Chemical Safety Manual

THE UNIVERSITY of NORTH TEXAS
HEALTH SCIENCE CENTER at FORT WORTH

Chemical Safety Manual

The purpose of this document is to provide all HSC employees, students, and visitors with an institution approved set of guidelines and procedures for the safe procurement, storage, use, and disposal of hazardous chemicals. "Hazardous chemicals" or "chemical" refers to an element, compound, or mixture of elements or compounds that are a physical or health hazard as defined by the Occupational Safety and Health Administration (OSHA) standards. The scope of this document is to provide a set of guidelines and best practices that apply to all HSC employees and students who handle, store, or dispose of hazardous chemicals and hazardous waste.

The guidance and procedures outlined in this document allow hazardous chemicals to be stored, manipulated, and disposed of safely in accordance with the following:

- National Research Council. 1995. **Prudent Practices in the Laboratory**: Handling and Disposal of Chemicals. Washington, DC: The National Academies Press. https://doi.org/10.17226/4911.
- Texas Hazard Communication Act (Title 6 Subtitle D Section 502.003 (13)).
- Texas Hazard Communication Act (Title 6 Subtitle D Section 502.005).
- Texas Hazard Communication Act (Title 6 Subtitle D Section 502.009 (a), (c)(3)).
- 21 CFR 1300.
- 29 CFR 1910.134.
- 29 CFR 1910.1200(c),(d)(3).
- 29 CFR 1910.1450(e)(3)(i)(ii), (iv), (v), (vi)(g).
- 42 CFR 73 (v).
- NFPA 30, *Flammable, and Combustible Liquids*. Ed. 2021
- NFPA 45, *Standard on Fire Protection for Laboratories Using Chemicals*. Ed. 2019
- NFPA 55. *Standard for the Storage, Use, and Handling of Compressed Gases*. Ed.2020
- NFPA 400, *Hazardous Materials Code*. Ed. 2019
- NTP (National Toxicology Program). 2016. Report on Carcinogens, 14th Ed.; US Department of Health and Human Services.
- NSF/ANSI 49-2019. Biosafety Cabinets: Design, Construction, Performance, and Field Certification.
- Resource Conservation and Recovery Act, 42 USC §§ 6901-6992k (1976).
- HSC Policies

The determination of the Engineering, Administrative, and controls will be defined by the HSC Institutional Biosafety Committee (IBC), The Office of Research Compliance (RC), and The Office of Environmental Health and Safety (EH&S).

For questions regarding this document, please contact HSC EH&S at (817) 735-2245.

APPLICABILITY

This institutional chemical safety manual must be adopted as a policy and utilized in conjunction with all Hazard Registrations. These documents must be readily accessible to all laboratory personnel.

Table of Contents

SC

proval and Implementation

s Chemical Safety Manual is hereby approved for the University of North Texas Health ence Center. This plan shall apply to all HSC personnel participating in all scientific medical research activities at HSC facilities or sanctioned activities. The details of this n are the institutional policies directing the safe use of Chen1ical in Biomedical earch. This plan is effective immediately and supersedes all previous editions.

DocuSigned by:
proved Chris Erickson 4B01A86DF4E2499... Date:11/28/2022

Erickson, MBA, CHMM
tor Environmental Health and Safety
Health Science Center

tact Information

H&S Program Contacts

Subject	Office Name	Telephone	Email
Hazardous Materials/ Chemical Saety Program	Assistant Director	817-735-2691	Alan.corbitt@unthsc.edu
Biosafety Program	Assistant Director	817-735-5431	Maya.nair@unthsc.edu
Contacting the IBC	IBC Coordinator	817-735-5431	ibc@UI1thsc.edu
Safety	Director	817-735-2245	ChristoQher.erickson@u
Occupational Health	Occupational Health	817-735-2273	

nergency Phone Numbers

		In-house phone: ext 26

Other Important Institutional Phone Numbers

Campus Police/Security Non-Emergency	Ext: 2210 / 817-735-2210
Facilities Non-Emergency	Ext: 2181 / 817-735-2181
Environmental Health and Safety	Ext: 2245 / 817-735-2245
Radiation Safety	Ext: 2243 / 817-735-2243
Department of Laboratory Animal Medicine (DLAM)	Ext: 2017 / 817-735-2017
IACUC	Ext: 2533 / 817-735-2533

HSC Relevant Website links

Report an Ethics Compliant	https://secure.ethicspoint.com/domain/media/en/gui/54789/index.html
First Report of Injury	https://www.unthsc.edu/administrative/wp-content/uploads/sites/23/WC_Employee_Forms.pdf
Student complaints	https://unthsc.qualtrics.com/jfe/form/SV_1Mn0IlToxxTH3QF?Q_JFE=qdg
Waste Pickup Requests	https://www.unthsc.edu/safety/radiological-and-biosafety/chemical-waste-removal-request-form/ https://www.unthsc.edu/safety/radioactive-waste-removal-request-form/
UNTHSC - IBC	https://www.unthsc.edu/safety/biosafety/

RECORD OF CHANGES

Change #	Date of Change	Change entered by	Description
1.	11/2/2021	Maya Nair	Update weblinks and contact information
2.	11/28/2022	Maya Nair	Update weblinks and contact information

Responsibilities

Executive Vice-President for Research

The Executive Vice-President for Research (EVPRI), appointed by the President of the University,is the primary oversight official for all research activities occurring on the HSC campus. The EVPR hasthe responsibility and authority to perform the following actions relevant to the Chemical Safety Program, including but not limited to:

- Revoke, retract, and modify any research activity occurring on the HSC campus.
- Monitor all human and non-human research activities occurring on the HSC campus.
- Collaborate with faculty and staff to adapt this Chemical Safety Manual to include lab-specific guidelines and to develop strategies to implement the manual
- Make budget arrangements for health and safety improvements.

The EVPR is the Institutionally Responsible Official for The Institutional Biosafety Committee (IBC). The EVPR has the responsibility and authority to perform the following actions relevant to the IBC, including but not limited to:

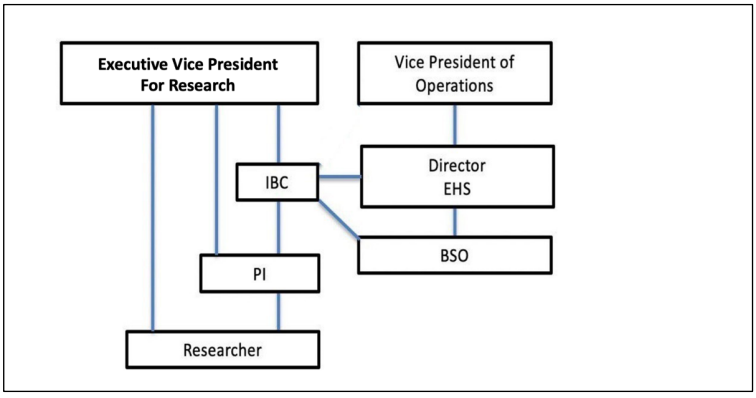
- Appoint IBC members, including the Chair, Vice-Chair, and *Ex Officio* members.
- Retract or modify IBC charters, policies, and procedures.
- Provide discretionary powers to the IBC, Chair, and Vice-Chair.
- Review documentation created, maintained, and/or authorized by the IBC.

Vice President of Operations

The Vice President of Operations (VPO) is the primary oversight official for EH&S. The VPO has the responsibility and authority to perform the following actions relevant to the Chemical Safety Program including but not limited to:

- Review the EH&S Program.
- Review any documentation created, maintained, or authorized by the IBC.
- Make budget arrangements for health and safety improvements.

Chemical Safety Program Organizational Structure



Department Chairpersons

Department Chairpersons bear overall responsibility for the implementation and maintenance of safe practices and procedures in their department. This responsibility includes the assurance that all departmental facilities (e.g., warm rooms, cold rooms) and equipment (e.g. autoclave) are operated and maintained in accordance with all relevant safety manuals and manufacturer's instructions. The Chairperson may choose to share this responsibility with a departmental chemical committee and/ or a unit director.

