.1000 Table Z-1 through Z-3
- Threshold Limit Values for Chemical Substances and Physical Agents in the Work Environment, ACGIH (latest edition)
- The Registry of Toxic Effects of Chemical Substances, NIOSH (latest edition)

TOXNET - http://toxnet.nlm.nih.gov/

3.3. Chemical Safety Information Sources

The primary sources of chemical safety information include: (1) the labels found on containers of hazardous chemicals; (2) the substance's Safety Data Sheet [SDS]; and (3) special chemical health and safety data bases available from OSHA's website link www.osha.gov. In addition, your supervisor and CHO are available to provide additional safety information about the hazards associated within each Laboratory and/or Studio.

The UT Chemical Safety Website has additional information regarding Reproductive Toxins .

3.4. Safety Data Sheet

The CHBO maintains a complete file of active links to Safety Data Sheets on the chemical safety website for chemicals that are known to be present at the University. Submit newly acquired SDSs in portable document format [PDF] to the CHBO for incorporation into this document. Principal investigators should be aware of their chemical inventories and work collaboratively with the CHBO to keep SDS lists current on an annual basis.

3.5. Container Labeling

OSHA states that the purpose of a container label is to provide an immediate identification and visual warning about the potential hazards of the chemicals within the container. Manufacturers, importers and distributors are required to label their containers prior to shipping the chemical to the intended recipient.

UT has provided training to demonstrate understanding of the Globally Harmonized System for the Classification and Labeling of Chemicals (GHS) as published in the Federal Register March 26, 2012.

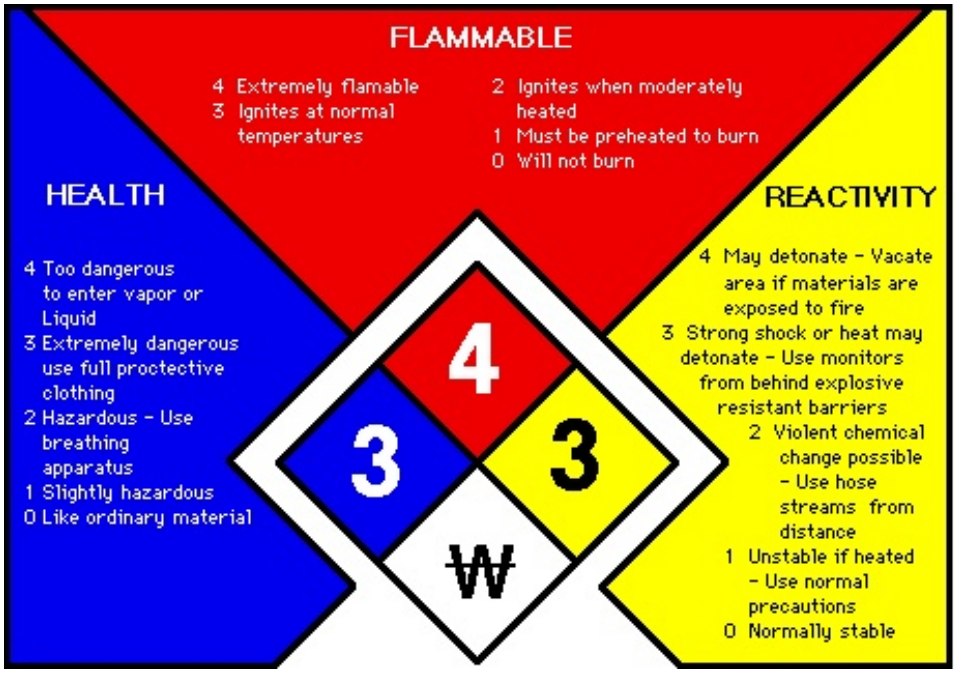
In compliance with OSHA regulations, the University has established a secondary container labeling system for all chemicals transferred out of the original container.

Chemicals in any work area that are stored in containers other than the original packaging should be labeled in accordance with the National Fire Protection Association [NFPA] standard chemical label. Laboratory Managers or PIs are responsible for ensuring that all chemical products in their work area are prominently and correctly labeled using the University approved NFPA label system.

The NFPA label should contain the following minimum information:

1. Product or Chemical name;
2. The numeric "Health", "Fire" and "Reactivity" hazard rating;
3. Specific Hazard (Incompatibility codes);

Ensure all label information is legible and written in indelible ink. To expand label life use a protective film over NFPA labels exposed to corrosives or liquids. A depiction of a NFPA label is shown below:



Short term chemical storage in glassware shall at a minimum be labeled with the chemical contents. Best management practices also suggest adding date of transfer to the outside of container.

4.0 HAZARD IDENTIFICATION GENERAL PRINCIPLES

The following general principals are expected to be performed prior to any faculty, staff or students performing work in laboratories.

4.1. Perform Hazard Assessment

Assessing potential hazards must be performed prior to initiation of new experiments or procedures. Appropriate protective measures, including personal protective equipment and engineering controls, must be identified and implemented. Whenever possible, laboratories should develop written processes or experiment-specific guidelines that designate key protective measure to be followed to minimize exposure should be made available to persons working with chemicals.

4.2. Minimize Chemical Exposures

Since most laboratory chemicals pose a health hazard, general precautions for chemical handling, storage and disposal is required in all laboratories or studios. Whenever possible, utilization of less hazardous materials and "greener" chemicals is encouraged as well implementation of engineering controls whenever feasible. Always maintain awareness and use appropriate personal protective equipment to avoid skin contact with or inhalation of chemicals is encouraged.

4.3. Avoid Underestimation of Risk

Even for substances with no known significant hazard, exposure should be minimized. For work with particularly hazardous substances, special precautions must be taken. Best laboratory practice methods suggest it should always be assumed that the toxicity of a mixture would be more toxic than its most toxic component. All substances of unknown toxicity should be treated appropriately as potentially very toxic.

4.4. Provide Adequate Ventilation

The best way to prevent exposure to airborne substances is to prevent their escape into the working atmosphere by using chemical fume hoods or other ventilation devices. The Facilities Department will subcontract out annual fume hood/local exhaust ventilation/bio-safety cabinet certifications. These certifications will assess the adequacy of air flow in the hood by determining average face velocity, air flow pattern and direction and extent of turbulence (if any). Details of the fume hood evaluation procedures and documentation are contained in Section 14 of this document.

4.5. Observe Established Standards

The permissible exposure limits and threshold limit values established by OSHA and other organizations should be observed. Where a regulatory standard does not exist, other recognized exposure limits should be followed. SDSs provide the exposure limits but they can also be found at UT's Chemical Safety Website Page:

http://utweb.ut.edu/ehs/

4.6. Follow the Chemical Hygiene Plan and Best Practices/Procedures.

Your professional training and personal experience, coupled with the Laboratory Specific Chemical Hygiene Plan procedures will help prevent and/or minimize exposure to hazardous chemicals within each unique space in which you conduct your work and supervise others. Consult the information contained therein to fulfill your role in creating as safe an environment as possible for all laboratory/studio participants and, because accidents do happen, ensure that proper procedures are followed in the event of an emergency.

5.0 TRAINING

5.1. Chemical Safety Training

The purpose of training is to ensure that all persons are adequately informed about the potential hazards within the workspace and the expected actions to be taken to protect themselves during normal operations as well as emergency events. All employees exposed, or potentially exposed, to hazardous chemicals while performing their laboratory duties must receive information and training regarding the OSHA Laboratory standard, the chemical hygiene plan and general laboratory and/or studio safety. Training sessions arranged by the CHBO are held regularly. The topics of these training sessions will include:

1. Physical and health hazards of various classes of laboratory and/or studio chemicals;
2. Signs and symptoms of exposure;
3. Methods/procedures for handling and safely using chemicals and their wastes present in laboratories;
4. Appropriate response in the event of a chemical emergency (spill, overexposure, etc.); and
5. Chemical Hygiene Laboratory/Studio Specific policies.

Additional laboratory/studio safety training specific to the chemicals and techniques employed in the space should be available through your supervisor or the laboratory's Principal Investigator. New employees must receive training prior to their handling potentially hazardous materials. Employees who are transferred to different departments must receive additional training that addresses the routine hazards anticipated within the lab or newly assigned tasks.

Every Laboratory and/or Studio worker should know the location and proper use of available protective clothing, emergency equipment/procedures, and the nearest evacuation route. Information on protective clothing and equipment is contained in Section 10 of this plan. In addition, ventilation engineering controls must be understood in each Laboratory and/or Studio environment as they are unique to the work space and

chemicals in use. Refer to Section 14 of this plan for more information about ventilation criteria.

Training records must be maintained for all workers and must minimally include the following information:

- A copy of the materials used in the training (i.e. handouts, agenda etc.); and
- An attendance record identifying the training provided, the date of training and the names; and signatures of the attendees. A generic training attendance sheet is contained in Appendix B.

Contact your supervisor or the CHBO if you have not attended a training session for your designated area.

5.2. Student Training

At the start of each semester, students shall be trained by the faculty member teaching the Laboratory and/or Studio about:

- A general overview of the hazardous chemicals in the /studio.
- Required personal protective equipment proper use, storage and limitations.
- The location and use of all safety related equipment and the evacuation route.
- What to do in the event of an emergency and the evacuation route.
- An overview of the information contained on the chemical safety website.

Appropriate reminders should be given in the Laboratory and/or Studio as it pertains to anticipated hazards of the current laboratory curriculum. Student Advisory Generic Forms have been successfully utilized to forewarn students of general Laboratory and/or Studio hazards and are included in Appendix C for completion by the appropriate faculty member.

5.3. Facilities Supervisors

In the course of pursuing their regular work tasks in laboratories, UT PI's and Facilities personnel must work cooperatively and in the spirit of mutual accountability to help ensure the safety of UT facilities staff and contractors who enter the lab. Therefore Facilities personnel shall be annually trained to ensure the following competencies:

- Facilities personnel and outside contractors must be made aware that when they enter a laboratory or studio, they are not to move any chemicals to complete their work.

- Facilities personnel and outside contractors must stop working if they encounter a situation that requires them to move any chemicals or equipment to do their job unless they are notified, in advance, that the materials they will be moving do not pose a hazard to them and/or will not disrupt the activities of the PI(s) in their space(s).

- Major activities planned in a space (e.g. bringing an outside contractor to do work in the space, planned power outages, waxing the floors) must include adequate notice to the PI, Department Chair, appropriate Dean and, when necessary, the CHBO. Adequate notice shall be defined as at least 5 business days' notice. Emergency situations requiring shorter notice shall be identified as such to the aforementioned individuals. Major activities can not commence until the PI and/or Department Chair approves, in writing, the work schedule. The PI or their designee shall work to properly secure the space so the scheduled work can be completed on the approved schedule.

6.0 CHEMICAL EXPOSURE SIGNS AND SYMPTOMS

The signs and symptoms of exposure to specific chemicals are contained in the "Health Hazard Information" section of the chemical SDS or other chemical hazard reference material. Laboratory and/or Studio personnel should be aware of the signs and symptoms of exposure to the chemicals they use to implement emergency protocols. The basic premise of this CHP is to avoid any adverse effects of chemical exposure and to ensure that all engineering controls are working properly to maintain exposure limits to safe working levels.

6.1. Common Signs and Symptoms of Chemical Exposure

The following general symptoms may indicate chemical exposure has occurred and warrant further investigation:

- Skin that has become dried, whitened, reddened, swelled, blistered, and itchy or exhibits a rash.

- A chemical odor identifies inhalation exposure is occurring. Many chemicals can be smelled at concentrations well below harmful levels. On the other hand, a chemical may be present without a detectable odor.

- A chemical taste may be detected following exposure as some chemicals have characteristic tastes.

- Tearing or burning of the eyes.

- Burning sensations of the skin, nose or throat.

- Cough.
- Headache or dizziness.

Seek prompt medical attention at a local hospital or, if circumstances warrant, contact 911 for onsite emergency response. An accident investigation must be completed and submitted (preferably by email) to the CHBO in any event of chemical exposure and within 48 hours of the incident.

UT Accident Investigation Form

6.2. Exposure Monitoring

When warranted, the CHBO will contract with outside consultants to perform air monitoring services of suspect environments. Monitoring will be conducted in accordance with established sample collection and analytical methodology for the chemical exposure being evaluated. Personal or air monitoring results will be made available to workers either individually or by posting in an appropriate location accessible to all affected occupants.

The periodic monitoring provisions of the relevant OSHA standard will be met if initial monitoring indicates that worker exposure is above the action level [AL] or permissible exposure level [PEL].

Conditions that require air monitoring may include:

- There is reason to believe that exposure levels for a substance routinely exceed either the AL or PEL set by OSHA.
- Workers suspect or report that they have been overexposed to a chemical in the Laboratory and/or Studio.
- A particularly hazardous substance is used on a regular basis (several times per week), for an extended period of time (3-4 hours at a time) or in large quantities. Use of particularly hazardous substances in this manner should be reviewed with the principal investigator and CHBO.

