CHAPTER 8

CHEMICAL SAFETY

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1.0 **ROLES & RESPONSIBILITIES FOR CHEMICAL SAFETY**

A wide variety of chemicals are used at UTMB in research, clinical and academic areas. If chemicals are used, stored and disposed of in a safe manner, the potential hazards involved can be greatly reduced. General information and precautions will be presented in this chapter. Detailed information on safe handling of specific chemicals can be obtained from Environmental Health & Safety – Biological and Chemical Safety (extension 21781).

1.1 **UTMB Administration**

- Provides facilities and equipment for the safe use and storage of hazardous chemicals
- Establishes mechanisms for dissemination and implementation of policies for the safe use and storage of hazardous chemicals

1.2 **Chemical Safety Committee**

1.2.1 **Scope**

The scope of the Chemical Safety Committee encompasses all UTMB chemical safety issues except those addressed by pharmaceutical safety and efficacy when administered to patients and research subjects.

1.2.2 **Mission**

The mission of the Chemical Safety Committee is to support the University’s fundamental objectives of teaching, research and healthcare delivery by promoting the safe use, management and control of chemicals as well as assuring that all activities involving these agents are in compliance with the applicable guidelines, standards, codes and regulations.

1.2.3 **Responsibilities of Chemical Safety Committee**

- Approve applications for work being conducted in the Environmental Toxicology Laboratory (ETL)
- Establish and maintain the UTMB list of high risk hazardous chemicals
- Review safety plans for the use and storage of high risk hazardous chemicals to:
  - a) ensure that unreasonable risks to personnel, property or the environment do not exist
  - b) verify the adequacy of technical procedures to minimize occupational exposures
  - c) review the qualifications of the applicants undertaking the proposed research and make recommendations, if appropriate
  - d) approve, recommend change to, or deny the intended use of the chemical as proposed in the High Risk Hazardous Chemical Safety Plan
- Develop policies, procedures and guidelines as necessary for the use of all other hazardous chemicals and related activities, including:
- Develop institutional chemical safety policies and procedures
- Maintain/review policies and procedures
- Identify problem areas
- Monitor effectiveness of policies and compliance with UTMB Chemical Safety Policies
- Assure safety of students, employees, visitors, volunteers, patients, environment and community
- Recommend facility modifications
- Monitor chemical disposal procedures
• Report and advise university administration on chemical safety issues
• Communicate to address:
  - Chemicals requiring chemical safety review,
  - Individual responsibilities with respect to chemical safety, and;
  - Chemical issues prompted by public awareness/media coverage.

1.3 Environmental Health & Safety-Biological & Chemical Safety (EHS-B&C)

• Provide training in general laboratory safety for all employees
• Collect and disseminate information about health and safety hazards
• Assist in the development of techniques and training programs for specialized purposes
• Provide consultation and technical information for chemical agents
• Review proposals and protocols for the use of high risk hazardous chemicals (if it is required, EHS-B&C will submit these proposals to the Chemical Safety Committee with recommendations)
• Present chemical safety seminars upon request
• Consult with Project Management personnel in evaluating design parameters to effectively reduce chemical exposure
• Monitor the work environment for potentially hazardous exposure to chemicals and recommend medical surveillance, procedural changes, or other methods to minimize exposure
• Provide annual ventilation surveys of chemical fume hoods
• Coordinate the repair of exhaust motors to protect laboratory and FOAM personnel from exposure to hazardous agents
• Report accidents to the proper authorities and work with those groups in the investigation of such accidents
• Provide assistance in the collection and disposal of hazardous materials
• Provide technical expertise and assistance for the cleanup of major chemical spills
• Document compliance with responsibilities listed above

1.4 The Department Manager/Principal Investigator

• Prepare written chemical safety guidelines for each laboratory/work area covering routine work, spill and accident procedures, and post these prominently in the work area
• File a chemical inventory with EHS B&C listing all chemicals present in the laboratory/work area
• Submit the initial Safety Plan required for High Risk Hazardous Chemicals, as well as the annual review/update and a renewal every 3 years if work with the agent continues
• Provide training and supervision to ensure personnel have appropriate knowledge and experience to handle chemicals safely including how to access MSDSs for the chemicals they work with
• Review work practices to ensure that safe handling guidelines are implemented properly
• Encourage employees to report any changes or suspected changes in their health status
• Appoint a Hazard Communication Act (HCA) trainer for their lab/work area and ensure all personnel are trained in the hazards of the chemicals they work with
• Advise EHS B&C of any significant changes in the use of high risk hazardous chemical agents
1.5 **Staff/Students/Other Chemical Handlers**