Principal Investigators (PIs)

PIs are faculty members or other HSC employees whose assigned laboratory space where research activities are conducted. Each PI is responsible for full compliance with policies, practices, and procedures set forth by the IBC. Their role in mentoring and instructing their students and employees on chemical safety as well as implementing this Chemical Safety Manual as a policy is essential to enhance safety within the labs and HSC campus. The responsibilities for PIs and faculty include:

- Comply with all federal, state, and/or local regulations, codes, statutes, and/or guidelines.
- Comply with all institutional policies and procedures and adopted guidelines, manuals, and/or standards.
- Register hazardous chemicals as defined by this document.
- Enforce the use of facility equipment, safety equipment, and personal protective equipment (PPE) by all lab personnel.
- Develop and implement written laboratory-specific chemical safety standard operating procedures (SOPs) consistent with the current IBC approved Hazard Registration nature. SOPs must describe specific research activities, and copies must be made available in each laboratory facility.
- Ensure that all laboratory personnel understand and comply with IBC approved hazard registrations, procedures, and SOPs.
- Ensure that all laboratory personnel, maintenance personnel, and visitors, who may be exposed to chemical hazards, are informed in advance of their potential exposure risk and the methods required to minimize that risk.
- Ensure that all maintenance work in, on, or around contaminated equipment is only conducted after the laboratory staff or PI thoroughly decontaminates that equipment.
- Work studiously and cooperatively with EH&S by responding promptly to any deficiencies or violations identified during routine safety surveillance
- Remain conscious of chemicals purchased, stored, and used in labs and their associated hazards and promptly dispose of old, expired, or unwanted chemicals.
- Conduct regular internal inspections of labs for health and safety concerns.
- Coordinate with EH&S to develop emergency response plans for handling accidental spills, facility and equipment contamination, and exposure to biological materials.
- Create and foster an environment in the laboratory that encourages open discussion of chemical safety issues, problems, and deviations from established procedures.

HSC Personnel

Laboratory personnel, employee, and student responsibilities regarding the implementation of the Chemical Safety Manual are as follows:

- Attend initial Lab Safety Training and any subsequent training as required and retain records of said training completion.
- Report all hazardous conditions to their supervisor.
- Follow all health and safety policies and procedures.
- Wear or use prescribed PPE when conducting bench work, working within a fume hood, or performing specific tasks/experiments.
- Report any job-related injuries or illnesses to their supervisor and seek treatment immediately.
- Refrain from using hazardous chemicals without proper instruction and authorization.
- Remain aware of the hazards of the chemicals in the Lab and how to handle hazardous chemicals safely.
- Request information and training when unsure how to handle a hazardous chemical or procedure.

The Office of Environmental Health & Safety (EH&S)

EH&S oversees Chemical Safety and supports the administrative and review functions of the IBC.

- Updates this manual on an annual basis.
- Provides safety consultation on operations within laboratory and clinic areas.
- Provides initial and ongoing institutional safety training related to chemical safety.
- Advises on safe methods for new procedures and the use of new equipment.
- Verifies and monitors institutional training records to ensure all pertinent HSC Personnel have attended all required initial and ongoing safety training courses.
- Assist the IBC with committee operations as described in the IBC Charter and consults with IBC members on chemical safety matters.
- Implements policy and guidelines approved by the IBC.
- Periodically reviews hazard registrations to ensure described facilities, equipment, PPE, procedures, and practices are consistent with IBC authorization and institutional policy.
- Ensures that proposed safety policies, manuals, plans, facilities, equipment, and procedures for work with chemical hazards meet applicable regulatory standards and guidelines.
- Evaluates and surveys laboratory, hospital, and clinical facilities to ensure chemical hazards are used, stored, and disposed of in accordance with IBC approved safety manuals, procedures, and hazard registrations, as well as federal and state regulations.
- Investigation of laboratory, hospital, and clinical incidents involving chemical hazards.
- Responds to and remediates chemical spills.
- Identifies potential problem areas and suggests to the IBC safety objectives to be achieved.
- Disseminates information on new safety programs and outreach services, as well as revisions to pertinent institutional policies, safety documentations, and federal and state regulations.

Institutional Biosafety Committee (IBC)

Currently, the HSC does not have a Chemical Safety Committee (CSC). While important, Faculty-based committees take time from our faculty's busy schedules, so we do not want this duty to become a burden by instituting more committees than are needed. Our research labs and scale of the work using chemicals currently do not require a separate CSC institution to evaluate chemical hazards. HSC does not have a Biochemistry department, and the number of protocols being submitted each month does not

indicate the need for another committee. Hence, the IBC will serve as the primary reviewer for chemical hazards being presented in our faculty's submissions for hazard review.

- Help identify hazardous chemicals and operations that are utilized, stored, generated, and disposed of at both on-campus and off-campus HSC locations.
- Facilitate the registration of identified Hazardous chemicals.
- Perform risk assessments to ensure the safe use of chemical agents.
- Monitor identified personnel, facilities, and laboratories for compliance with established institutional safety policies, manuals, plans, and specific IBC directives.

The objectives of the IBC are to protect staff, research subjects, the general public, and the environment from exposure to hazardous chemicals generated, stored, used, and managed as waste by HSC. The IBC operates in accordance with its approved charter and holds monthly meetings on the second Wednesday of each calendar month with exceptions for holidays. The IBC advises the VPRI and VPO on policy matters concerned with protecting personnel from chemical materials present in laboratory, hospital, or clinical areas. The IBC shall also recommend guidelines relating to procedures and facilities used at HSC, including such matters as safety training and health surveillance.

The IBC will offer its counsel to all HSC personnel regarding matters of chemical safety. The VPRI and VPO may ask the IBC to inform the community about developments in the general area of chemical safety.

Hazardous Chemical Registration

As per the guidance established in [29 CFR 1910.1450(e)(3)(v)], *"The circumstances under which a particular laboratory operation, procedure or activity shall require prior approval from the employer or the employer's designee before implementation."*

All chemicals pose some degree of hazard and toxicity. However, certain chemicals and substances pose a significantly elevated hazard to staff. Because these chemicals present a high risk, whenever a laboratory wishes to conduct work using them, the PI/supervisor must register these materials with the IBC. This occurs through the completion and submission of a Hazardous protocol registration with the IBC. Registrations must be completed by the PI or a laboratory member/student who has extensive knowledge of the hazardous chemical and/or chemical operation/experiment. Once completed, the registration must be signed by the PI and submitted to the IBC for review. Once approved, the registration is valid for three years with the requirement to submit an annual notification of hazard usage continuation. Approximately three months before authorization expiration, a renewal registration must be submitted.

Chemicals Requiring Registration

The criteria for determining if a chemical requires registration include:

- chemicals defined by OSHA as Potentially Hazardous Substances (i.e., chemicals with known toxic properties, a reproductive/mutagenic/teratogenic hazard, or a known carcinogen);
- specific operations, reactions, and experiments that involve the manipulation of hazardous chemicals under pressure or heat;

- chemicals with natural properties (e.g., pyrophoric) that create immediate physical hazards and chemical reactions that can generate immense heat or flammable/explosive byproducts may require registration;
- storage of select toxins or biological toxins;
- storage of highly toxic compounds in quantities exceeding 5 grams or the request to store greater than 20% of the exempt quantity of a select toxin;
- Any experiment or chemical use, application, process, or operation that EHS has identified as potentially creating significant physical and health hazards.

Cytotoxic Chemicals

Chemicals that can directly or through metabolic processes indirectly damage living tissue are considered toxic. Chemicals with known toxic properties may be used in medical treatments to destroy cells including malignant and tumor masses associated with cancer, as well as self-reactive cells observed in autoimmune disease. These are commonly referred to as cytotoxic compounds, chemotherapeutics, and antineoplastic drugs.

Toxicity data for most chemicals are found within the corresponding Safety Data Sheets (SDSs). When evaluating a chemical's potential toxicity, it is always worthwhile to review data from multiple SDS. OSHA Potential Hazardous Substances website, the Centers for Disease Control National Institution for Occupational Health and Safety's Pocket Guide to Chemical Hazards, the National Toxicology Program website, Environmental Protection Agency's Toxic Substances Control Act (TSCA) list, and the TOXNet Toxicology Data Network website, as well as current scientific and clinical literature describing a chemical's toxicokinetics and dynamics.