Regular environmental or worker exposure monitoring of airborne contaminants is not typically warranted in laboratories as chemical exposure times are relatively short, in small doses and performed under local exhaust controls.

7.0 MEDICAL EXAMINATION AND CONSULTATION

7.1. Determination

Under the provision in the OSHA standard, the University is required to provide laboratory personnel who work with hazardous chemicals medical attention, including physician-determined follow-up examinations, when any of the following conditions are met:

- The worker develops signs or symptoms associated with a hazardous chemical used in the laboratory and/or studio;
- Exposure monitoring reveals consistent worker exposure greater than the action level or applicable osha exposure limit for a chemical;
- Whenever a leak, spill, explosion or other occurrence results in the likelihood of hazardous exposure to ut faculty, staff and/or student;
- When respiratory protective equipment is required;
- When medical surveillance requirements for osha regulated-substances must be met; or
- At the discretion of the CHBO and/or a member of University senior staff.

7.2. Exposure Information

A licensed physician providing care to a potentially exposed worker must be provided the following information:

- The identity of and SDS(s) for the hazardous substance(s) to which the worker may have been exposed;
- The conditions that surrounded the exposure; and
- The signs and symptoms of exposure that the worker is exhibiting.

7.3. Examination Criteria and Frequency

Medical exam criteria will be determined by the licensed physician performing or directly supervising the exam. OSHA-regulated substances have specific medical exam guidance criteria and as such the physician must be provided the information required by the substance-specific standard [e.g., 29 CFR 1910.1048(l) for formaldehyde] to be included in the physician's exam.

Frequency of medical examinations is at the discretion of the physician. Examinations will be at least as frequent as the period set in the OSHA standard for each particular substance if the examination resulted from an exposure to an OSHA-regulated substance. Medical evaluations provided for required respirator use will be performed at a frequency determined by the physician.

7.4. Physician's Written Opinion

The physician is required to submit a written opinion to UT HR following a medical examination or consultation. In due course of the accident investigation, this opinion will be treated as privileged; however appropriate University personnel (e.g. the CHBO and any outside consultant of the University's choosing) should be notified as part of the investigation to work toward reducing the likelihood of a recurrent event, if possible, unless precluded by HIPPA law. This opinion should not reveal any specific findings or diagnoses unrelated to the chemical exposure. The written opinion must include the following information:

- Results of the medical examination, including any test results;
- Any medical condition, revealed during examination, which may place the worker at increased risk as a result of the chemical exposure or use of personal protective equipment;
- Recommendations for further medical follow-up; and
- A statement that the worker was informed of the medical examination results.

7.5. Cost and Scheduling

All required medical examinations and consultations must be provided to Laboratory and/or Studio personnel at no cost, without loss of pay, and at a reasonable time and place.

8.0 RECORDKEEPING

8.1. Records

The University maintains complete records concerning the following:

- Medical examination and consultation;
- Exposure monitoring;
- Training;
- Fume hood certifications; and
- Laboratory and/or Studio inspections and audits.

8.2. Retention and Storage

Medical examination and consultation records, including test results and physician's written opinions, are to be maintained in an appropriate confidential manner by the University's Human Resources department. These records are to be kept, transferred and made available for at least the duration of the worker's employment plus thirty years. These records shall be maintained in accordance with 29 CFR 1910.1020 "Access to Employee Exposure and Medical Records".

Employee exposure records, exposure monitoring records, including sampling results, SDSs or other chemical-specific information, are to be maintained in the CHBO department files. These records are to be kept, transferred and made available for at least 30 years. These records shall be maintained in accordance with 29 CFR 1910.1020.

Training records are maintained in the CHBO department files. These records are maintained for a period of 3 years.

Fume hood certification records for annual certifications conducted by certified vendors are maintained by the CHBO. These records are maintained until the next certification is

performed. Records of supplemental fume hood evaluations requested by the CHBO will be maintained in the department central files.

Laboratory and/or Studio inspection records are maintained in the laboratory's department files. These records are maintained until the next inspection is performed. Records of inspections conducted by the CHBO will be maintained in the department central files.

8.3. Custom Forms

The CHBO is required to keep records of all UT procedures and forms related to this CHP. With the exception of the Laboratory Specific Chemical Hygiene Plan provided in Section 29.0, it is essential that customized forms/procedures are not created for chemical and hazardous waste matters without consulting the CHBO.

9.0 CHEMICAL HYGIENE PLAN EVALUATION, REVIEW AND UPDATE

9.1. Plan Evaluation and Inspections

All laboratory personnel, laboratory supervisors, Chemical Hygiene Officers, and/or the CHBO are required by OSHA shall annually evaluate the effectiveness of this Chemical Hygiene Plan. A standard check-list has been prepared and included as Appendix D to this plan. Use of these inspection checklists is strongly recommended to document the results of these inspections.

9.2. Plan Review and Update

The laboratory Principal Investigator or designee shall review annually and, if necessary, update laboratory-specific safety procedures in Part V when particularly hazardous substances are introduced into or removed from the laboratory or when experimental procedures involving particularly hazardous substances are developed. The CHBO will review annually and update this Chemical Hygiene Plan if warranted by regulatory changes, changes in university-wide safety practices, feedback from laboratory personnel or results of laboratory or studio inspections.

9.3. Hyperlinks Imbedded in Plan

The links within this document are checked annually; however, immediately report any broken links to the CHBO.

10.0 TOXIC SUBSTANCES CONTROL ACT (TSCA)

10.1. Introduction

Note: Section 10 applies only to the synthesis of novel chemical compounds and not to existing known chemicals for which a SDS sheet can be obtained from the US. Section

10 also applies to known chemicals obtained from other countries, which are not available in the US.

Thus, this section is largely for informational purposes for UT faculty who are engaging in original research that involves the manipulation of chemicals in reactions with the intended goal of producing novel chemical compounds. These standards do not apply to investigating/developing novel chemical pathways to synthesize a known chemical. See also Section 10.2 for exemption status for the synthesis/discovery of small quantities of novel chemicals in the course of research activities by a PI or those under her/his supervision.

The U.S. Environmental Protection Agency (EPA) administers the Toxic Substances Control Act (TSCA) to ensure that the human health and environmental effects of chemical substances are identified and adequately addressed prior to production or transport of those substances. Chemical substances regulated by TSCA include:

> *"Any organic or inorganic substance of a particular molecular identity including any combination of such substances occurring, in whole or in part, as a result of chemical reaction or occurring in nature and any element or uncombined radical."*

Regulatory requirements under TSCA can include:

- Required testing of environmental and health effects;
- Pre-manufacture notifications;
- Prohibition of use or distribution of chemicals;
- Record keeping of "significant adverse reactions" to chemicals;
- Reporting of information supporting the conclusion of substantial risk from a chemical;
- Certification of TSCA applicability for imported chemicals; and
- Notification to EPA of chemical exports.

10.2. Research and Development (R&D) Exemption

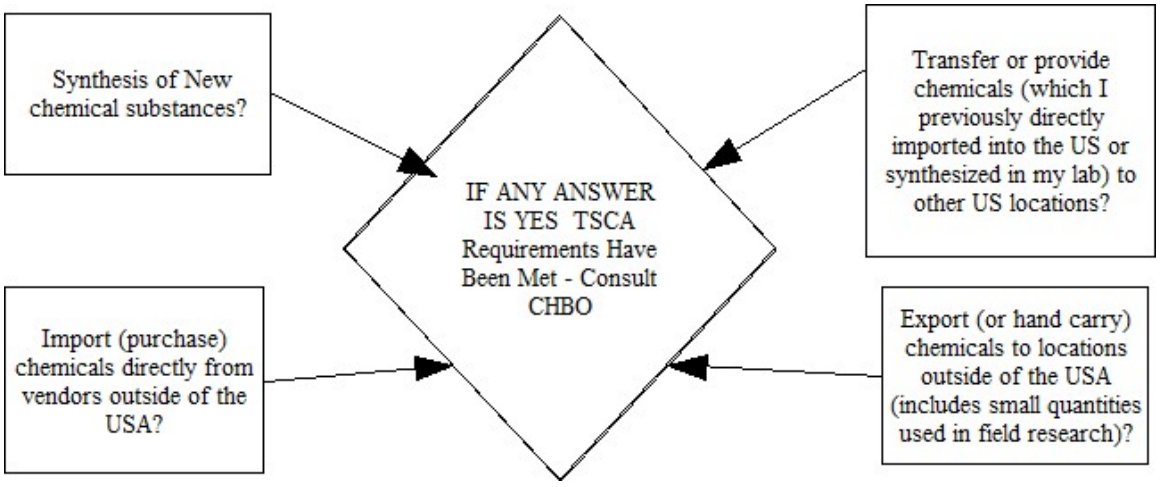
Chemicals and activities meeting the criteria for Research and Development are considered exempt from certain TSCA requirements. All laboratory investigators and laboratory personnel must be aware of TSCA and it is their responsibility to direct any questions about its applicability to their research to the UT CESHC. Each laboratory or research group conducting chemical reactions designed to synthesize novel chemical compounds, which does not include short-lived intermediate molecules that are consumed in a multi-step synthesis reaction(s), should perform an annual TSCA Applicability Determination as described in the following EPA document:

Compliance Guide for the Chemical Import Requirements of the Toxic Substance Control Act

Any chemical substance is exempt from many of the requirements of TSCA when it is: imported, manufactured or used in small quantities, and solely for purposes of non-commercial scientific experimentation, analysis or research, and under the supervision of a technically qualified individual. To maintain this exemption status, laboratories engaged in research and development must comply with the following TSCA requirements:

- IMPORT OF CHEMICAL(s) -Certify the TSCA status of imports of R&D substances, in writing.
- EXPORT OF CHEMICAL(s) -Notify receiving countries of exports of certain R&D substances, in writing.
- SHIPMENT OF CHEMICAL(s) TO LOCATION WITHIN U.S. -Label containers, shipping containers and shipping papers of any substance shipped for R&D purposes with language to that effect. Evaluate and communicate risks for any shipped R&D substance by preparing and shipping an SDS and/or shipment form with the substance.
- ALLEGATIONS OF ADVERSE REACTIONS -Create and maintain records of any allegations of effects to human health or the environment potentially caused by R&D substances.
- DISCOVERY OF SUBSTANTIAL RISK -Document and report any significant risks to human health or the environment potentially associated with R&D substances.

Note that chemical substances that do not meet this definition or laboratories that do not meet the requirements of the R&D exemption are subject to significant additional TSCA requirements. If you answer YES to any of the following statements or if you suspect that your operation does not meet the R&D exemption; please contact the CHBO for assistance.



11.0 CHEMICAL FACILITY ANTITERRORISM STANDARD

The Department of Homeland Security issued the Chemical Facility Antiterrorism Standard (CFATS) regulation that requires maintenance of an inventory of listed chemicals. Exceeding the listed standard threshold quantity [STQ} of the Chemicals of Interest [COI] prompts participation under this regulation. Prior approval by the University is required for procurement of any material exceeding 25% of the STQ for the COI. Refer to the following regulatory link for more information:

Department of Homeland Security 6 CFR Part 27-

http://www.dhs.gov/xlibrary/assets/chemsec_appendixa-chemicalofinterestlist.pdf

12.0 CONTROLLED SUBSTANCES

The US Drug Enforcement Agency (DEA) regulates the use of controlled substances, or common drugs of abuse. Researchers who use these drugs for their research are required to comply with these regulations, which address licensing, recordkeeping, proper disposal and secure storage requirements. Information about creating a controlled substance program can be found at http://www.deadiversion.usdoj.gov/drugreg/index.html. For more information contact the CHBO.

13.0 BASIC RULES AND PROCEDURES FOR WORKING WITH CHEMICALS

13.1. General Rules

- Carefully read the label before using a chemical. The SDS will provide special handling information and safety precautions to avoid adverse exposure. Be aware of the potential hazards existing in the laboratory and/or studio and the appropriate safety precautions. Know the location and proper use of emergency equipment, the appropriate procedures for responding to emergencies, and the proper methods for storage, transport and disposal of chemicals within the facility.

- Do not work alone in the laboratory and/or studio. If you must work alone or in the evening, let someone else know and have them periodically check on you.

- Anyone considering running an experiment unattended should consider the possible hazards that could occur as a result of failures, malfunctions, operational methods, environments encountered, maintenance error and operator error.

- Label all secondary chemical containers with appropriate identification and hazard information (see Section 3.5, Container Labeling).

- Use only those chemicals for which you have the appropriate exposure controls (such as a chemical fume hood) and administrative programs/procedures (training, restricted access, etc.). Always use adequate ventilation when working with chemicals. Operations using large quantities [averaging >500 milliliters of volatile substances] should be performed in a chemical fume hood.

- Use hazardous chemicals and all laboratory and/or studio equipment only as directed or for their intended purpose.

- Inspect equipment or apparatus for damage before adding a hazardous chemical. Do not use damaged equipment. Malfunctioning laboratory equipment (hood) should be labeled or tagged "out of service" so that others will not inadvertently use it before repairs are made.

- Inspect personal protective apparel and equipment for integrity or proper functioning before use.

- Handle and store laboratory glassware with care. Do not use damaged glassware. Use extra care with Dewar flasks and other evacuated glass apparatus; shield or wrap them to contain chemicals or fragments should implosion occur.

- Do not purchase or dispense more of a hazardous chemical than is needed for immediate or near-term use. As-needed procurement is encouraged. Bulk purchasing and storage for a period greater than 6 months is discouraged.

13.2. Supervision

Departments that utilize and maintain teaching/research laboratories and work shops on campus are responsible for implementing applicable safety programs to ensure that these work areas in full compliance with appropriate best practices as set forth in the documents the chemical hygiene plan. Departments must ensure that proper supervision is provided during University affiliated activities conducted off campus.

To ensure that risk is properly managed and minimized, supervisors (PI's, laboratory instructors and qualified staff leadership) are responsible for ensuring that all activities with hazardous materials and/or in potentially hazardous work environments are done in compliance with environmental/occupational health regulations.

Qualified supervisors need to be University of Tampa employees who actively participate in the applicable safety programs by periodically attending safety training/awareness sessions. It is their continual responsibility to provide oversight of all activities in assigned work areas, and take necessary action to abate unsafe activities or conditions. Supervisors may make a written request to the CHBO for a routine safety audit of work areas to assist in their efforts to help best ensure maintaining as safe a working environment as possible.

Undergraduate students, visitors, and any other non-employee must be properly trained and/or supervised, as appropriate, at all times when working in laboratories.

- Everyone who is allowed access to a laboratory and/or studio must be provided with the applicable safety awareness information by the PI, instructor and/or staff who is responsible for the space or must attend a regularly scheduled training session provided by the CHBO.

- Be sure that all chemicals are properly stored and secured in a manner so that staff is not at risk of inadvertent exposure for routine housekeeping tasks (emptying garbage, washing floors, cleaning tables).

13.3. Personal Hygiene

- Remove contaminated clothing and gloves before leaving laboratory and/or studio.

- Avoid direct contact with any chemical. Keep chemicals from contacting your hands, face, clothing, and shoes.

- Wash hands thoroughly with soap and water after handling any chemical.

- Never smell, inhale or taste a hazardous chemical.
- Smoking, drinking, eating and the application of cosmetics is forbidden in laboratories where hazardous chemicals are used.
- Never pipette by mouth. Use a pipette bulb or other mechanical pipette filling device.

13.4. Housekeeping

- Keep floors clean and dry.
- Keep all aisles, hallways, and stairs clear of all chemicals. Stairways and hallways should not be used as storage areas.
- Keep all work areas, and especially work benches, clear of clutter and obstructions.
- All working surfaces should be cleaned regularly.
- Access to emergency equipment, utility controls, showers, eyewashes and exits should never be blocked.
- Wastes and broken glassware should be kept in the appropriate containers and labeled properly.
- Any unlabeled containers must be labeled if it is not under your supervision or at the end of each working day.

13.5. Unintended Experiment or Unusual Risk

Certain indicators or procedural changes should cause the employee to stop and review the safety aspects of the procedure. Laboratory workers should proceed cautiously with a task when hazards may exist that are not fully recognized. These indicators may include:

- A new procedure, process or test, even if it is very similar to older practices.
- A change or substitution of any of the ingredient chemicals in a procedure.
- A substantial change in the amount of chemicals used (scale up of experimental procedures); usually, one should review safety practices if the volume of chemicals used increases by 200%.
- A failure of any of the equipment used in the process, especially safeguards such as chemical hoods.

- Unexpected experimental results (such as a pressure increase, increased reaction rates, unanticipated byproducts). When an experimental result is different from the predicted, a review of how the new result impacts safety practices should be made.

- Chemical odors, illness in the laboratory staff that may be related to chemical exposure or other indicators of a failure in engineered safeguards.

The occurrence of any of these conditions should be carefully evaluated for safety implications and, as a direct result, make changes as necessary to proceed cautiously. In the event of any injury or suspected injury under any of these conditions, an accident report form must be filled out and submitted to the CHBO.

14.0 PERSONAL PROTECTIVE EQUIPMENT

14.1. General Consideration

Personal protective clothing and equipment should be selected carefully and used in situations where engineering and administrative controls cannot fully eliminate exposure potential. Protective gear is viewed as less protective than other controls because they rely heavily on each employee's work practices and training to be effective. Engineering and administrative controls should always be considered the first option when reducing or eliminating exposures to hazardous chemicals. These options may include:

- **Substitution** of a less hazardous substance
- **Scaling down size of experiment**
- **Substitution** of less hazardous equipment or process (e.g., safety cans for glass bottles)
- **Isolation** of the operator or the process
- **Local and general ventilation** (e.g. fume hoods)

The SDS will list the personal protective equipment (PPE) recommended for use with the chemical. The SDS should address normal working conditions and worst case conditions when suggesting PPE.

Your supervisor, the CHO or the CHBO can assist you in determining which personal protective devices are required for each task. Appropriate personal protective equipment will be provided to employees.

14.2. Protection of Skin and Body

Skin and body protection involves wearing protective clothing over all parts of the body, which could become contaminated with hazardous chemicals. Personal protective equipment (PPE) should be selected on a task basis, and checked to ensure it is in good condition prior to use (e.g., no pinholes in gloves). Additional protective clothing may be required for some types of procedures or with specific substances such as carcinogens,

cryogens, corrosives, oxidizing agents or organic solvents. The equipment may include impermeable aprons, face shield and gloves as well as plastic coated coveralls, shoe covers, and arm sleeves. Protective sleeves should always be considered when wearing an apron. These garments can either be washable or disposable in nature. They should never be worn outside the laboratory. The choice of garment depends on the degree of protection required and the areas of the body, which may become contaminated. Rubberized aprons, plastic coated coveralls, shoe covers, and arm sleeves offer much greater resistance to permeation by chemicals than laboratory coats and, therefore, provide additional time to react if contaminated.

14.2.1 Normal Clothing Acceptable in the Laboratory

All laboratory occupants should select clothing to minimize exposed skin surfaces. Ideally, employees should wear long sleeved/long legged clothing and avoid short sleeved shirts, short trousers or skirts. A laboratory coat should be worn over street clothes and be laundered regularly. If a laboratory coat becomes contaminated, it should be removed immediately and the affected skin surface washed thoroughly. Shoes should be worn in the laboratory at all times. Sandals and perforated shoes are not appropriate. In addition, long hair and loose clothing should be confined.

14.2.2 Hand Protection

Chemically resistant gloves should be worn whenever the potential for contact with corrosive, cryogen or toxic substances and substances of unknown toxicity exists. Gloves should be selected on the basis of the materials being handled, the particular hazard involved, and their suitability for the operation being conducted. Before each use, gloves should be checked for integrity. Gloves should be washed prior to removal whenever possible to prevent skin contamination. Non-disposable gloves should be replaced periodically, depending on frequency of use and their resistance to the substances handled.

Protective gloves are not equally effective for every hazardous chemical. Some chemicals will "break through" the glove material in a very short time. Therefore, glove selection is based on the specific chemical utilized. The following glove selection criteria chart is provided for general reference. Consult with the glove's manufacture to determine the appropriate glove material for your laboratory and/or studio use.

The following is a concise guide for choosing glove protection. Guides from major manufacturers are available on the UT chemical safety website.

GLOVE TYPE SELECTION GUIDE					
CHEMICAL FAMILY	BUTYL RUBBER	NEOPRENE	PVC (VINYL)	NITRILE	NATURAL LATEX

GLOVE TYPE SELECTION GUIDE					
CHEMICAL FAMILY	BUTYL RUBBER	NEOPRENE	PVC (VINYL)	NITRILE	NATURAL LATEX
Acetates	G	NR	NR	NR	NR
Acids, inorganic	G	E	E	E	E
Acids, organic	E	E	E	E	E
Acetonitrile, Acrylonitrile	G	E	G	S	E
Alcohols	E	E	NR	E	E
Aldehydes	E	G	NR	S*	NR
Amines	S	NR	NR	F	NR
Bases, inorganic	E	E	E	E	E
Ethers	G	F	NR	E	NR
Halogens (liquids)	G	NR	F	E	NR
Inks	G	E	E	S	F
Ketones	E	G	NR	NR	G
Nitro compounds (Nitrobenzene, Nitromethane)	G	NR	NR	NR	NR
Oleic Acid	E	E	F	E	NR
Phenols	E	E	NR	NR	G
Quinones	NR	E	G	E	E
Solvents, Aliphatic	NR	NR	F	G	NR
Solvents, Aromatic	NR	NR	F	F	NR

Table Key:

S *- Superior* ***E*** *- Excellent* ***G*** *- Good* ***F*** *- Fair* ***NR*** *- Not Recommended*
******* *- Not recommended for Acetaldehyde, use Butyl Rubber*

14.2.3 Eye Protection

Eye protection is required for all occupants, including visitors, in locations where a chemical splash hazard exists. Selection of safety glasses, goggles or goggles with face shield is based upon the chemical physical state, the experiment/operation, or the level of chemical toxicity. Safety glasses effectively protect the eye from solid materials such as dusts and flying objects, but are less effective at protecting the eyes from chemical splash hazards. Goggles should be worn in situations where bulk quantities of chemicals are handled and chemical splashes to the face are possible. Goggles form a liquid-proof seal around the eyes, protecting them from splash occurrences. Goggles in addition to a face shield should be worn when handling highly reactive substances or large quantities of hazardous chemicals, corrosives, poisons and hot chemicals.

Contact lenses can increase the risk of eye injury if worn in the laboratory and/or studio - particularly if they are of the gas permeable variety. Gases and vapors can be concentrated under such lenses and cause permanent eye damage. Chemical splashes to the eye can become concentrated behind all types of lenses. Once behind a lens the chemical is difficult to remove with a typical eye wash. For these reasons it is recommended that contact lenses not be worn in laboratories.

The following general reference chart identifies the selection of eye protection for minimizing the occurrence of eye or face injuries:

COMPARISON CHART -- EYE PROTECTION DEVICES

TYPE	FRONT SPLASH Protection	SIDE SPLASH Protection	FRONT FLYING OBJECT IMPACT Protection	SIDE IMPACT Protection	NECK, FACE Protection	COMFORT TO WEARER	USER ACCEPTANCE	USE LIFETIME	COST
Goggles	Excellent	Excellent	Excellent	Excellent	Poor	Fair	Poor	Fair	Moderate
Glasses (no shields)	Good	Poor	Excellent	Poor	Poor	Good to very good	Very good	Very good	Moderate
Glasses (shields)	Good	Good	Good	Fair	Poor	Good	Good	Very good	Moderate
Face shield (various sizes)	Excellent	Good to excellent	Excellent (if adequate thickness)	Good to excellent	Depends on type and length	Fair	Good for short periods	Fair	Moderate (depending on type)

SOURCE: *ANSI Z87.1 (1989) Occupational and Educational Eye and Face Protection, available from American National Standards Institute, Inc., 1430 Broadway, New York, N.Y. 10018*

14.2.4 Respiratory Protection

Inhalation hazards can be minimized using exhaust ventilation or as the last resort, respiratory protection. Check the chemical label and SDS for information on a substance's inhalation hazard and special ventilation requirements. Controlling inhalation exposures via engineering controls (i.e. fume hood) is always the preferred method).

Respirators are designed to protect against specific types of substances in limited concentration ranges. Respirator selection is based upon the specific type of hazard (toxic chemical, oxygen deficiency, etc.), the contaminant's anticipated airborne concentration, and required protection factors.

Types of respiratory protective equipment include:

- Particulate removing air purifying respirators;
- Gas and vapor removing air purifying respirators; and
- Atmosphere supplying respirators.

Respirators are not to be used except in conjunction with a complete respiratory protection program as required by OSHA. If your work requires the use of a respirator, contact your supervisor or the CHBO to be included in UT's Respiratory Protection Program.

15.0 ENGINEERING CONTROLS

15.1. Chemical Hoods, Bio-Safety Cabinets and Local Exhaust Ventilation

The chemical fume hood is the primary means of controlling inhalation exposures in the laboratory. Hoods are designed to remove vapors and gases released within them while protecting the laboratory employee's breathing zone from the contaminant. This protection is accomplished by generating an air curtain of typically 100 linear feet per minute move constantly through the face (open sash) of the hood. Chemical hoods can also be used to isolate apparatus or chemicals that may present physical hazards to employees.

The closed sash on a hood serves as an effective barrier to physical assaults by fire, flying object, chemical splash or spattering and small implosion or explosions.

The following principles of safe chemical fume hood operation should be acknowledged:

- Keep all chemicals and apparatus at least six inches inside the hood and behind the sash.

- Hoods are not intended for storage of chemicals. Materials stored in them should be kept to a minimum. Stored chemicals should not block vents or alter air flow patterns.