According to Appendix A of 29 CFR 1910.1200, OSHA defines acute toxicity as "…those adverse effects occurring following oral or dermal administration of a single dose of a substance, or multiple doses given within 24 hours, or an inhalation exposure of 4 hours." To evaluate chemicals and determine if they are acutely toxic, they must be tested and possess any one of the following toxicity criteria:

- **Chemicals with moderate toxicity**

  a) Oral LD_{50} (rats): > 5mg/kg to < 50 mg/kg
  b) Dermal LD_{50} (rabbits): >50mg/kg to < 200 mg/kg
  c) Inhalation LC_{50} (rats): >100ppm for 4hrs < 500 ppm for 4 hrs
  d) Inhalation LC_{50} (rats): > 05.mg/L for 4hrs to < 2.0 mg/l for 4 hrs

- **Chemicals with high toxicity**

  a) Oral LD_{50} (rats): < 5 mg/kg
  b) Dermal LD_{50} (rabbits): < 50 mg/kg
  c) Inhalation LC_{50} (rats): < 100 ppm for 4 h
  d) Inhalation LC_{50} (rats): < 0.5 mg/l for 4 h

Reproductive Hazards

OSHA defines reproductive hazards as "… chemicals that affect the reproductive capabilities including adverse effects on sexual function and fertility in adult males and females, as well as adverse effects on the development of the offspring." This definition also encompasses mutagenic (damage to genetic

material and germ cells) and teratogenic (damage to developing fetuses) hazards. Information about reproductive hazards for a particular chemical can be obtained from Section 11 of the SDS.

Unlike other forms of toxicity, there is no standardized method to determine the relative reproductive toxicity of a chemical. Most chemical classifications are based upon empirical evidence, and as such exact doses to inflict these effects are unknown. Furthermore, most reproductive effects are not known until later in life, long after an exposure has occurred.

For these reasons, all laboratory personnel exposed to these chemicals should recognize their risks and discuss their health concerns with their health practitioner and/or Occupational Health. Occupational Health is available to counsel pregnant women and men and women in family planning on their potential exposure and health risks.

Carcinogens

Carcinogens are substances that have been shown, either directly or indirectly, to cause cancer. Some chemicals, however, pose a more serious risk in the laboratory than others. Those that are of the greatest carcinogenic concern are referred to as *select carcinogens* by OSHA. To be considered a select carcinogen, a chemical must meet one of the following criteria:

- It is regulated by OSHA as a carcinogen
- It is listed within the category "Known to be Carcinogens" in the most current edition of the Annual Report on Carcinogens published by the National Toxicology Program (NTP);
- It is listed within Group 1 ("Carcinogenic to Humans") by the International Agency for Research on Cancer (IARC);
- It is listed within either Group 2A or 2B by IARC or under the category "Reasonably Anticipated to be Carcinogens" by the NTP and causes statistically significant tumor incidence with any of the following criteria:
    - After inhalation exposure of 6-7 hours per day, five days a week, for a significant portion of a lifetime to dosage less than 10 mg/m^3
    - After repeated skin application of less than 300 mg/kg of body weight per week
    - After oral dosages of less than 50 mg/kg of body weight per day.

Biological Toxins

The term "biotoxin" is sometimes used to specify toxins of biological origin explicitly. These are toxins produced by bacteria, fungi, protozoa, plants, reptiles, amphibians, fish, echinoderms (spiny urchins and starfish), mollusks, and insects. Although these materials are classified based on toxicity, they are separated here to emphasize the degree of precaution that must be applied when handling these materials.

Select Toxins

Some biotoxins are subject to federal regulations and are further classified as select toxins under 42 CFR 73. Toxins classified as select toxins have specific uses, storage, disposal, and quantity stipulations enforced by the Centers for Disease Control Division of Select Agents and Toxins (DSAT). **It is important to ensure that the total amount of toxin per PI in a laboratory is maintained below these limits at all times for exemption from registration and the attendant restrictive requirements. Due to the severe penalties associated with non-compliance with the Select Agent rules, each laboratory using and storing toxins must maintain current inventory information for these substances. Failure to register a Select Agent is**

now a criminal offense, punishable by up to five years in prison and/or $500,000 in fines. (Public Health Security & Preparedness Response Act of 2002, s. 231(c))).

Table 1

HHS Toxins [§73.3(d)(3)]	*Amount That Cannot Be Exceeded without DSAT Registration*
Abrin	100 mg
Botulinum neurotoxins	0.5 mg
Clostridium perfringens epsilon toxin	100 mg
Conotoxin	100 mg
Diacetoxyscirpenol (DAS)	1000 mg
Ricin	100 mg
Saxitoxin	100 mg
Shiga-like ribosome-inactivating proteins	100 mg
Shiga toxin	100 mg
Staphylococcal enterotoxins	5 mg
T-2 toxin	1000 mg
Tetrodotoxin	100 mg

The potential for exposure risk increases when laboratory personnel purchase and store large quantities of highly toxic compounds. Additionally, the regulatory exemptions applied to select toxins are quantity dependent, and any amount exceeding these quantity exemptions are required to be registered with the DSAT. Registration with DSAT will subject the user and the institution to significant regulatory burdens. It should only be requested when such quantities can be sufficiently justified based on continued access, use, and need.

Explosives

An explosive is a chemical or compound that causes a sudden, almost instantaneous release of pressure, gas, heat, and light when subjected to sudden shock, pressure, high temperature, or applied potential.

Chemical Classes for Registration

- Pyrophoric
- Alkali Metals
- Metal-carbonyl complexes
- Water Reactive: Hydrides & Acid Chlorides

Chemical Processes for Registration

- Nitration
- Diazotization
- Ozonolysis
- Diazomethane formation
- Metal-catalyzed Carbonylation
- Hydrogenation
- Lachrymator formation

Exempt Chemicals

There are many chemicals routinely utilized on the HSC campus that do not require registration with The IBC. These chemicals are commonly found in physical plant shops, clinics, and research and educational laboratories. These chemicals have recognized hazardous properties that have been evaluated, and standard controls have been implemented to contain the potential hazards associated with these materials within the areas of use. However, PIs and department supervisors must ensure these materials are properly stored, utilized, and disposed.

Risk Management

According to the Texas Hazard Communication Act (Title 6 Subtitle D Section 502.009 (c)(3)), an education and training program must include the proper use of protective equipment and first aid treatment to be used for the hazardous chemicals to which the employees may be exposed. Additionally, as per the guidance provided in 29 CFR 1910.1450(e)(3)(ii), *"Criteria that the employer will use to determine and implement control measures to reduce employee exposure to hazardous chemicals including engineering controls, the use of personal protective equipment and hygiene practices; particular attention shall be given to the selection of control measures for chemicals that are known to be extremely hazardous."*

Many protective control measures have been implemented to safeguard HSC personnel from hazardous chemicals. These safeguards include training, laboratory facilities and engineering controls, chemical storage and segregation, the implementation of work practice controls and standard operating procedures, PPE use, and the strict application of personal hygiene practices.

Chemical Safety Training

According to the Texas Hazard Communication Act (Title 6 Subtitle D Section 502.009 (a)), an employer shall provide an education and training program for employees who use or handle hazardous chemicals.

HSC requires that all employees and students be adequately informed regarding the physical and health hazards present in the workplace; how their occupational duties will impact their exposure to these physical and health hazards; the required facilities, equipment, and practices that are designed to mitigate their exposure risks; and the emergency procedures to follow if an incident occurs. Every laboratory worker must be trained on the location and proper use of available facility equipment, including primary barriers (e.g., fume hood, glove box, biosafety cabinet, and PPE) and safety equipment (Section 3.1(c)).

The PI/supervisor is responsible for ensuring employees and students under their direction have received all required initial training and continue to take all required annual training courses. Additionally, the PI/supervisor must ensure employees and students under their direction receive continual workplace-specific training.