- Keep the hood sash at a minimum height (4 to 6 inches) when not manipulating chemicals or adjusting apparatus within the hood.

- When working in front of a fume hood, make sure the sash opening is aligned appropriately to the arrows or black line placed on the sash door and hood frame. This sash opening will ensure an adequate air velocity through the face of the hood.

- Do not allow objects such as paper particles to enter the exhaust ducts. This can clog ducts and adversely affect their operation.

Follow the chemical SDS for controlling inhalation exposures with ventilation equipment to ensure compliance with OSHA exposure criteria. If specific guidance is not available from the chemical manufacturer or supplier, or if the guidance is inappropriate for the laboratory environment, contact the CHBO. Typical fume hood use guidelines are shown in the table below. These guidelines are based on information readily available on a chemical's SDS:

1. Applicable workplace exposure standards [Permissible Exposure Limits (PEL) or Threshold Limit Values (TLV)];
2. Acute and chronic toxicity data (LD_{50} and specific organ toxicity); and
3. Potential for generating airborne concentrations (vapor pressure).

These terms are defined in the glossary located in Appendix E. The table below provides guidelines that are to be considered reasonable "rules of thumb" when handling the type of substance listed in Column 1 if the exposure standard or toxicological criteria in Column 2 apply.

Guidelines For Chemical Fume Hood Use	
Column 1 Substance Type & Preferred Handling Procedure	**Column 2** Exposure Standard or Toxicity of Substance
Substance handled is solid, liquid or gaseous And When other effective controls are not being used.	TLV or PEL < 5 ppm (vapor) or < 0.2 mg/M^3 (particulate) or oral LD_{50} < 10 mg/Kg (rat or mouse) (See note 1 below)

Guidelines For Chemical Fume Hood Use	
Column 1 Substance Type & Preferred Handling Procedure	**Column 2** Exposure Standard or Toxicity of Substance
	or chemicals handled are respiratory sensitizers.
Substance handled is liquid or gaseous and it is handled in large quantities (greater than 500 milliliters) or the procedure used could release the substance to the laboratory atmosphere (heating) or you may be exposed to the substance (handling it in open containers) for an extended period of time (greater than 2 hrs. per day).	TLV or PEL >5 but < 50 ppm or substances handled are toxic to specific organ systems, carcinogens or reproductive toxins with a vapor pressure exceeding 25 mm Hg at 25°C. or oral LD_{50} >10 but < 500 mg/Kg (rat or mouse)(see note 1 below)
Substance handled is a solid and the particle size of the material is small (respirable) or consistency of the material is "light and fluffy" and the procedure used may generate airborne particulates.	TLV or PEL >0.2 but < 2 mg/M^3 or oral LD_{50} >10 but < 50 mg/Kg (rat or mouse)(see note 1 below)

Note 1: The oral LD_{50} hood use criteria have been included because it is often the only toxicological data available on a Safety Data Sheet. The species of animals most often used in these acute toxicity tests are the rat and/or the mouse. The LD_{50} criterion outlined in the table is a reasonable "rule of thumb" for materials that require control due to their acute toxicity characteristics. LD_{50} data should only be used if other criteria are unavailable

The UT Chemical Safety Website had a detailed procedure for all onsite ventilation equipment and can be referenced at:

http://utweb.ut.edu/ehs

16.0 LABORATORY AND STUDIO EMERGENCY EQUIPMENT

16.1. Emergency Eyewashes and Safety Showers

Whenever chemicals have the possibility of damaging the skin or eyes, an emergency supply of water must be available. All laboratories in which bulk quantities of hazardous chemicals are handled and could contact the eyes or skin resulting in injury should have access to eyewash stations and safety showers. As with any safety equipment, these can only be useful if they are accessible, therefore:

- Keep all passageways to the eyewash and shower clear of any obstacle;
- The eyewash should be checked routinely to be certain that water flows through it;
- Showers should be checked routinely to assure that access is not restricted and that the pull chain/bar is within reach; and
- The flow through the safety showers should be tested periodically to ensure sufficient flow (approximately 30 gallons per minute).

UT Facilities will check eyewashes and showers monthly. Laboratory personnel should confirm inspections are being conducted by periodically reviewing the hang tag or assessment chart. Notify the CHBO if any lapses in these inspections are noted.

16.2. Fire Extinguishing Equipment

Fire safety equipment provided in the laboratory and/or studio must include an ABC type fire extinguisher and may include automatic extinguishing systems if deemed appropriate. Laboratory and/or studio personnel shall have training to ensure their knowledge and use about engaging any fire or emergency situation.

17.0 CHEMICAL PROCUREMENT, DISTRIBUTION AND STORAGE

17.1. Chemical Procurement

Be sure to research information on the proper handling, storage, and disposal of any newly acquired chemical in the laboratory and/or studio. It is the PI's responsibility to ensure that the laboratory and/or studio facilities in which the substance will be handled are adequate and that those who will handle the substance have received the proper training. The basic information on proper handling of hazardous substances can be obtained from the SDS. Be sure to order small-container lots to avoid hazards of chemical storage within the laboratory and/or studio space.

Certain chemicals are highly regulated by the Environmental Protection Agency after they become a waste product. UT has to abide by stringent rules when dealing with these specific hazardous wastes. Therefore it is important that the CHBO become aware when

these chemicals are brought onsite. These wastes are incorporated into lists published by the Agency and for more information please reference this link:

EPA Listed Wastes

The person placing an order for a chemical is responsible for determining whether it is p-listed. Notify the CHBO Prior to Ordering Acutely Toxic (p-listed) Chemicals. List can be found on UT's Chemical Safety Website: P-Listed Chemical Please see Section 24.1 of this Plan for more information.

17.2. Distribution and Transporting Chemicals on Campus

Small open containers of hazardous chemicals or unopened containers with corrosive or highly acutely or chronically toxic chemicals shall be placed in a secondary container or a bucket when hand carrying back to laboratory from chemical storage room. Rubberized buckets are commercially available and provide secondary containment as well as "bump" protection. If several bottles must be moved at once, the bottles should be transported on a small cart with a substantial rim to prevent spillage. Wherever available, a freight elevator should be used to transport chemicals from one floor to another.

17.3. Chemical Storage in the Laboratory

Carefully read the label before storing a hazardous chemical. The SDS will provide any special storage information as well as information on incompatibilities. *Do not store un-segregated chemicals in alphabetical order. Do not store incompatible chemicals in close proximity to each other.*

Separate hazardous chemicals in storage as follows:

- Solids:
  - oxidizers
  - flammable solids (red phosphorus, magnesium, lithium)
  - water reactive
  - others
- Liquids:
  - acids
  - oxidizers
  - flammable/combustible
  - caustics
  - perchloric acid
- Gases:
  - toxic
  - oxidizers and inert
  - flammable

Once separated into the above hazard classes, chemicals may then be stored alphabetically.

Use approved storage containers and safety cans for flammable liquids. Flammable storage cabinets should be used to store flammable chemicals. *Flammable chemicals requiring refrigeration should be stored only in the refrigerators and freezers specifically designed for flammable storage.*

Many chemical fume hoods are equipped with acid or flammable storage cabinets beneath the hood opening. Chemicals of different chemical classes can be segregated by placing them in trays. Do not store chemicals on bench tops or in hoods. Liquids (particularly corrosives or solvents) should not be stored above eye level.

Use secondary containers (one inside the other) for especially hazardous chemicals (carcinogens, etc.). Use spill trays under containers of strong reagents.

Avoid exposure of chemicals while in storage to heat sources (especially open flames) and direct sunlight.

PI's should conduct annual inventories of chemicals stored in the laboratory and dispose of old or unwanted chemicals promptly in accordance with the University's hazardous chemical waste program. Visit:

UT's Hazardous Waste Disposal Protocols

Importantly, ensure that all containers are properly and legibly labeled.

17.4. Chemical Stability or Reactivity

Chemical Stability refers to the susceptibility of a chemical to dangerous decomposition. The label and SDS will indicate if a chemical is unstable or reactive.

Special note: peroxide formers- Ethers, liquid paraffins and olefins form peroxides on exposure to air and light. Peroxides are extremely sensitive to shock, sparks, or other forms of accidental ignition (even more sensitive than primary explosives such as TNT). Since these chemicals are packaged in an air atmosphere, peroxides can form even though the containers have not been opened. Sealed containers of ethers should be discarded as hazardous after one (1) year unless an inhibitor was added by the manufacturer. Opened containers of ethers should also be discarded within one (1) year of opening. Containers should be labeled with the date upon opening and all secondary containers to which the material is transferred must be labeled as well.

Many accidents involving peroxides occur when the material is transferred from a dated primary container to an un-dated secondary container, in order to work with the material. Personal awareness of this potential hazard and attention to proper labeling effectively mitigates this risk.

For additional information and examples of materials that may form explosive peroxides See Section 21.0 Highly Reactive Chemicals and High Energy Oxidizers.

17.5. Incompatible Chemicals

Certain hazardous chemicals should not be mixed or stored with other chemicals because a severe reaction can take place or an extremely toxic reaction can result. The label and SDS will contain detailed information on chemical incompatibilities. The UT Chemicals Safety Website provides a reference table that contains some common examples of incompatible chemicals:

Incompatible Chemical List

18.0 CHEMICAL SPILLS & ACCIDENTS

18.1. General Information

Try to anticipate the types of chemical spills that can occur in your laboratory and/or studio and obtain the necessary equipment (spill kits and personal protective equipment) to respond to a minor spill. It is an individual's decision as to whether to learn how to properly and safely clean up minor spills of the chemicals used regularly. Inexperienced personnel (e.g. students) should never clean up a spill on their own accord. Consult the SDS for any special spill clean-up information. *Chemical spills should only be cleaned up by knowledgeable and experienced personnel.*

If the spill is too large for you to handle, is a threat to health safety or the environment, or involves a highly toxic or reactive chemical, call Security for immediate assistance:

813-257-7777 or Extension 7777

The UT Chemical Emergency Plan is maintained by the CHBO to address spills and emergency actions and is located on the chemical safety website. Please refer to the following link for the most current version:

UT Chemical Emergency Plan

If you are comfortable cleaning up a small spill yourself, make sure that you are aware of the hazards associated with the materials spilled, have adequate ventilation (open windows, chemical fume hood on) and proper personal protective equipment (gloves, goggles, and lab coat). Consider all residual chemical and cleanup materials (adsorbent, gloves, etc.) as potential hazardous waste. Place these materials in a sealed container (plastic bags) and store in a chemical fume hood. Contact the CHBO for disposal instructions.

The PI is responsible for the chemicals which are ordered and placed in the lab/studio. If the PI intends to clean up a minor spill, it is their responsibility to order any specialized

materials that are required for the clean up (see below for examples). The CHBO maintains a supply of agents to clean up spills such as an acid or base spill, and other generic materials for common spills.

18.2. Sink Traps

Do not turn water faucet on following accidental chemical spills into laboratory sinks. Most laboratory sinks are equipped with sink traps and recovery of spilled materials may be accomplished by designated UT personnel. Notify the CHBO of any spill down any sink drain.

18.3. Minor Chemical Spill

- Alert people in immediate area of spill.
- Increase ventilation in area of spill (open windows, turn on hoods).
- Wear personal protective equipment, including safety goggles, gloves and long-sleeve lab coat.
- Avoid breathing vapors from spill.
- Use appropriate kit to neutralize and absorb inorganic acids and bases. Collect residue, place in container, and dispose as hazardous chemical waste.
- For other chemicals, use appropriate kit or absorb spill with vermiculite, dry sand, diatomaceous earth or paper towels. Collect residue, place in container, and dispose as chemical waste.
- Clean spill area with water.

18.4. Major Chemical Spill

- **Chemical Spill Emergency Response** number: call security at x7777 or 257-7777.
- Attend to injured or contaminated persons and remove them from exposure.
- Alert people in the laboratory and/or studio to evacuate.
- If spilled material is flammable, turn off ignition and heat sources. Place a container or plastic bag over spilled material to keep substance from volatilizing.
- Close doors to affected area.

Have a person with knowledge of the incident and laboratory and/or studio available to answer questions from responding emergency personnel.

18.5. Acid/Base Spills

- Your lab should have a supply of proper commercial neutralizers to handle an acid or base spill. Consult the CHBO should you need neutralizers and they are not available in your lab.

18.6. Mercury Spills

Immediately notify the CHBO if there is a mercury spill. The response required by federal regulations depends on the size of the spill. It is preferred that the CHBO

mobilize a response to have the spill professionally remediated. However, if you decide to clean up the spill, you are responsible for doing so properly and packaging all wastes associated with the cleanup per UT policies for hazardous waste. You can reference the Chemical Emergency Spill Plan procedures to clean up a mercury thermometer or fluorescent lamp fixture. More detailed procedures can be found at the EPA's website link:

EPA's Mercury Releases and Spills

Under no circumstances are you to use a domestic or commercial vacuum cleaner to clean up any mercury. Contact the CHBO should you choose not to participate in cleaning up a small mercury spill or have any doubts as to these instructions.