Table 2: Chemical Safety Training Courses

Course	Who Must Take the Course?	Delivery Method	Frequency
Right to Know: Hazard Communication Training	Faculty, Clinicians, Fellows, Postdoctoral fellows, Students, Staff, Temps, Interns, Volunteers, Visiting Scientists	online	Upon Hire or Job Advancement
Complete Laboratory Safety (includes Biosafety and Bloodborne)	Faculty, Clinicians, Fellows, Postdoctoral fellows, Students, Staff, Temps, Interns, Volunteers, Visiting Scientists	Online	Upon Hire or Job Advancement

NIH Guidelines	Faculty, Clinicians, Fellows, Postdoctoral Fellows, IBC members	Online	Upon Hire or Job Advancement
Biosafety Refresher	Faculty, Clinicians, Fellows, Postdoctoral fellows, Students, Staff, Temps, Interns, Volunteers, Visiting Scientists	Classroom Scheduled /online	As needed
Bloodborne Pathogen Refresher	Every individual working with or exposed to human blood, body fluids, or other potentially infectious materials	Online	Annually
Specialized Courses	Courses are designed as needed to capture individuals who have a need-to-know not provided by the training requirements above. Examples: EH&S staff, Physical Plant staff, Housekeeping staff, EH&S Emergency Responders, Police Officers, and Security Guards.	Classroom and On-site	As needed
Medical Waste	Any individual who packages or transports medical waste. Any individual who signs a medical waste manifest.	On-site	As needed
Autoclave	Any individual who utilizes autoclaves to treat biological waste.	On-site	As needed
Exposure and/or Incident Remediation	Faculty, Clinicians, Fellows, Postdoctoral fellows, Students, Staff, Temps, Interns, Volunteers, Visiting Scientists, Auditors/Inspectors, Physical Plant, Police/Security	On-site	Post-incident

Laboratory Facilities and Engineering Controls

As defined within *Prudent Practices*, engineering controls are "…measures that eliminate, isolate, or reduce exposure to chemical or physical hazards through the use of various devices." These devices are considered primary containment and separate hazards from the user through airflow (e.g., chemical fume hood) or physical isolation (e.g., glove box).

Laboratory facilities are designed to contain specific activities, hazards, and operations. The structure of these facilities, in conjunction with mechanical controls (HVAC and exhaust systems,) provides a workplace where hazardous chemicals can be contained, utilized, stored, and properly disposed. Additionally, these facilities provide the work surfaces (e.g., benches) and equipment (e.g., fume hoods) necessary to facilitate specific chemical experiments, equipment, and operations.

Chemical fume hoods (i.e., fume hoods) are the most important components used to protect laboratory personnel from exposure to hazardous chemicals and agents (Figures 1 & 2). All operations involving the use of hazardous chemicals must be conducted within a chemical fume hood.

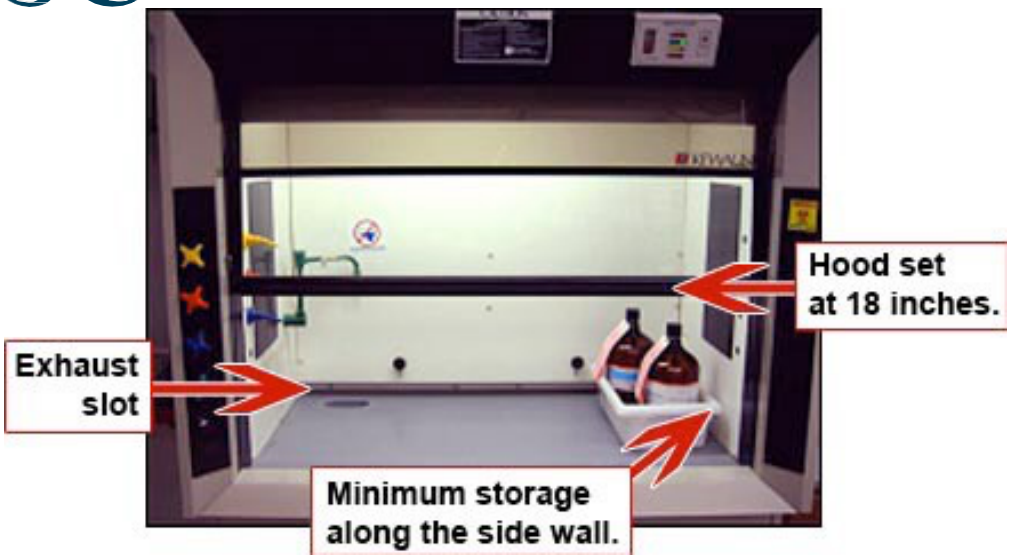


Figure 1. Properly maintained Fume Hood

Figure 2. An Overcrowded Fume Hood

EHS surveyors will conduct annual fume hood monitoring, which will include but is not limited to: works surface and storage assessments and sash air velocity measurements. If the fume hood is functioning (i.e., proper face velocity is achieved) and the work surface and storage are properly maintained, EH&S will place a sticker on the side of the fume hood. This sticker will list the date the fume hood was tested and will indicate the sash height that provides a face velocity between 60-150 linear feet per minute.

Additional stickers may be placed on the front side of the fume hood. These additional stickers are designed to inform users of proper sash height and management.

To maximize the fume hood's effectiveness, laboratories should evaluate their operations and ensure that a 2ft X 2ft work surface is available within the fume hood for activities that involve the manipulation of hazardous chemicals. This work surface area may be populated by equipment, supplies, and apparatuses required for current and ongoing experiments, reactions, and chemical manipulations. However, this area should be free of storage containers, waste containers, and surplus chemicals and equipment. If a fume hood does not have a face velocity between 60-150 LFM, EH&S will place the hood out of service and inform Facilities. Once Facilities confirmed the fume hood is functioning, EH&S will verify the sash face velocity and, if approved, will release the fume hood back to service.

Chemical Storage & Segregation

One of the primary methods of minimizing unnecessary employee exposure to hazardous chemicals is properly storing them according to their hazard class and compatibility. Proper storage and segregation ensure that the vast majorities of chemicals remain in storage and will not be mixed with anything that can cause a harmful reaction in the event of a spill or accident. The most common chemical classes with the most concern are flammables, corrosives, and oxidizers.

Flammable and corrosive cabinets may be hard installed into the laboratory's structure or maybe purchased and housed as independent cabinets. These cabinets are designed specifically for the storage of chemicals as per the cabinet’s construction and name.

Hazardous Chemicals have many promising and needed applications in medicine, research, education, and industry; however, these same materials can deliberately hurt people, destroy property, damage the environment, and for terroristic purposes. As such, the safe and secure storage of these materials is imperative to our campus, employees, and community's overall security. All laboratories must be locked when not occupied, and chemical inventories should be routinely monitored. Employees and students are required to notify the University Police immediately if a security breach is identified, hazardous chemicals are found missing, there is evidence of chemical theft, or if a suspicious person is observed in the building, Lab, or storage room. The University Police will alert EH&S following their investigation.

Flammables

The definition and classification of flammable and combustible liquids are addressed in Subsection 3.3.33 and Chapter 4 of NFPA 30. A flammable liquid is defined as a liquid whose flashpoint does not exceed 100°F when tested by closed-cup test methods, while a combustible liquid is one whose flash point is 100°F or higher when tested by closed-cup methods. These broad groups are further classified as follows:

- Class IA - Flash Point less than 73°F; Boiling Point less than 100°F
- Class IB - Flash Point less than 73°F; Boiling Point equal to or greater than 100°F
- Class IC - Flash Point equal to or greater than 73°F, but less than 100°F
- Class II - Flash Point equal to or greater than 100°F, but less than 140°F
- Class IIIA - Flash Point equal to or greater than 140°F, but less than 200°F
- Class IIIB - Flash Point equal to or greater than 200°F

The most commonly encountered chemical class at HSC are flammable liquids such as ethanol, 2-propanol (isopropyl alcohol), ethyl acetate, hexane, acetonitrile, and methanol. All chemicals that are classified as flammable contain the GHS symbol located to the right. HSC operations that utilized flammable liquids must comply with the flammable liquid storage requirements defined in applicable NFPA codes (e.g., NFPA 45 and NFPA 30).
The general rules for storing flammable liquids in laboratories are as follows:

- Flammables shall, at all times, be stored separately from corrosives and oxidizers.
- Hazardous Chemical Registrations are not routinely required for flammable liquids. However, EH&S and the IBC may require the submission of registration if a flammable chemical will be used in a manner that significantly increases the hazards posed by these materials or their use.
- All flammable liquids must be stored in an appropriately labeled flammable cabinet. Every flammable cabinet has a maximum volume that it can contain, which cannot be exceeded.
- Large opened solvent drums (20-L or larger) requiring a pump to dispenser must be stored separately from unopened (i.e., factory seal is not broken) solvent drums.
- Flammable liquids cannot be stored near sources of ignition or heat. This includes Bunsen burners, vacuum pumps, or tanks of compressed hydrogen.
- Flammable liquids cannot be permanently stored on the floor, benchtop, or within a fume hood.

Toxics

HSC has a vast array of research studying models in the laboratory and research animals. These studies may utilize cytotoxic compounds in various experiments, which create exposure risks for laboratory workers and animal care personnel. Additionally, the increasing use of chemotherapeutics to treat an ever-growing number of cancers increases the potential exposure risks for health care personnel and pharmacist. All chemicals that are classified as toxic contain the GHS symbol located to the right.

Standard laboratory precautions when manipulation cytotoxic compounds may not be sufficient to prevent exposure or injury. In addition to the standard safety precautions highlighted throughout this document, certain extra precautions may be required when using cytotoxic compounds. If the chemical has been approved for use, then the approval letter will detail any extra mandatory safety precautions that must be implemented. A minimum set of guidelines for working with cytotoxic compounds is presented below. **These criteria must be used for all PHSs (particularly hazardous substances), including those exempt from registration.**

- Quantities of these chemicals used and stored in the laboratory should be minimized, as should their concentrations in solution or within mixtures.
- Work with PHSs must be performed within a fume hood or fully operational glove box. In all cases, work with these types of chemicals shall be done in such a manner that the OSHA permissible exposure levels (PEL) or similar authoritative standards (e.g., ACGIH-Threshold Limit Values and NIOSH-Recommended Exposure Levels) are not exceeded.
- Each principal investigator or departmental supervisor, utilizing PHSs, must designate a specific area for this purpose and ensure this area is a label with a sign bearing the appropriate hazard

warnings (e.g., acutely toxic, reproductive hazard, carcinogen, etc.). The designated area may be an entire laboratory or a single chemical fume hood or glove box.

- All HSC assigned to work with PHSs must be informed and trained on the harmful effects of these substances, including known signs and symptoms of exposure. Training must also be provided to personnel regarding the safe handling, storage, and disposal of the PHSs and training on the proper means to contain, neutralize, cleanup PHS spills. This training is the responsibility of the PI/departmental supervisor and must be done before working with these chemicals.
- All laboratory workers working with PHSs must have access to all appropriate protective clothing, equipment, and procedures, including any special provisions stipulated by EH&S or the IBC.

Corrosives

Every laboratory contains corrosives. These include inorganic acids and bases (e.g., aqueous hydrochloric acid and sodium hydroxide, respectively) and organic acids and bases (e.g., trifluoroacetic acid and triethylamine, respectively). All chemicals that are classified as corrosive contain the GHS symbol located to the right. The rules for the storage of corrosives are adopted from *Prudent Practices* and are as follows:

- Corrosives shall, at all times, be stored separately from flammables and oxidizers.
- Corrosive materials are not typically required to be listed in hazardous protocol registrations. However, EH&S and the IBC may require the submission of a registration if a flammable chemical will be used in a manner that significantly increases the hazards posed by these materials or their use.
- All corrosives must be stored in an appropriately labeled corrosives cabinet.
- Acids must be stored separately from bases, as these are incompatible chemical classes. It is recommended that acids and bases be physically separated in different storage cabinets. However, acids and bases may be stored in the same cabinet **so long as they are in separate plastic storage bins.** This ensures that the chemicals will remain separated in case of a leak or a spill.
- Organic acids may be stored alongside inorganic acids; likewise, organic bases may be stored alongside inorganic bases.
- **Nitric acid and Perchloric acid must be stored separately from all other chemicals.**
- Corrosives cannot be permanently stored within a fume hood.

Oxidizers

Oxidizers are chemicals, which, as the name implies, take part in oxidation reactions. Specifically, these chemicals supply oxygen to a system and, as a result, generate a significant amount of heat. Oxidizers often react violently with other chemicals, and for this reason, they are viewed as being particularly hazardous within a laboratory setting. Additionally, many oxidizers are incompatible with a wide range of other chemicals. Consequently, the proper storage and segregation of oxidizers are of high importance. All chemicals that are classified as oxidizers bear the GHS symbol located to the right. The rules for the storage and segregation of oxidizers are adopted from NFPA 400 and NFPA 430, and are as follows:

- Oxidizers shall, at all times, be stored separately from flammables and corrosives.

- Oxidizers are not typically required to be listed in hazardous protocol registrations. However, EH&S and the IBC may require the submission of a registration if an oxidizer will be used in a manner that significantly increases the hazards posed by these materials or their use.
- All oxidizers must be stored within a cabinet or shelf bearing the label "Oxidizers".
- All oxidizers must be stored separately from all incompatible chemicals. This may include alcohols, amines, thiols, carbon-carbon double bonds (alkenes), and carbon-carbon triple bonds (alkynes).
- All oxidizers must be stored away from sources of heat and ignition.
- Organic oxidants that are temperature-sensitive (e.g., Dess-Martin periodinane and 2,2,6,6-tetramethyl-1-piperidinyloxy radical) must be stored in an explosion-proof refrigerator. Recommended storage conditions for all chemicals can be found within the manufacturer's SDS.

Peroxides

Peroxides, and in particular organic peroxides, are a special class of oxidizer. Many campus research laboratories contain one or more members of this class of chemicals. Peroxides are chemically predisposed to spontaneous decomposition, and many are sensitive to heat, light, and friction, often with explosive consequences. For these reasons, all peroxides must be handled and stored with an increased degree of precaution. Because of their explosive nature, peroxide stock container's labels will contain at least one of the two GHS symbols located right. The rules for the storage and segregation of peroxides are adopted from NFPA 432 and are given below.

- Peroxides shall, at all times, be stored separately from flammables and corrosives.
- All peroxide stock containers must be labeled with the date of acquisition and the date when the container is opened.
- Peroxides are not typically required to be listed in hazardous protocol registrations. However, EH&S and the IBC may require the submission of a registration if an oxidizer will be used in a manner that significantly increases the hazards posed by these materials or their use.
- All peroxide-containing chemicals must be stored separately from other oxidizers.
- All peroxides, which are temperature-sensitive, must be stored within an explosion-proof refrigerator.
- The shelf life for peroxides varies, but they should be disposed of after one year as a general rule. Please contact EH&S for the proper disposal of peroxides.

Peroxide Forming Chemicals (PFC)

Many chemicals undergo a process of autoxidation to form peroxides. These materials, classified as peroxide forming chemicals (PFC), are a particularly hazardous group. The rate of peroxide formation varies from one chemical to another and also depends upon storage conditions. Dangerous levels of peroxides can be generated, as a result, creating a significant hazard for laboratory personnel who may handle PFC containers. PFC's are generally classified into the following three categories:

- Group A: PFCs that form explosive levels of peroxides *without the concentration* of the solvent.
  - These should be disposed of after three months.

- Group B: PFCs that form a peroxide hazard *upon the concentration* of the chemical/solvent.

- Group C: PFCs that can form peroxides and may auto-polymerize.
  - o These chemicals should be disposed of after six months.

Table 2. Categories of Peroxide Forming Chemicals

Group A		Group B		Group C	
Chemical	**CAS #**	**Chemical**	**CAS #**	**Chemical**	**CAS #**
1,3-Butadiene	106-99-0	Acetaldehyde	75-07-0	Vinyl acetate	108-05-4
Diisopropyl ether	108-20-3	Tetrahydrofuran	109-99-9	Styrene	100-42-5
Potassium metal	7440-09-7	1,4-Dioxane	123-91-1	Tetrafluoroethylene	116-14-3
Potassium amide	7782-92-5	Diethyl ether	60-29-7	Vinyl acetylene	689-97-4

There are no special precautions for storing PFC's; however, it is the PI and laboratory personnel's responsibility to be aware of what chemicals are stored within the inventory and where they are located. EHS will document the locations of any bottles of PFC's that are encountered during the laboratory safety surveys. Contact EH&S for the proper disposal of all PFC's.