18.7. Alkali Metal Spills

Smother with powdered graphite, sodium carbonate, calcium carbonate or "Met-L-X". Call the CHBO for assistance.

18.8. White Phosphorus

Smother with wet sand or wet "noncombustible" absorbent. Call the CHBO or Security for immediate assistance.

19.0 INCLEMENT WEATHER AND PLANNED POWER OUTAGE PRECAUTIONS

Laboratory preparations should begin immediately upon receiving notice of severe weather. Depending upon the weather event, this may involve ample advance notice (hurricanes) or minimal notice (tornado alerts). Laboratory equipment and chemicals can be protected from loss during severe weather events by taking precautions that will minimize the impact of dangerous conditions (e.g. wind, rain) and loss of services (e.g. electric power, heat, air conditioning, water). Prepare a lab contingency plan that meets your specific needs. This plan should be shared with your lab, your department and the CHBO. A check-list for preparations is included on the UT Chemical Safety Website at:

http://utweb.ut.edu/ehs

20.0 PERSONAL SAFETY, CONTAMINATION AND INJURY

20.1. General Information

- Know your evacuation route.
- Know the locations of the nearest safety shower and eye wash fountain.
- Report all incidents and injuries to your supervisor.

- If an individual is contaminated or exposed to a hazardous material in your laboratory and/or studio, do what is necessary to protect their life and health as well as your own. Determine what the individual was exposed to. The SDS will contain special first aid information and should be provided to responding medical personnel.
- Do not move an injured person unless they are in further danger from inhalation or skin exposure.
- Get medical attention promptly by dialing x7777 or 813-257-7777.
- An Accident Investigation Report should be completed upon stabilization of the victim.

20.2. Chemicals Spills on the Body

- Quickly remove all contaminated clothing and footwear.
- Immediately flood the affected body area with cold water for at least 15 minutes. Remove jewelry to facilitate removal of any residual material.
- Wash off chemical with water only. *Do not use neutralizing chemicals, unguents, creams, lotions or salves.*
- Get medical attention promptly by dialing x7777 or 813-257-7777.

It should be noted that some chemicals (phenol, aniline,) are rapidly adsorbed through the skin. If a large enough area of skin is contaminated, an adverse health effect (systemic toxicological reaction) may occur immediately or up to several hours after initial exposure depending on the chemical. If more than 9 square inches of skin area has been exposed to a hazardous chemical, seek medical attention after washing the material off the skin. If the incident involves hydrofluoric acid (HF), seek immediate medical attention. Provide the physician with the chemical name and SDS.

20.3. Chemical Splash in the Eye

- Irrigate the eyeball and inner surface of eyelid with plenty of cool water for at least 15 minutes. Use eyewash station for best water source. Forcibly hold eyelids open to ensure effective wash.
- Check for and remove contact lenses.
- Get medical attention promptly.

20.4. Ingestion of Hazardous Chemicals

- Identify the chemical ingested.
- Call for an ambulance by dialing Extension x7777 or 813-257-7777.
- Call the Poison Information Center by dialing (813) 253-4444 or (800) 282-3171
- Cover the injured person to prevent shock.
- Provide the ambulance crew and physician with the chemical name and any other relevant information. If possible, send the container, SDS or the label with the victim.

20.5. Inhalation of Smoke, Vapors and Fumes

- Anyone overcome with smoke or chemical vapors or fumes should be removed to uncontaminated air and treated for shock.
- Do not enter the area if you expect that a life threatening condition still exists - oxygen depletion, explosive vapors or highly toxic gases (cyanide gas, hydrogen sulfide, nitrogen oxides, carbon monoxide)
- If CPR certified, follow standard CPR protocols.
- Get medical attention promptly.

20.6. Burning Chemicals on Clothing

- Use an emergency shower if it is immediately available to extinguish burning clothing or use the drop-and-roll technique.
- Remove contaminated clothing to avoid further damage to the burned area.
- Use cool water or ice packs on tissue.
- Cover injured person to prevent shock.
- Get medical attention promptly.

20.7. Actions to be Avoided During an Emergency

There are some actions which must **not** be taken when handling emergencies. These include:

- Do not force any liquids into the mouth of an unconscious person.
- Do not handle emergencies alone, especially without notifying someone that the accident has occurred.
- Do not linger at the accident scene if you are not one of the emergency responders.

21.0 FIRE AND FIRE RELATED EMERGENCIES

If you discover a fire or fire-related emergency such as abnormal heating of material, a flammable gas leak, a flammable liquid spill, smoke, or odor of burning, immediately follow these procedures:

- Notify Security by dialing x7777 or 813-257-7777.
- Activate the building alarm fire pull station. If not available or operational, verbally notify people in the building and order evacuation.
- Isolate the area by closing windows and doors and evacuate the building.
- Shut down equipment in the immediate area, if possible.
- Use a portable fire extinguisher to assist in evacuation and control a small fire, if possible.

Provide the fire/police teams with the details of the problem upon their arrival. Special hazard information you might know is essential for the safety of the emergency responders.

If the fire alarms are ringing in your building:

- You must evacuate the building and stay out until notified to return.
- Move up-wind from the building and stay clear of streets, driveways, sidewalks and other access ways to the building.
- If you are a supervisor, try to account for your employees, keep them together and report any missing persons to the emergency personnel at the scene.

22.0 HAZARDOUS WASTE DISPOSAL PROGRAM

Laboratory and/or studio hazardous chemical waste must be disposed of in accordance with local, state, and federal regulations. The University's waste management practices are designed to ensure maintenance of a safe and healthy environment for laboratory and/or studio employees and the surrounding community without adversely affecting the environment. This is accomplished through regular removal and disposal of hazardous waste in compliance with all regulations and policies. Specific guidance on how to identify, handle, collect, segregate, store and dispose of chemical waste is available on the UT Chemical Safety Website link at:

UT Waste Disposal Procedures

Contact the CHBO directly with specific questions or concerns about your current waste disposal practices.

Key elements of UT's Hazardous Waste Program include:

- Hazardous waste must be disposed of in a timely manner, which is within six (6) months of storage in a chemical waste storage room (Cass Room 180 or Thompson Storage Building).
- Hazardous waste containers must be closed at all times during storage, except when waste is being added or removed.
- All hazardous waste must be properly labeled at the time the waste is first placed in the container.
- Hazardous waste should be accumulated in a designated storage area consistent with applicable regulations.
- Hazardous waste regulations require separate training of personnel who generate or handle hazardous waste.
- Do not use sinks drains or standard trash bins for hazardous waste disposal.
- Generators of hazardous waste are required to incorporate waste minimization into any process that generates hazardous waste.
- Materials to be recycled are NOT to be labeled as hazardous waste. They must be labeled with a recycling label that is available from the CHBO. Such materials include mercury, spent batteries, used pump oil and the like.

SECTION III

GENERAL HEALTH AND SAFETY INFORMATION FOR WORK WITH CHEMICALS OF SPECIFIC HAZARD CLASS

23.0 FLAMMABLE LIQUIDS

23.1. General Information

Flammable liquids are the most common hazardous materials found in laboratories. They are usually highly volatile (have high vapor pressures at room temperature) and their vapors when mixed with air at the appropriate ratio can ignite and burn. By definition, the lowest temperature at which they can form an ignitable vapor/air mixture (the flash point) is less then 37.8°C (100°F) and for several common laboratory solvents (ether, acetone, toluene, acetaldehyde) the flash point is well below that. As with all solvents, their vapor pressure increases with temperature and, therefore, as temperatures increase they become more hazardous.

The U.S. Occupational Health and Safety Administration (OSHA) defines a flammable liquid as "*any liquid having a flash point below 100 deg. F. (37.8 deg. C.), except any mixture having components with flash points of 100 deg. F. (37.8 deg. C.) or higher, the total of which make up 99 percent or more of the total volume of the mixture. Flammable liquids shall be known as Class I liquids."* A combustible liquid is somewhat harder to ignite (flash point above 100°F). OSHA divides flammable (and combustible) liquids into several classes. For more detailed information reference 29 CFR 1910.106.

For a fire to occur, three distinct conditions must exist simultaneously:

1. The concentration of the vapor must be between the upper and lower flammable limits of the substance (the right fuel/air mix);

2. An oxidizing atmosphere, usually air, must be available; and

3. A source of ignition must be present.

Removal of any of these three conditions will prevent the start of a fire or extinguish one. Flammable liquids may pose a threat in either open or closed containers or spaces (such as refrigerators), when leaks or spills occur in the laboratory and/or studio, and when heated.

Control strategies for preventing ignition of flammable vapors include removing all sources of ignition or maintaining the concentration of flammable vapors below the lower

flammability limit by using local exhaust ventilation. There are numerous ignition sources in laboratories including open flames, hot surfaces, operation of electrical equipment and static electricity.

The concentrated vapors of flammable liquids are denser than air and can travel a considerable distance way from the source into hallways or down stairways. A flame can result if the vapors reach a source of ignition and it may flash back to the source of the vapor.

The danger of fire and explosion presented by flammable liquids can usually be eliminated or minimized by strict observance of safe handling, dispensing and storing procedures.

23.2. Special Handling Procedures

While working with flammable liquids you should wear gloves, protective glasses, and a long sleeved lab coat. Wear goggles if dispensing solvents or performing an operation that could result in a splash to the face.

Larger quantities of flammable liquids should be handled in a chemical fume hood or under some other type of local exhaust ventilation. Five gallon containers must be dispensed to smaller containers in a hood or under local exhaust ventilation. Preferably, use metal or plastic containers or safety cans that are grounded when dispensing flammable solvents into small storage containers.

Make sure that metal surfaces or containers through which flammable substances are flowing are properly grounded so as to discharge static electricity. Free flowing liquids generate static electricity which can produce a spark and ignite the solvent.

Large quantities of flammable liquids must be handled in areas free of ignition sources (including spark emitting motors and equipment) using non-sparking tools. Remember that vapors are denser than air and can travel to a distant source of ignition.

Never heat flammable substances by using an open flame. Instead, use any of the following heat sources: steam baths, water baths, oil baths, heating mantles or hot air baths. Do not distill flammable substances under reduced pressure.

Flammable substances should always be stored away from ignition sources or combustible materials. The preferred storage location is in ANSI approved flammable storage cabinets. Five gallon containers of volatile chemicals should only be stored in a flammable storage cabinet. The OSHA standard prohibits more than 60 gallons of Class I or Class II liquids or more than 120 gallons of Class III liquids in one storage cabinet. Storage in chemical fume hoods is not preferred because it reduces hood performance by obstructing air flow.

The volume of flammable liquids dispensed in small containers (not including safety cans) in the open areas of laboratories should not exceed 10 gallons in most laboratories. Never store glass containers of flammable liquids on the floor.

Oxidizing and corrosive materials should not be stored in close proximity to flammable liquids.

Flammable liquids should not be stored or chilled in domestic refrigerators and freezers only in ANSI approved refrigeration units specifically designed for this purpose.

If flammable liquids will be placed in ovens, make sure they are appropriately designed for flammable liquids (no internal ignition sources and/or vented mechanically).

24.0 HIGHLY REACTIVE CHEMICALS & HIGH ENERGY OXIDIZERS

24.1. General Information

Highly reactive chemicals are inherently unstable and susceptible to rapid decomposition. Additionally, under specific conditions chemicals can react alone or with other substances in a violent, uncontrolled manner, liberating heat, toxic gases, or leading to an explosion. Reaction rates almost always increase dramatically as the temperature increases. Therefore, if heat evolved from a reaction is not dissipated, the reaction can accelerate out of control and possibly result in injuries or costly accidents.

Air, light, heat, mechanical shock (when struck, vibrated or otherwise agitated), water and certain catalysts can cause decomposition of some highly reactive chemicals, and initiate an explosive reaction. Hydrogen and chlorine react explosively in the presence of light. Alkali metals, such as sodium, potassium and lithium, react violently with water, liberating hydrogen gas. Examples of shock sensitive materials include acetylides, azides, organic nitrates, nitro compounds, and many peroxides.

Organic peroxides are a special class of compounds that have unusual stability problems, making them among the most hazardous substances normally handled in laboratories. As a class, organic peroxides are low powered explosives. Organic peroxides are extremely sensitive to light, heat, shock, sparks, and other forms of accidental ignition, as well as to strong oxidizing and reducing materials. All organic peroxides are highly flammable.

Peroxide formers can form peroxides during storage and especially after exposure to the air (once opened). Peroxide forming substances include aldehydes, ethers (especially cyclic ethers), compounds containing benzylic hydrogen atoms, compounds containing the allylic structure (including most alkenes), vinyl and vinylidene compounds.

Examples of shock sensitive chemicals, a high energy oxidizers and substances which can form explosive peroxides are listed at the end of this section.