Pyrophorics

Pyrophoric substances represent one of the most dangerous classes of chemicals to be found in a research laboratory. These substances are highly reactive and will ignite spontaneously in the air. Pyrophorics can be purchased as pure liquids (e.g., trimethylaluminum, diethylzinc) or pure solids (e.g., lithium aluminum hydride). They may also be purchased as solutions (e.g., *n*-butyllithium, *s*-butyllithium, and *t*-butyllithium), usually inflammable solvents such as hexane, diethyl ether, and toluene. All pyrophoric chemicals bear the GHS symbol on the right. The guidelines for the proper storage and segregation of pyrophorics are based upon best-practices and are as follows:

- Pyrophorics shall, at all times, be stored separately from flammables and oxidizers.
- Pyrophoric substances, which are temperature-sensitive, must be stored within an explosion-proof refrigerator.
- Pyrophoric solids must be stored either within a glove box, dry box, or a desiccator.
- Old containers of pyrophoric substances should not be used or shelved. Please call EH&S for their proper disposal of pyrophorics.

Chemical Waste

All laboratories which utilize hazardous chemicals generate chemical waste. The appropriate collection and disposal of chemical waste are regulated by the Texas Commission on Environmental Quality (TCEQ) and the EPA. EH&S will complete a waste characterization for all newly identified hazardous wastes streams. These characterizations will define the waste and will determine the proper methods for final disposition. To ensure institutional compliance with all chemical waste regulations, the following rules have been established at HSC:

- Never pour hazardous chemicals down the drain or through hazardous chemicals into the trash.This includes organic solvents (ethanol, methanol, acetone, acetonitrile, etc.).
- All waste containers must be capped when not in use. This includes both liquid and solid waste containers. All waste containers including solid and liquid waste containers must be kept in secondary containers large enough to contain thevolume of the primary vessel in case of a spill or leak.
- Waste containers may be stored in a chemical fume hood, so long as the containers are cappedand stored in a secondary container. A fume hood is not considered a secondary box.
- It is best practice to separate halogenated waste (chloroform, dichloromethane, bromoform, etc.)from non-halogenated waste (ethyl acetate, acetone, ethanol, hexanes, etc.).
- When a chemical waste container is full, submit an online chemical waste pickup request. EH&Swill collect the waste within three business days.

Whereas the above criteria outline the guidelines regarding chemical waste generated during experimental research, there are instances where bottles of unused chemicals will need to be disposed. These situations may arise when chemicals are stored past their expiration date. When the chemicals are exposed to air and moisture, leading to decomposer or hydration, when chemicals become tainted or contaminated due to bad practices or a chemical is no longer needed or wanted by the laboratory. In these circumstances, do not discard the chemicals into the trash. Please contact EH&S, and they will pick up the identified containers.

Prescription Pharmaceutical waste

Expired and unused prescription drugs should be packed in a zip lock bag and taken to the drug collection drop box located at UNTHSC police department.

Figure 3 - Drug collection drop box

Compressed Gas Cylinders

Compressed gas cylinders are commonly found in labs at HSC. While they are commonplace, their contents can vary widely. Compressed gases include inert substances (e.g., nitrogen and argon), corrosives (e.g., HCl, methylamine), toxic substances (e.g., carbon monoxide), pyrophoric chemicals (e.g., phosphine, diborane), oxidizers (e.g., oxygen, chlorine), and flammable substances (e.g., hydrogen, acetylene). Some general guidelines for the safe use and storage of compressed gases are as follows:

- All compressed gas cylinders, whether in use or in storage, shall be securely strapped or fastened to a benchtop or wall mount in accordance with NFPA 55.
- All gas cylinders in use must be equipped with a regulator.
- Gas cylinders in storage or which are empty must have a cylinder cap securely fastened at the top.
- Do not store corrosive materials near compressed gas cylinders, as these may cause the valves to corrode.
- Do not store flammable gases near sources of ignition or heat, including bunsen burners and vacuum pumps.
- Store chemically incompatible compressed gases separately from one another.
- When transporting compressed gas cylinders, always use a cylinder cart. The cylinder must be strapped to the cart at all times. These rules also apply to the transport of empty gas cylinders.

Standard Operating Procedures

As per the guidance established in [29 CFR 1910.1450(e)(3)(i)], *"Standard operating procedures relevant to safety and health considerations to be followed when laboratory work involves the use of hazardous chemicals."*

Every laboratory that utilizes hazardous chemicals does so with specific experiments or uses in mind. To minimize the potential for unnecessary exposure to hazardous chemicals, each Lab is required to develop new or utilize existing standard operating procedures (SOP). These SOPs must describe how employees and students are required to perform tasks that involve hazardous chemicals.

SOPs are highly recommended for standard hazardous chemical applications, including but not limited to decanting and dispensing hazardous chemicals from large containers to small containers; storing and inventorying chemicals; using the fume hood, blast shield, and glove box; weighing and solubilizing hazardous chemicals, and storing hazardous waste. Blank SOP templates are available from the EH&S.

A SOP must be prepared for any chemical operations that will *generate* particularly hazardous materials or *cause* physical hazards. These materials can be acutely toxic, carcinogenic, teratogenic, or explosive. An experiment which occurs under pressure will generate hydrogen, or that heat flammable liquids are considered physical hazards. Additionally, hazardous materials may be intermediates along a chemical pathway and are not representative of the final material obtained. In this regard, a SOP should be created for the hazards associated with the chemical process, not just the beginning or end materials.

Each SOP must be written or selected by a knowledgeable laboratory member or student and approved by the PI. Once approved, a hard copy of all SOPs must be kept in the laboratory along with this document. Additionally, the IBC can, at their discretion, require the creation and submission of SOPs for any application involving hazardous chemicals.

Emergency Response

Unexpected accidents and inadvertent exposures may occur when working with hazardous chemicals. Being prepared to respond swiftly and efficiently is the best way to keep laboratory personnel safe, minimize damage to equipment and facilities, and prevent environmental releases. Emergency response planning for releases or spills shall be prepared by the lab supervisor or PI with the assistance of EH&S. The following action should be implemented by all principal investigators/departmental supervisors to ensure personnel has the basic information and tools to respond to chemical spills, thefts, losses, exposures, injuries, and releases.

- A list of telephone numbers must be posted by a phone that is accessible by all laboratory personnel. This list should contain contact information for the principal investigator (PI), laboratory manager, Student Health Services, Emergency Medical Services, and EH&S.
- All personnel should know how to access or be instructed on the location(s) of Safety Data Sheets (SDS) for each chemical stored in their laboratories.
- All laboratory personnel must know the location(s) of and be able to access safety equipment housed within or immediately outside of their laboratory. These include:
  - Portable equipment such as PPE, fire extinguishers, fire blankets, first aid kits, absorbent materials, and spill kits.
  - Installed equipment such as sink bound drench hoses, hard plumbed safety showers and eyewash stations, automated defibrillators.

- Building systems such as natural gas shut-off valves, emergency exhaust activation buttons, and fire alarms.

- Store and maintain both universal and, if needed, specialized (e.g., hydrofluoric acid, formaldehyde, or oil) chemical neutralization and spill containment kits. This universal neutralization and spill containment kits should include but are not limited to the following components:

  - Absorbent spill pillows or pads;
  - Inert absorbents such as vermiculite or kitty litter;
  - Chemsorb or other universal chemical absorbent powders or granules;
  - Sodium bicarbonate for neutralizing acid spills,
  - Ascorbic acid or Citric acid for neutralizing alkali spills;
  - A dustpan and broom; and
  - Appropriate PPE for the hazard, which could include gloves, eye protection, and N95 respirators.

- All personnel should be trained in the proficient use of available safety equipment. This training process should include random drills and/or exercises to ensure staff retains the necessary knowledge and skills needed to respond to and remediate small-scale chemical incidents. Reading this manual is an appropriate preparedness and training step.

Hazardous Chemical Exposure

One of the most common incidents involving hazardous chemicals is unintended exposure. Exposure can occur when a chemical is spilled onto skin, is splashed into eyes, mucus membranes, or onto clothing, or is inadvertently ingested or inhaled. The following procedures must be reviewed before handling hazardous chemicals and should be used as a reference if exposure occurs. When exposed to a hazardous chemical, seeking assistance from other personnel is an important first step. The assisting personnel can acquire first aid and spill kits, assist in using safety equipment, help apply first aid, and contact emergency responders. Additionally, the assisting personnel can ensure any spills during or after the exposure are contained and remediated.

Localized Skin Exposure

- If the skin is exposed to hazardous chemicals, immediately flush the affected area with flowing water for no less than 15 minutes and remove any jewelry or clothing as necessary to facilitate clearing any residual materials.
- Check the chemical's SDS to determine if special procedures are needed or if any delayed effects should be expected. Note that special attention must be paid to chemicals known to be readily absorbed through the skin.
- Report the incident to the PI immediately and seek medical attention for even minor chemical burns. Complete the first report of injury
- Do not use creams, lotions, or salves on exposed areas unless applied under the direction of a licensed health care provider.

Liquid or Powder Exposure to the Eyes or Mucus Membranes

- Immediately flush with water from an available emergency drench hose or eyewash station. Flush the orbits for no less than 15 minutes.
    - Hold the affected individual's eyelids open, and instruct him or her to move the eye up and down and sideways to wash thoroughly behind the eye.
- Seek immediate medical attention.
    - If the exposed person is non-ambulatory (can't move on their own), notify University police and request an ambulance.
    - Bring a copy of the SDS for the exposing chemical and provide this document to the treating medical personnel. If the exposed person is ambulatory (can move on their own,) arrange for the person to be taken to the nearest Hospital Emergency Room.
    - Report the incident to the manager or PI.

Clothing or Large Skin Exposure

- Immediately place the victim underneath the nearest safety shower and activate the shower.
- With the water flowing quickly, remove, if necessary, cut off, all contaminated clothing, shoes, and jewelry. Do not limit the showering of body areas because of modesty. When removing clothing, take care not to contaminate unexposed skin or the eyes. Keeping the eyes and mouth shut while under the shower will reduce the potential for chemicals, vapors, or gases to impact the eyes or to be inhaled or ingested.
- Rinse the affected areas for no less than 15 minutes.
- Provide the exposed person with a clean lab coat, scrubs, or clothing. If severely burned, be careful when covering injured skin.
- Seek immediate medical attention.
    - If the exposed person is non-ambulatory (can't move on their own), notify HSC police and request an ambulance.
    - Bring a copy of the SDS for the exposing chemical and provide this document to the treating medical personnel.
    - If the exposed person is ambulatory (can move on their own), arrange for the person to be taken to the nearest Hospital Emergency Room.
    - Report the incident to the manager or PI.
- EH&S may remove contaminated clothing for assessment and, if needed, will dispose of the material as hazardous waste.

Suspected Ingestion or Inhalation of Chemical Powders, Liquids, Vapors, or Gases

- Immediately remove the exposed person from the environment if it is safe to do so.
    - If the exposed person is non-ambulatory (can't move on their own,) notify HSC police and request an ambulance.
    - Bring a copy of the SDS for the exposing chemical and provide this document to the treating medical personnel.
    - If the exposed person is ambulatory (can move on their own,) arrange for the person to be taken to the nearest Hospital Emergency Room.
    - Report the incident to the manager or PI.

Non-emergency Chemical Spill

The frequent use of hazardous chemicals and the diversity of chemical applications can create conditions that lead to spills. The majority of these spills are considered a small scale and can be handled by trained laboratory personnel. These spills are considered non-emergency incidents.

However, these incidents must be immediately remediated by absorbing, neutralizing, or otherwise controlling the chemical at the spill location. In these situations, it is prudent to utilize the laboratory's spill kit to contain the chemical. Once the spill has been contained and collected and the area has been cleaned, contact EH&S to report the incident and to request the collection of the spill materials.

Emergency Chemical Spill

An emergency chemical spill is a situation that poses an immediate threat to personal safety and health, the environment, or property and cannot be controlled and corrected by individuals at the scene. These situations typically involve the large-scale release of hazardous chemicals and materials. If a spill occurs which laboratory personnel is unable to contain, conduct the following:

- Immediately evacuate the area. Inform laboratory personnel in the immediate area and in adjacent locations of the situation.
- Attempt to isolate the spill to a single location by closing doors.
- Notify the HSC Police by calling 817-735-2600. Be sure to communicate the following:
  - **the location of the spill and if the location is contained**
  - **the identity of the chemical(s) involved if known**
  - **if there are exposed personnel (suspected or known)**
- Seek immediate medical attention if anyone was exposed to the chemical during the spill.

Medical Consultation

As per the guidance provided in [29 CFR 1910.1450(e)(3)(vi)], *"Provisions for medical consultation and medical examinations in accordance with paragraph (g) of this section."*

Medical consultation and advice is available for all employees who are exposed to hazardous chemicals in the workplace. Exposure can be correlated to the standard handling, use, storage, or disposal of chemicals in the laboratory, a known or suspected exposure through a route of entry, or being near or responding to a spill/release. Employees and students who have health concerns associated with these exposure risks should contact Student Health Services and/or EH&S.

If signs and symptoms consistent with exposure to a chemical are exhibited, the affected employee or student must immediately alert their supervisor to coordinate seeking medical treatment. In the case of an emergency, personnel should dial 911, and medical attention should be sought immediately. In all cases of exposure or injury, a "First Report of Injury" must be completed by the employee/student and their PI/supervisor. FRI forms must be faxed to the Human Resources office. Employees' health impacts or injuries following exposure to a hazardous chemical must comply with the medical personnel's directions evaluating their exposure.

Security

Hazardous Chemicals have many promising and needed applications in medicine, research, education, and industry; however, these same materials can deliberately hurt people, destroy property, damage the

environment, and for terroristic purposes. As such, the safe and secure storage of these materials is imperative to the overall security of our campus, our employees, and our community.

All chemical storage rooms must be locked when not in use, laboratories must be locked when not occupied, and chemical inventories should be routinely monitored. Employees and students are required to notify the HSC Police immediately if a security breach is identified, hazardous chemicals are found missing, there is evidence of chemical theft, or if a suspicious person is observed in the building, Lab, or storage room. The HSC Police will alert EH&S following their investigation.

Controlled Substances Secured

Controlled substances must be secured in accordance with 21 CFR 1300 and the Texas Legislature Chapter 481 *Texas Controlled Substances Act,* which include the following criteria:

- Establishing adequate security to prevent unauthorized access to controlled substances and dangerous drugs, including a preliminary inspection (contact HSC Police for assistance).
- Not allowing any individual access to controlled substances and dangerous drugs storage areas except those authorized for efficient operations during business activities.
- Storing controlled substances and dangerous drugs listed in schedules I, II, III, IV, and V in a securely locked, substantially-constructed cabinet or security cabinet or safe.

APPENDIX 1: Common Chemicals Exempt from Hazardous Chemical Registration

As mentioned above, many chemicals exhibit one or more of the characteristics of PHSs, but do not require the submission of a Hazardous Registration with the IBC. Instead, the PI/departmental supervisor and their staff members' responsibility is to be aware of which chemicals exhibit these effects and take the necessary precautions. Please contact EH&S for guidance and assistance before using these chemicals.

Table 3. Partial List of Chemicals Exempt from Hazardous Registration

Chemical	CAS#	PHS Classification
Phenol	108-95-2	LD50 Oral: 317 mg/kg; Mutagen, Teratogen
Aniline	62-53-3	LD50 Oral: 250 mg/kg; Mutagen
Carbon Tetrachloride	56-23-5	Carcinogen
Triphenylphosphine	603-35-0	LC Inhalation: 12.5ppm for 4 hours
1,3 Butadiene	106-99-0	Carcinogen
Epichlorohydrin	106-89-8	Carcinogen
Quinoline	91-22-5	LD50 Oral: 262 mg/kg; Mutagen
Ethylene Glycol	107-21-1	Teratogen
Chloroacetic Acid	79-11-8	LD50 Oral: 55 mg/kg
Triethylamine	121-44-8	LD50 Oral: 460 mg/kg
Hydroxylamine hydrochloride	5470-11-1	LD50 Oral: 144 mg/kg
Benzene	71-43-2	Carcinogen
Thionyl chloride	7719-07-7	LD50 Oral: 324 mg/kg
Thiophenol	108-98-5	LD50 Oral: 46 mg/kg; LC Inhalation: 33ppm

APPENDIX 2: NFPA 45 Regulation Regarding Laboratory Flammable Limits

The most commonly encountered class of hazardous chemicals at HSC is flammable liquids. This class includes common solvents such as ethanol, methanol, benzene, hexane, ethyl acetate, acetone, acetonitrile, and tetrahydrofuran (THF). While these solvents are common, their flammability creates a serious fire hazard within the laboratory. For this reason, the amount of flammable liquid is regulated by the NFPA. As a state institution, HSC is subject to and must follow applicable NFPA codes (e.g., NFPA 30, 45, 55, 101).