24.2. Special Handling Procedures

Before working with a highly reactive material or a high energy oxidizer, review available reference literature to obtain specific safety information. The proposed reactions should be discussed with your supervisor. Always minimize the amount of material involved in the experiment; the smallest amount sufficient to achieve the desired result should be used. Scale-ups should be handled with great care, giving consideration to the reaction vessel size and cooling, heating, stirring and equilibration rates.

Excessive amounts of highly reactive compounds should not be purchased, synthesized, or stored in the laboratories. Just-in-time ordering and use of such chemicals is encouraged.

The key to safely handling reactive chemicals is to keep them isolated from the substances that initiate their violent reactions. Unused peroxides should not be returned to the original container.

Do not work alone. All operations where highly reactive and explosive chemicals are used should be performed during the normal work day or when other employees are available either in the same laboratory and/or studio or in the immediate area.

Perform all manipulations of highly reactive or high energy oxidizers in a chemical fume hood. At a minimum consider the adequacy of the hood including its size in relation to the reaction and required equipment, the ability to fully close the sash, and the composition of the sash.

Make sure that the reaction equipment is properly secured. Reaction vessels should be supported from beneath with tripods or lab jacks. Use shields or guards, which are clamped or secured.

If possible, use remote controls for controlling the reaction (including cooling, heating and stirring controls). These should be located either outside the hood or at least outside the shield.

Handle shock sensitive substances gently to avoid friction, grinding and all forms of impact or abrasion. Glass containers that have screw-cap lids or glass stoppers should not be used. Polyethylene bottles that have screw-cap lids may be used. Handle water-sensitive compounds away from water sources. Light-sensitive chemicals should be used in light-tight containers. Handle highly reactive chemicals away from the direct light, open flames and other sources of heat. Oxidizing agents should only be heated with fiberglass heating mantles or sand baths.

High energy oxidizers, such as perchloric acid, should only be handled in a wash down hood if the oxidizer will volatilize and potentially condense in the ventilation system. Inorganic oxidizers such as perchloric acid can react violently with most organic materials.

When working with highly reactive compounds and high energy oxidizers, always wear the following personal protection equipment: lab coats, gloves and protective glasses/goggles. During the reaction, a face shield long enough to give throat protection should be worn.

Labels on peroxide forming substances should contain the date the container was received, first opened and the initials of the person who first opened the container. They should be checked for the presence of peroxides before using, and quarterly while in storage (peroxide test strips are available for this function). If peroxides are found, the materials should be decontaminated, if possible, or disposed of as hazardous waste. The results of any testing should be placed on the container label. Never distill substances contaminated with peroxides. Peroxide forming substances that have been opened for more than one year should be discarded. Never use a metal spatula with peroxides. Contamination by metals can lead to explosive decompositions.

Store highly reactive chemicals and high energy oxidizers in closed cabinets segregated from the materials with which they adversely react and, if possible, in secondary containers. You can also store them in the cabinet under a hood. Do not store these substances above eye level or on open shelves.

Store peroxides and peroxide forming compounds at the lowest possible temperature. If you use a refrigerator, make sure it is appropriately designed for the storage of flammable substances. Store light-sensitive compounds in light-tight containers. Water-sensitive compounds should be stored away from water sources or water vapors.

Shock sensitive materials should be discarded properly after one year if in a sealed container and within six months of opening unless an inhibitor was added by the manufacturer.

24.3. List of Shock Sensitive Chemicals

Shock sensitivity refers to the susceptibility of the chemical to rapidly decompose or explode when struck, vibrated or otherwise agitated. The following are shock sensitive examples of materials that can be found in a typical laboratory:

Known Shock Sensitive Chemicals		
Acetylides of heavy metals	Heavy metal azides	Picramic acid
Aluminum ophrite explosive	Hexanite	Picramide
Amatol	Hexanitrodiphenylamine	Picratol

Known Shock Sensitive Chemicals		
Acetylides of heavy metals	Heavy metal azides	Picramic acid
Aluminum ophrite explosive	Hexanite	Picramide
Amatol	Hexanitrodiphenylamine	Picratol
Ammonal	Hexanitrostilbene	Picric acid
Ammonium nitrate	Hexogen	Picryl chloride
Ammonium perchlorate	Hydrazinium nitrate	Picryl fluoride
Ammonium picrate	Hydrazoic acid	Polynitro aliphatic compounds
Ammonium salt lattice	Lead azide	Potassium nitroaminotetrazole
Butyl tetryl	Lead mannite	Silver acetylide
Calcium nitrate	Lead mononitroresorcinate	Silver azide
Copper acetylide	Lead picrate	Silver styphnate
Cyanuric triazide	Lead salts	Silver tetrazene
Cyclotrimethylenetrinitramine	Lead styphnate	Sodatol
Cyclotetramethylenetranitramine	Trimethylolethane	Sodium amatol
Dinitroethyleneurea	Magnesium ophorite	Sodium dinitro-orthocresolate
Dinitroglycerine	Mannitol hexanitrate	Sodium nitrate-potassium
Dinitrophenol	Mercury oxalate	Sodium picramate
Dinitrophenolates	Mercury tartrate	Styphnic acid
Dinitrophenyl hydrazine	Mononitrotoluene	Tetrazene

Known Shock Sensitive Chemicals		
Dinitrotoluene	Nitrated carbohydrates	Tetranitrocarbazole
Dipicryl sulfone	Nitrated glucoside	Tetrytol
Dipicrylamine	Nitrated polyhydric alcohol	Trimonite
Erythritol tetranitrate	Nitrogen trichloride	Trinitroanisole
Fulminate of mercury	Nitrogen triiodide	Trinitrobenzene
Fulminate of silver	Nitroglycerin	Trinitrobenzoic acid
Fulminating gold	Nitroglycide	Trinitrocresol
Fulminating mercury	Nitroglycol	Trinitro-*meta*-cresol
Fulminating platinum	Nitroguanidine	Trinitronaphthalene
Fulminating silver	Nitroparaffins	Trinitrophenetol
Gelatinized nitrocellulose	Nitronium perchlorate	Trinitrophloroglucinol
Germane	Nitrourea	Trinitroresorcinol
Guanyl nitrosamino	Organic amine nitrates	Tritonal
guanyltetrazene	Organic nitramines	Urea nitrate
Guanyl nitrosaminoguanylidene-hydrazine	Organic peroxides	

24.4. List of High Energy Oxidizers

The following are examples of materials that are powerful oxidizing reagents:

Known High Energy Oxidizers		
Ammonium permaganate	Fluorine	Potassium perchlorate

Known High Energy Oxidizers		
Barium peroxide	Hydrogen peroxide	Potassium peroxide
Bromine	Magnesium perchlorate	Propyl nitrate
Calcium chlorate	Nitric acid	Sodium chlorate
Calcium hypochlorite	Nitrogen peroxide	Sodium chlorite
Chlorine trifluoride	Perchloric acid	Sodium perchlorate
Chromium anhydride or chromic acid	Potassium bromate	Sodium Peroxide

24.5. List of Peroxide Forming Chemicals

The following are examples of the materials commonly used in laboratories which may form explosive peroxides:

Peroxide Forming Chemicals		
Acetal	Dimethyl ether	Sodium amide
Cyclohexene	Dioxane	Tetrahydrofuran
Decahydronaphthalene	Divinyl acetylene	Tetrahydronaphthalene
Diacetylene	Ether (glyme)	Vinyl ethers
Dicyclopentadiene	Ethyleneglycol dimethyl ether	Vinylidene chloride
Diethyl ether	Isopropyl ether	Diethylene glycol
	Methyl acetylene	

25.0 USE OF COMPRESSED GASES AND WELDING ACTIVITIES

25.1. General Information

Compressed gases are unique in that they potentially represent a physical and chemical hazard (depending on the particular gas). Gases contained in cylinders may be flammable, reactive, corrosive, or toxic. Because of their gaseous physical state, concentrations in the laboratory can increase instantaneously if a leak develops at the regulator or piping systems and thereby create the potential for a toxic chemical exposure or a fire/explosion hazard. Often there is little or no indication that leaks have or are occurring. Finally, the large amount of potential energy resulting from compression of the gas makes a compressed gas cylinder a potential rocket, if the tank or valve is physically broken.

25.2. Special Handling Procedures

The contents of any compressed gas cylinder should be clearly identified. No cylinder should be accepted for use that does not legibly identify its contents by name. Color coding is not a reliable means of identification and labels on caps have no value as caps are interchangeable.

Carefully read the label before using or storing a compressed gas. The SDS will provide any special hazard information.

Transport gas cylinders in carts one or two at a time only while they are secured and capped. All gas cylinders should be capped and secured when stored. Use suitable racks, straps, chains or stands to support cylinders. All cylinders, full or empty, must be restrained and kept away from heat sources. Laboratories should store as few cylinders as possible to minimize unnecessary risks.

Use only Compressed Gas Association standard combinations of valves and fittings for compressed gas installations. Always use the correct pressure regulator. Do not use a regulator adaptor.

All gas lines leading from a compressed gas supply should be clearly labeled identifying the gas and the laboratory served.

Place gas cylinders in such a way that the cylinder valve is accessible at all times. The main cylinder valve should be closed as soon as the gas flow is no longer needed. Do not store gas cylinders with pressure on the regulator. Use the wrenches or other tools provided by the cylinder supplier to open a valve if available. In no case should pliers be used to open a cylinder valve.

Use soapy water to detect leaks. Leak test the regulator, piping system and other couplings after performing maintenance or modifications, which could affect the integrity of the system.

Oil or grease on the high pressure side of an oxygen cylinder can cause an explosion. Do not lubricate an oxygen regulator or use a fuel/gas regulator on an oxygen cylinder.

Never bleed a cylinder completely empty. Leave a slight pressure to keep contaminants out (172 kPa or 25 psi). Empty cylinders should not be refilled in laboratories unless they are equipped to prevent overfilling.

All gas cylinders should be clearly marked with appropriate tags indicating whether they are in use, full, or empty. Empty and full cylinders should not be stored in the same place.

Cylinders of toxic, flammable or reactive gases should be purchased in the smallest quantity possible and stored/used in a fume hood or under local exhaust ventilation. If at all possible, avoid the purchase of lecture bottles. These cylinders are not returnable and it is extremely difficult and costly to dispose of them. Use the smallest returnable sized cylinder.

Wear safety goggles when handling compressed gases that are irritants, corrosive or toxic.

25.3. Special Precautions for Hydrogen

Hydrogen gas has several unique properties which make it potentially dangerous to work with. It has an extremely wide flammability range (LEL 4%, UEL 74.5%) making it easier to ignite than most other flammable gases. Unlike most other gases, hydrogen's temperature increases during expansion. If a cylinder valve is opened too quickly, the static charge generated by the escaping gas may cause it to ignite. Hydrogen burns with an invisible flame. Caution should therefore be exercised when approaching a suspected hydrogen flame. A piece of paper can be used to tell if the hydrogen is burning. Hydrogen embrittlement can weaken carbon steel, therefore cast iron pipes and fittings must not be used.

25.4. Special Precautions for Cryogens

If not handled properly, cryogenic liquids can be hazardous to personnel. Be aware of conditions that increase the risk of accidents and injuries that can occur when working with cryogenic liquids.

26.0 CORROSIVE CHEMICALS

26.1. General Information

Corrosive chemicals are strong acids and bases, dehydrating agents, and oxidizing agents. These chemicals can erode the skin and the respiratory epithelium and are particularly damaging to the eyes. Inhalation of vapors or mists of these substances can cause severe bronchial irritation.

Strong acids - All concentrated acids can damage the skin and eyes and their burns are very painful. Nitric, chromic, and hydrofluoric acids are especially damaging because of the degree of burns they inflict. Rinse the exposed area with copious amounts of water and seek immediate medical treatment if you have been contaminated with these materials, particularly hydrofluoric acid.

Strong alkalis - The common bases used in the laboratories are potassium hydroxide, sodium hydroxide and ammonia. Burns from these materials are often less painful than acids. However, the dermal damage may be more severe than acid burns because the injured person feeling little pain, often does not take immediate action and the material is allowed to penetrate into the tissue. Ammonia is a severe bronchial irritant and should always be used in a well-ventilated area or chemical hood.

Dehydrating agents - This group of chemicals includes concentrated sulfuric acid, sodium hydroxide, phosphorus pentoxide and calcium oxide. Because much heat is evolved on mixing these substances with water, mixing must be done by adding the agent to water and not the reverse, to avoid violent reaction and spattering. Because of their affinity for water, these substances cause severe burns on contact with skin. Affected areas should be washed promptly with large volumes of water.

Oxidizing agents - In addition to their corrosive properties, powerful oxidizing agents such as perchloric and chromic acids may present fire and explosion hazards on contact with organic compounds and other oxidizable substances. The hazards associated with the use of perchloric acid are especially severe. Handle these agents only after thorough familiarization with recommended operating procedures.