Per NFPA code, all locations on the UT Southwestern campus that utilize flammable liquids are subject to storage limitations.
The following three parameters define these limitations:

- The construction of the laboratory (whether it is classified as an A, B, C, or D lab);
- The floor of the building on which the laboratory is located;
- The square-footage of the laboratory unit

Laboratory Construction Requirements

HSC laboratories and support facilities are constructed using various fire protection standards that define the structure required to contain identified hazards, including flammable liquids and materials. Based on these standards, HSC recognizes four classes of laboratory designs (i.e., A, B, C, D), each with specific construction requirements (see Table 4). Knowing what laboratory unit classification your Lab falls under is vital to understanding the maximum flammable volume that a facility is allowed to store. The vast majority of Lab spaces fall under category “C”.

Table 4. Laboratory Construction and Height Requirements

Laboratory Classification	Area of Lab Unit	Fire Wall Separation	Floors Permitted Above Grade
A (High Fire Hazard)	≤ 10,000 ft^2 >10,000 ft^2	2 hours Not Permitted	1-3 Not Permitted
B (Moderate Fire Hazard)	≤ 10,000 ft^2 ≤ 10,000 ft^2 >10,000 ft^2	1 hour 2 hours Not Permitted	1-3 4-6 Not Permitted
C (Low Fire Hazard)	Any Size Any Size Any Size	Not Required 1 hour 2 hours	1-3 4-6 Over 6
D (Minimal Fire Hazard)	Any Size	Not required	No Limit

Floor of Building and Square Footage Requirements

In addition to knowing the laboratory classification, it is also necessary to understand the laboratory's square footage. Larger labs are allowed a larger volume of flammable liquids. If you do not know the square footage of your laboratory, contact facilities. Once the laboratory's size is known, Table 5 details the maximum volume per 100 ft^2 that a laboratory can contain.

Table 5. Maximum Allowable Quantity of Flammable Liquids in Laboratories

		Quantities in Use		Quantities in Use & Storage	
Laboratory Classification	Flammable and Combustible Liquid Class	Maximum Quantity per 100 ft^2 of Lab (L)	Maximum Quantity per Lab (L)	Maximum Quantity per 100 ft^2 of Lab (L)	Maximum Quantity per Lab (L)
A	I I, II, & IIIA	38 76	1820 3028	76 150	1820 6060
B	I I, II, & IIIA	20 38	1136 1515	38 76	1820 3028
C	I I, II, & IIIA	7.5 15	570 757	15 30	1136 1515
D	I I, II, & IIIA	4 4	284 284	7.5 7.5	570 570

Footnotes: *a*) The maximum amount in use in open systems is limited to 10% of the quantities listed. *b*) Reduce the quantities by 50% for B laboratory units located above the 3rd floor. *c*) Reduce quantities by 25% for C and D laboratory units located on the 4th-6th floors of a building and reduce quantities by 50% for C and D laboratory units located above the 6th floor.

It is important to pay attention to the footnote of Table 5. Specifically, it states that "B" labs must have their flammable liquid volume reduced by 50% if they are located above the third floor. Likewise, "C" labs located on floors 4-6 of a building must have their flammable liquid volume reduced by 25%. Finally, "C" labs located above the sixth floor of a building must reduce their flammable liquid quantities by 50%. These reductions are imposed due to the time and difficulty that is required for fire rescue personnel to reach these floors during an emergency.

Applying the NFPA Regulations

While the details of NFPA 45 about flammable liquid storage in labs are given above, they can be somewhat confusing in their application. Hypothetical situations detailing the use of NFPA 45 is given below:

Example 1

Professor J. Doe has a laboratory located on the 5th floor of her building. After checking with Facilities, she learns that her Lab is 847 ft^2. Additionally, she is informed that her Lab was constructed with 2-hour firewalls and a 90-minute fire door. Using this information, Professor Doe has learned that her Lab is a "B" hazard lab. Using Table 5, her maximum allowable flammable volume in use and storage is as follows:

$$76\ L/100\ ft^2 = X/847\ ft^2$$
$$X(100\ ft^2) = (76\ L)(847\ ft^2)$$
$$X(100\ ft^2) = 64{,}372\ L/ft^2$$
$$X = 644\ L \text{ (reduce by 50\%)}$$
$$X = 322\ L$$

By applying the NFPA 45 rules, Professor Doe learns she can have, at most, 322 L in her laboratory. Note that the volume was reduced by 50% because her Lab was located above the building's third floor.

Example 2

Professor Xavier has a laboratory located on the 10th floor of his building. He placed a call to Facilities and learned that his Lab is a "C" rated Lab, complete with 2-hour firewalls and 90-minute fire doors. He also learned that his Lab is 688 ft^2. By using Table 5, Professor Xavier finds that his maximum allowable quantity of flammable liquids in storage and use is as follows:

$$30\ L/100\ ft^2 = X/688\ ft^2$$
$$X(100\ ft^2) = (30\ L)(688\ ft^2)$$
$$X(100\ ft^2) = 20{,}640\ L/ft^2$$
$$X = 206\ L \text{ (reduce by 50\%)}$$
$$X = 103\ L$$

The volume of flammable liquids Professor Xavier can have in his Lab is 103 L. Once again, the final quantity of allowable flammable liquids was reduced by 50% because the "C" rated lab was located above the building's sixth floor.

Appendix 3: Resistance to Chemicals of Common Glove Materials

(E=Excellent, G=Good, F=fair, P=poor)

Chemical	Natural Rubber	Neoprene	Nitrile	Vinyl
Acetaldehyde	G	G	E	G
Acetic acid	E	E	E	E
Acetone	G	G	G	F
Acrylonitrile	P	G	-	F
Ammonium hydroxide	G	E	E	E
Aniline	F	G	E	G
Benzaldehyde	F	F	E	G
Benzene	P	F	G	F
Benzyl chloride	F	P	G	P
Bromine	G	G	-	G
Butane	P	E	-	P
Butyraldehyde	P	G	-	G
Calcium hypochlorite	P	F	G	F
Carbon disulfide	P	P	G	F
Carbon tetrachloride	P	F	F	F
Chlorine	G	G	-	G
Chloroacetone	F	E	-	P
Chloroform	P	F	F	P
Chromic acid	P	F	F	E
Cyclohexane	F	E	-	P
Dibenzyl ether	F	G	-	P
Dibutyl phthalate	F	G	-	P
Diethanolamine	F	E	-	E
Diethyl ether	F	G	E	P
Dimethyl sulfoxide	P	E	E	G

Ethyl acetate	F	G	G	F
Ethylene dichloride	P	F	G	P
Ethylene glycol	G	G	E	E
Fluorine	G	G	-	G
Formic acid	G	E	E	E
Glycerol	G	G	E	E
Hexane	P	E	-	P
Hydrobromic acid (40%)	G	E	-	E
Hydrochloric acid (conc)	G	G	G	E
Hydrofluoric acid (30%)	G	G	G	E
Hydrogen peroxide	G	G	G	E
Iodine	G	G	-	G
Methylamine	G	G	E	E
Methyl cellosolve	F	E	-	P
Methyl chloride	P	E	-	P
Methyl ethyl ketone	F	G	G	P
Methylene chloride	F	F	F	F
Monoethanolamine	F	E	-	E
Morpholine	F	E	-	E
Naphthalene	G	G	E	G
Nitric acid (conc)	P	P	P	G
Perchloric acid	F	G	F	E
Phenol	G	E	-	E
Phosphoric acid	G	E	-	E
Potassium hydroxide	G	G	G	E
Propylene dichloride	P	F	-	P
Sodium hydroxide	G	G	G	E
Sodium hypochlorite	G	P	F	G
Sulfuric acid (conc)	G	G	F	G
Toluene	P	F	G	F
Trichloroethylene	P	E	G	F
Tricresyl phosphate	P	E	-	F
Triethanolamine	F	E	E	E
Trinitrotoluene	P	E	-	P