26.2. Special Handling Procedures

Corrosive chemicals should be used in the chemical fume hood and over plastic trays especially when handled in bulk quantities (> 1 liter) and when dispensing into secondary containers.

When working with bulk quantities of corrosives always wear gloves, face shields, laboratory coats and rubber aprons.

If you are handling bulk quantities on a regular basis, an eyewash station should be immediately available as well as an emergency shower. A spill kit minimally containing

absorbent pillows, neutral absorbent materials or neutralizing materials should be readily available in the laboratory and/or studio.

Corrosives should be store in ANSI approved cabinets or on low shelves, preferably in impervious trays to separate them physically from other groups of chemicals. Keep containers not in use in storage areas and off bench tops.

If it is necessary to move bulk quantities from one laboratory to another or from the stockroom, use a safety carrier (rubber bucket for secondary containment and protection of the container).

27.0 CHEMICALS OF HIGH ACUTE & CHRONIC TOXICITY

27.1. General Information

High acute toxicity substances can cause injury after a single or short term exposure. The immediate toxic effects to human health can range from localized irritation to death. Hydrogen cyanide, phosgene and nitrogen dioxide are examples of substances with high acute toxicity. The lethal oral doses for an average human adult of highly toxic substances range from one ounce to a few drops.

The Environmental Protection Agency [EPA] has identified acutely toxic substances and assigned them corresponding EPA Hazardous Waste Numbers. That list may be found at: 40 CFR 261.33 P-List Acutely Toxic.

Another way to determine if a chemical substance is acutely toxic is to read the SDS for the LD_{50} toxicity test results. The LD_{50} toxicity test is a good indicator of a substance's acute toxicity. Oral LD_{50} data for the rat or mouse is listed in the substance's SDS. Acutely toxic substances typically have ***oral LD_{50} values in the rat or mouse as less then 50 milligrams per kilogram body weight for solid materials or non-volatile liquids and 500 mg/kg body weight for volatile liquids or gases***

The definition of each of these categories of toxic substances, and examples of substances, which fall into each of these different categories, can be found in the following table:

Toxins	Target Organ Effect	Signs and Symptoms	Example Chemicals
Hepatotoxins	Cause liver damage	Jaundice; liver enlargement	Nitrosamines, chloroform, toluene, perchloroethylene, cresol, dimethylsulfate
Nephrotoxins	Cause kidney	Edema;	Halogenated

Toxins	Target Organ Effect	Signs and Symptoms	Example Chemicals
	damage	proteinuria	hydrocarbons, uranium, chloroform, mercury, dimethylsulfate
Neurotoxins	Affect the nervous system	Narcosis; behavior changes; decreased muscle coordination	Mercury, carbon disulfide, benzene, carbon tetrachloride, lead, mercury, nitrobenzene
Hematopoietic Toxins	Decrease blood function	Cyanosis; loss of consciousness	Carbon monoxide, cyanides, nitro-benzene, aniline, arsenic, benzene, toluene
Pulmonary toxins	Irritate or damage the lungs	Cough; tightness in chest, shortness of breath	Silica, asbestos, ozone, hydrogen sulfide, chromium, nickel, alcohols
Reproductive toxins	Affect the reproductive system	Birth defects; sterility	Lead, dibromodichloropropane
Skin hazards	Affect the dermal layer of the body	Defatting of skin; rashes; irritation	Ketones, chlorinated compounds, alcohols, nickel, phenol, trichloroethylene
Eye hazards	Affect the eye or vision	Conjunctivitis, corneal damage	Organic solvents, acids, cresol, quinone, hydroquinone, benzol, chloride, butyl alcohol, methanol, bases

Substances that possess the characteristic of high chronic toxicity cause damage after repeated exposure or exposure over long periods of time. Health effects often do not become evident until after a long latency period averaging twenty to thirty years. Substances that are of high chronic toxicity may be toxic to specific organ systems. Toxic agents may be identified as hepatotoxins, nephrotoxins, neurotoxins, toxic agents to the hematopoietic system and pulmonary tissue or carcinogens, reproductive toxins, mutagens, teratogens or sensitizers.

27.2. Other Factors That Affect Toxicity

- ***Rate of entry*** and ***route of exposure***; that is, how fast is the toxic dose delivered and by what means.
- ***Age*** can affect the capacity to repair tissue damage.
- ***Previous exposure*** can lead to tolerance, increased sensitivity or make no difference.
- ***State of health, physical condition and life style*** can affect the toxic response.
- ***Pre-existing disease*** can result in increased sensitivity.
- ***Environmental factors*** such as temperature and pressure.
- Host factors including ***genetic predisposition*** and the ***sex*** of the exposed individual.

Specific acute and chronic toxicity information on the substances used in your laboratory and/or studio can be found on the SDS. If you have additional questions, contact the CHBO

27.3. Special Handling Procedures

Keep accurate records of the amounts of these substances stored and used, the dates of use, and names of users.

Avoid or minimize contact with these types of chemicals by any route of exposure. Protect the hands and forearms by wearing gloves and a laboratory coat. Rinse gloves with water prior to removing them.

Use these chemicals in a chemical fume hood or other appropriate containment device if the material is volatile or the procedure may generate aerosols (See guidelines for chemical fume hood use in Section 14.2.5). If a chemical fume hood is used, it should be evaluated to confirm that it is performing adequately (a face velocity of at least 100 linear feet per minute (±20%)) with the sash at the operating height.

Volatile chemicals of high acute or chronic toxicity should be store under the hood. Volatile chemicals should be stored in unbreakable primary or secondary containers or placed in chemically resistant trays (to contain spills). Nonvolatile chemicals should be stored in cabinets or in drawers. *Do not store these chemicals on open shelves or counters.*

Assure that contingency plans, equipment, and materials to minimize exposures of people and property in case of accident are available. Decontaminate working surfaces with wet paper towels after completing laboratory procedures. Place the towels in plastic bags and secure. Confirm disposal requirements with the CHBO.

Volatile chemicals should be transported between laboratories in durable outer containers.

Vacuum pumps used in procedures should be protected from contamination with scrubbers or HEPA filters and vent them into the hood. Decontaminate vacuum pumps

or other contaminated equipment, including glassware, in the hood before removing them from the controlled area.

If one or more of these substances are used in large quantities, on a regular basis (three or more separate handling sessions per week) or for long periods of time (4-6 hours), a qualitative and potentially quantitative exposure assessment or medical surveillance should be performed. Contact the CHBO for more information on this assessment.

Lab personnel of childbearing age should be informed of any known male and female reproductive toxins used in the space. An employee who is pregnant, or planning to become pregnant, and who is working with potential reproductive toxins that might affect the fetus, should contact the CHBO to evaluate his or her exposure. The CHBO can assess potential exposures and work with the employee and laboratory supervisor, if necessary, to adjust work practices to minimize the potential risk. Refer to the UT Chemical Safety Website for the following documents:

Chemicals and Pregnancy in the Work Environment

Reproductive Toxins

28.0 UT BEST MANAGEMENT PRACTICES

The following policies can be found on the UT Chemical Website Page located at:

http://utweb.ut.edu/ehs

Principal Environmental Health & Safety Documents	
UT Emergency Operations Plan	Chemical Hygiene Plan
Chemical Emergency Procedures	Chemical Emergency Spill Plan
Chemical Spills on Laboratory Attire	Medical Emergency Procedures
Accident Incident Investigation Procedure	Inclement Weather Check-List
Chemical Safety Information	
NIOSH Carcinogen List	P-Listed Waste
Pregnancy	Reproductive Toxins
Incompatible Chemicals List	Unknown Waste Management
Procedures for Handling Chemical Waste & Materials In Laboratories and Studios	
Chemistry Department Lab Rules	Studio and Lab Hazardous Waste Management
Biohazardous Waste Disposal Policy	Bloodborne Pathogens Policy
Laboratory Glassware Disposal Policy	Studio and Lab General Waste Disposal Policy
Lab and Studio Audit Checklist	Lab Ventilation Standards
Facilities Waste Management Procedures	
Facilities Paint Waste Disposal Policy	Consejos Rapidos de Pintura
Facilities General Waste Disposal Policy	Contractor Expectations Haz Waste

Facilities Hazardous Waste Information	Painting Quick Tips
Unknown Waste Management	Universal Waste Management

29.0 LABORATORY SPECIFIC CHEMICAL HYGIENE PLAN TEMPLATE

This form can be found at: Laboratory Specific Chemical Hygiene Form

Appendix A - OSHA Lab Standard (29 CFR 1910.1450)

Follow the attached link to the most current version of the OSHA Laboratory Standard Regulation:

OSHA Laboratory Regulations

Appendix B – Copy of Training Record

The current version can be found on the UT Chemical Safety Website at:

Training Record

Appendix C – Laboratory and Art Studio General Safety Summary

Chemistry Department Laboratory Rules

Art Studio Rules Under Development

Appendix D – Laboratory and Studio Self Audit

Self Audit Form

Appendix E – Glossary of Terms

ACGIH - The American Conference of Governmental Industrial Hygienists is a voluntary membership organization of professional industrial hygiene personnel in governmental or educational institutions. The ACGIH develops and publishes recommended occupational exposure limits each year called Threshold Limit Values (TLV's) for hundreds of chemicals, physical agents, and biological exposure indices.

ACUTE - Short duration, rapidly changing conditions.

ACUTE EXPOSURE - An intense exposure over a relatively short period of time.

ANSI - The American National Standards Institute is a voluntary membership organization (run with private funding) that develops consensus standards nationally for a wide variety of devices and procedures.

ASPHYXIANT - A chemical (gas or vapor) that can cause death or unconsciousness by suffocation. Simple asphyxiants, such as nitrogen, either remove or displace oxygen in the air. They become especially dangerous in confined or enclosed spaces. Chemical asphyxiants, such as carbon monoxide and hydrogen sulfide, interfere with the body's ability to absorb or transport oxygen to the tissues.

BOILING POINT - The temperature at which the vapor pressure of a liquid equals atmospheric pressure or at which the liquid changes to a vapor. The boiling point is usually expressed in degrees Fahrenheit. If a flammable material has a low boiling point, it indicates a special fire hazard.

"C" OR CEILING - A description usually seen in connection with ACGIH exposure limits. It refers to the concentration that should not be exceeded, even for an instant. It may be written as TLV-C or Threshold Limit Value-Ceiling. (See also THRESHOLD LIMIT VALUE).

CARCINOGEN - A substance or physical agent that may cause cancer in animals or humans.

CAS NUMBER - Identifies a particular chemical by the Chemical Abstracts Service, a service of the American Chemical Society that indexes and compiles abstracts of worldwide chemical literature called Chemical Abstracts.

cc - Cubic centimeter, a volumetric measurement which is also equal to one milliliter (ml).

°C - Degrees, Celsius; a temperature scale.

CHEMICAL - As broadly applied to the chemical industry, an element or a compound produced by chemical reactions on a large scale for either direct industrial and consumer use or for reaction with other chemicals.

CHEMICAL HYGIENE OFFICER means an employee who is designated by the employer, and who is qualified by training or experience, to provide technical guidance in the development and implementation of the provisions of the Chemical Hygiene Plan. This definition is not intended to place limitations on the position description or job classification that the designated individual shall hold within the employer's organizational structure.

CHEMICAL REACTION - A change in the arrangement of atoms or molecules to yield substances of different composition and properties. (See REACTIVITY)

CHRONIC - Persistent, prolonged or repeated conditions.

CHRONIC EXPOSURE - A prolonged exposure occurring over a period of days, weeks, or years.

COMBUSTIBLE - According to the DOT and NFPA, combustible liquids are those having a flash point at or above 100oF (37.8oC), or liquids that will burn. They do not ignite as easily as flammable liquids. However, combustible liquids can be ignited under certain circumstances, and must be handled with caution. Substances such as wood, paper, etc., are termed "Ordinary Combustibles".

CONCENTRATION - The relative amount of a material in combination with another material. For example, 5 parts of (acetone) per million (parts of air).

CORROSIVE - A substance that, according to the DOT, causes visible destruction or permanent changes in human skin tissue at the site of contact or is highly corrosive to steel.

CUBIC METER (m3) - A measure of volume in the metric system.

CUTANEOUS - Pertaining to or affecting the skin.

DECOMPOSITION - The breakdown of a chemical or substance into different parts or simpler compounds. Decomposition can occur due to heat, chemical reaction, decay, etc.

DERMAL - Pertaining to or affecting the skin.

DERMATITIS - An inflammation of the skin.

DILUTION VENTILATION - See GENERAL VENTILATION.

DOT - The United States Department of Transportation is the federal agency that regulates the labeling and transportation of hazardous materials.

DYSPNEA -Shortness of breath; difficult or labored breathing.

EPA - The Environmental Protection Agency is the governmental agency responsible for administration of laws to control and/or reduce pollution of air, water, and land systems.

EPA NUMBER - The number assigned to chemicals regulated by the Environmental Protection Agency (EPA).

EPIDEMIOLOGY - The study of disease in human populations.

ERYTHEMA - A reddening of the skin.

EVAPORATION RATE - The rate at which a material is converted to vapor (evaporates) at a given temperature and pressure when compared to the evaporation rate of a given substance. Health and fire hazard evaluations of materials involve consideration of evaporation rates as one aspect of the evaluation.

°F - Degrees, Fahrenheit; a temperature scale.

FLASH POINT - The lowest temperature at which a liquid gives off enough vapor to form an ignitable mixture with air and burn when a source of ignition (sparks, open flames, cigarettes, etc.) is present. Different tests are used to determine the flash point. The test method is indicated on the SDS after the flash point.

FLAMMABLE LIQUID - According to the DOT and NFPA a flammable liquid is one that has a flash point below 100oF. (See FLASH POINT)

Classes of Flammable Liquids

Flammable Solvent Class	Boiling Point	Flash Point
Class 1A	< 100°F	< 73°F
Class 1B	> 100°F	< 73°F
Class 1C	> 100°F	Between 73 and 100°F

g - See GRAM.

GENERAL VENTILATION - Also known as general exhaust ventilation, this is a system of ventilation consisting of either natural or mechanically induced fresh air movements to mix with and dilute contaminants in the workroom air. This is not the recommended type of ventilation to control contaminants that are highly toxic, when there may be corrosion problems from the contaminant, when the worker is close to where the contaminant is being generated, and where fire or explosion hazards are generated close to sources of ignition (See LOCAL EXHAUST VENTILATION).

g/Kg - See GRAMS PER KILOGRAM.

GRAM (g) - A metric unit of weight. One ounce equals 28.4 grams.

GRAMS PER KILOGRAM (g/Kg) - This indicates the dose of a substance given to test animals in toxicity studies. For example, a dose may be 2 grams (of substance) per kilogram of body weight (of the experimental animal).

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

Appendices A and B of the Hazard Communication Standard (29 CFR 1910.1200) provide further guidance in defining the scope of health hazards and determining whether or not a chemical is to be considered hazardous for purposes of this standard.

IGNITABLE - A solid, liquid or compressed gas that has a flash point of less than 140oF. Ignitable material may be regulated by the EPA as a hazardous waste, as well.

INCOMPATIBLE - The term applied to two substances to indicate that one material cannot be mixed with the other without the possibility of a dangerous reaction.

INGESTION - Taking a substance into the body through the mouth, such as food, drink, medicine, or unknowingly as in contaminated hands or cigarettes, etc.

INHALATION - Breathing in of an airborne substance that may be in the form of gases, fumes, mists, vapors, dusts, or aerosols.

INHIBITOR - A substance that is added to another to prevent or slow down an unwanted reaction or change.

IRRITANT - A substance that produces an irritating effect when it contacts skin, eyes, nose, or respiratory system.

Kg - See KILOGRAM.

KILOGRAM (Kg) - A unit of weight in the metric system equal to 2.2 pounds.

LABORATORY USE OF HAZARDOUS CHEMICALS - means handling or use of such chemicals in which all of the following conditions are met:

(i) Chemical manipulations are carried out on a "laboratory scale;"

(ii) Multiple chemical procedures or chemicals are used;

(iii) The procedures involved are not part of a production process, nor in any way simulate a production process; and

(iv) Protective laboratory practices and equipment" are available and in common use to minimize the potential for employee exposure to hazardous chemicals.

L - See LITER.

LC50- See LETHAL CONCENTRATION50.

LD50- See LETHAL DOSE50.

LEL - See LOWER EXPLOSIVE LIMIT.

LETHAL CONCENTRATION50 - The concentration of an air contaminant (LC50) that will kill 50 percent of the test animals in a group during a single exposure.

LETHAL DOSE50 - The dose of a substance or chemical that will (LD50) kill 50 percent of the test animals in a group within the first 30 days following exposure.

LFL - See LOWER EXPLOSIVE LIMIT.

LITER (L) - A measure of capacity. One quart equals 0.9 liters.

LOCAL EXHAUST VENTILATION - (Also known as exhaust ventilation.) A ventilation system that captures and removes the contaminants at the point where they are being produced before they escape into the workroom air. The system consists of hoods, ducts, a fan and possibly an air cleaning device.

Advantages of local exhaust ventilation over general ventilation include: It removes the contaminant rather than dilutes it; it requires less air flow and thus is more economical over the long term; and the system can be used to conserve or reclaim valuable materials. However, the system must be properly designed with the correctly shaped and placed hoods, and correctly sized fans and duct work.

LOWER EXPLOSIVE LIMIT (LEL) - (Also known as Lower Flammable Limit). The lowest concentration of a substance that will produce a fire or flash when an ignition source (flame, spark, etc.) is present. It is expressed in percent of vapor or gas in the air by volume. Below the LEL or LFL, the air/contaminant mixture is theoretically too "lean" to burn. (See also UEL).

M^3 - See CUBIC METER.

MEDICAL CONSULTATION - means a consultation which takes place between an employee and a licensed physician for the purpose of determining what medical examinations or procedures, if any, are appropriate in cases where a significant exposure to a hazardous chemical may have taken place.

MELTING POINT - The temperature at which a solid changes to a liquid. A melting range may be given for mixtures.

mg - See MILLIGRAM.

mg/Kg - See MILLIGRAMS PER KILOGRAM.

mg/M3 - See MILLIGRAMS PER CUBIC METER.

MILLIGRAM (mg) - A unit of weight in the metric system. One thousand milligrams equal one gram.

MILLIGRAMS PER CUBIC METER - Units used to measure air (mg/m3) concentrations of dusts, gases, mists, and fumes.

MILLIGRAMS PER KILOGRAM - This indicates the dose of a substance (mg/kg) given to test animals in toxicity studies. For example, a dose may be 2 milligrams (of substance) per kilogram of body weight (of the experimental animal).

MILLILITER (ml) - A metric unit used to measure capacity. One milliliter equals one cubic centimeter. One thousand milliliters equal one liter.

ml - See MILLILITER.

MSHA - The Mine Safety and Health Administration; a federal agency that regulates the mining industry in the safety and health area.

MUTAGEN - Anything that can cause an inherited change (or mutation) in the genetic material of a living cell.

NARCOSIS - Stupor or unconsciousness caused by exposure to a chemical.

NFPA - The National Fire Protection Association is a voluntary membership organization whose aims are to promote and improve fire protection and prevention. NFPA has published 16 volumes of codes known as the National Fire Codes. Within these codes is Standard No. 704, Identification of the Fire Hazards of Materials. This is a system that rates the hazard of a material during a fire. These hazards are divided into health, flammability, and reactivity hazards and appear in a well-known diamond system using from zero through four to indicate severity of the hazard. Zero indicates no special hazard and four indicates severe hazard.

NIOSH - The National Institute of Occupational Safety and Health is a federal agency designated with the responsibility of training occupational health and safety professionals, conducting research on health and safety concerns, and testing and certifying respirators for workplace use.

ODOR THRESHOLD - The minimum concentration of a substance at which a majority of test subjects can detect and identify the substance's characteristic odor.

ORAL - Having to do with the mouth.

OSHA - The Occupational Safety and Health Administration - a federal agency under the Department of Labor that publishes and enforces safety and health regulations for most businesses and industries in the United States.

OXIDATION - The process of combining oxygen with some other substance to a chemical change in which an atom loses electrons.

OXIDIZER - Is a substance that gives up oxygen easily to stimulate combustion of organic material.

OXYGEN DEFICIENCY - An atmosphere having less than the normal percentage of oxygen found in normal air. Normal air contains 21% oxygen at sea level.

PEL - See PERMISSIBLE EXPOSURE LIMIT.

PERMISSIBLE EXPOSURE LIMIT (PEL) - An exposure limit that is published and enforced by OSHA as a legal standard. PEL may be either a time-weighted-average (TWA) exposure limit (8 hour), a 15-minute short term exposure limit (STEL), or a ceiling (C). The PEL's are found in Tables Z-1, Z-2, or Z-3 of OSHA regulations 1910.1000. (See also TLV).

PERSONAL PROTECTIVE EQUIPMENT - Any devices or clothing worn by the worker to protect against hazards in the environment. Examples are respirators, gloves, and chemical splash goggles.

POLYMERIZATION - A chemical reaction in which two or more small molecules combine to form larger molecules that contain repeating structural units of the original molecules. A hazardous polymerization is the above reaction with an uncontrolled release of energy.

ppm - Parts (of vapor or gas) per million (parts of air) by volume.

REACTIVITY - A substance's susceptibility to undergoing a chemical reaction or change that may result in dangerous side effects, such as explosions, burning, and corrosive or toxic emissions. The conditions that cause the reaction, such as heat, other chemicals, and dropping, will usually be specified as "Conditions to Avoid" when a chemical's reactivity is discussed on a SDS.

RESPIRATOR - A device which is designed to protect the wearer from inhaling harmful contaminants.

RESPIRATORY HAZARD - A particular concentration of an airborne contaminant that, when it enters the body by way of the respiratory system or by being breathed into the lungs, results in some bodily function impairment.

SELECT CARCINOGEN - means any substance which meets one of the following criteria:

(i) It is regulated by OSHA as a carcinogen; or

(ii) It is listed under the category, "known to be carcinogens," in the Annual Report on Carcinogens published by the National Toxicology Program (NTP)(latest edition); or

(iii) It is listed under Group 1 ("carcinogenic to humans") by the International Agency for research on Cancer Monographs (IARC)(latest editions); or

(iv) It is listed in either Group 2A or 2B by IARC or under the category, "reasonably anticipated to be carcinogens" by NTP, and causes statistically significant tumor incidence in experimental animals in accordance with any of the following criteria:

- After inhalation exposure of 6-7 hours per day, 5 days per week, for a significant portion of a lifetime to dosages of less than 10 mg/m(3);
- After repeated skin application of less than 300 (mg/kg of body weight) per week; or
- After oral dosages of less than 50 mg/kg of body weight per day.

SENSITIZER - A substance that may cause no reaction in a person during initial exposures, but afterwards, further exposures will cause an allergic response to the substance.

SHORT TERM EXPOSURE LIMIT - Represented as STEL or TLV-STEL, this is the maximum concentration to which workers can be exposed for a short period of time (15 minutes) for only four times throughout the day with at least one hour between exposures. Also the daily TLV-TWA must not be exceeded.

"SKIN" - This designation sometimes appears alongside a TLV or PEL. It refers to the possibility of absorption of the particular chemical through the skin and eyes. Thus, protection of large surface areas of skin should be considered to prevent skin absorption so that the TLV is not invalidated.

STEL - Short Term Exposure Limit.

SUBSTANCE - Any chemical entity.

SYNONYM - Another name by which the same chemical may be known.

SYSTEMIC - Spread throughout the body; affecting many or all body systems or organs; not localized in one spot or area.

TERATOGEN - An agent or substance that may cause physical defects in the developing embryo or fetus when a pregnant female is exposed to that substance.

THRESHOLD LIMIT VALUE - Airborne concentrations of substances devised by the ACGIH that represent conditions under which it is believed that nearly all workers may

be exposed day after day with no adverse effect. TLV's are advisory exposure guidelines, not legal standards that are based on evidence from industrial experience, animal studies, or human studies when they exist. There are three different types of TLV's: Time Weighted Average (TLV-TWA), Short Term Exposure Limit

(TLV-STEL) and Ceiling (TLV-C). (See also PEL.)

TIME WEIGHTED AVERAGE - The average time, over a given work period (e.g. 8-hour work day), of a person's exposure to a chemical or an agent. The average is determined by sampling for the contaminant throughout the time period. Represented as TLV-TWA.

TLV - See THRESHOLD LIMIT VALUE.

TOXICITY - The potential for a substance to exert a harmful effect on humans or animals and a description of the effect and the conditions or concentrations under which the effect takes place.

TRADE NAME - The commercial name or trademark by which a chemical is known. One chemical may have a variety of trade names depending on the manufacturers or distributors involved.

TWA - See TIME WEIGHTED AVERAGE.

UEL - See UPPER EXPLOSIVE LIMIT.

UNSTABLE LIQUID - A liquid that, in its pure state or as commercially produced will react vigorously in some hazardous way under shock conditions (i.e., dropping), certain temperatures, or pressures.

UPPER EXPLOSIVE LIMIT - Also known as Upper Flammable Limit. Is the highest concentration (expressed in percent of vapor or gas in the air by volume) of a substance that will burn or explode when an ignition source is present. Theoretically above this limit the mixture is said to be too "rich" to support combustion. The difference between the LEL and the UEL constitutes the flammable range or explosive range of a substance. That is, if the LEL is 1ppm and the UEL is 5ppm, then the explosive range of the chemical is 1ppm to 5ppm. (See also LEL).

VAPOR - The gaseous form of substances which are normally in the liquid or solid state (at normal room temperature and pressure). Vapors evaporate into the air from liquids such as solvents. Solvents with low boiling points will evaporate.

Appendix F – Laboratory Safety Reference Material

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