- Aid in the development of safe work procedures/working environments
- Observe the policies and guidelines for chemical safety as they apply to their specific work assignment and laboratory area
- Participate in applicable Occupational Health programs/medical surveillance
- Report to their supervisors any work-related change or suspected work-related change in health status
- Report all spills and accidents to their supervisor

1.6 **Environmental Toxicology Lab**

The Environmental Toxicology Lab (ETL) is a core facility designed for experimental research projects focusing on airborne exposures to toxic agents. The ETL is located on the 2nd floor of Ewing Hall in the Preventive Medicine and Community Health Department. The lab facilities allow for both in vitro and in vivo experiments. Application for use of the facilities is made through the Chemical Safety Committee. Contact EHS B&C for assistance in gaining access to this facility.

Environmental Toxicology Lab management will:
- Review applications for use of the facility together with the Chemical Safety Committee (the ETL Manager is a member of the Chemical Safety Committee)
- Make recommendations to the Chemical Safety Committee regarding applications for use of the ETL
- Establish and maintain safe working procedures for the ETL
- Maintain all equipment and facilities in the ETL
- Safely conduct and manage experiments for personnel requesting use of the ETL

2.0 **HAZARD COMMUNICATION**

2.1 **Hazardous Chemical Definition**

A hazardous chemical is any chemical that poses a physical and/or health hazard.

A chemical that is a physical hazard has scientifically valid evidence that it is a combustible liquid, a compressed gas, explosive, flammable, an organic peroxide, an oxidizer, pyrophoric, unstable (reactive), or water-reactive.

A chemical that is a health hazard has 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 persons. This includes chemicals that are:
- carcinogens or known to cause neoplastic effects
- highly toxic agents
- moderately toxic agents
- reproductive system toxins
- teratogens
- mutagens
• sensitizers or allergens (immunologic system effects)
• substances causing target organ effects (hepatotoxins, nephrotoxins, neurotoxins, hematopoietic system toxins, and agents which damage the lungs, skin, eyes, or mucous membranes)
• corrosives
• irritants

2.2 Texas Hazard Communication Act

The Texas Hazard Communication Act (HCA) of the Texas Health and Safety Code (Chapter 502) is a law that requires public employers to provide employees with specific information on the hazards of the chemicals to which employees may be exposed in the workplace. The specific information required includes:
• A list of hazardous chemicals used or stored in the workplace; the list must be revised as necessary, but at least annually.
• Readily accessible and current Material Safety Data Sheets (MSDSs) for these chemicals (hard-copy or online)
• Labeling information for the chemicals; Employees shall not be required to work with unlabeled chemicals except for portable containers for immediate use, the contents of which are known to the user.
• Training on the hazards of the chemicals and measures employees can take to protect themselves from those hazards; The training shall be repeated as needed, but at least whenever new chemicals are introduced into the workplace or new information is received on the chemicals already present.

Per the HCA, hazardous chemicals are defined as in section 2.1 above and include any of the substances listed in 29 CFR 1910.1200, parts (c) or (d), or any chemicals listed in the most current American Conference of Governmental Industrial Hygienists booklet “Threshold Limit Values and Biological Exposure Indices”.

2.3 Chemical Inventory Systems

UTMB Policy and the Texas HCA require that all areas using or storing hazardous chemicals maintain a chemical inventory. This inventory must be updated each year via a physical inventory of chemical containers. This inventory must be provided to EHS on request, typically during the annual Lab Audit process.

Keep the following guidelines in mind while performing the physical inventory:
• Replace deteriorating labels before the information is illegible or lost.
• Dispose of material not anticipated to be used within a reasonable time period.
• Have experienced personnel inspect and dispose of deteriorating containers or containers in which it is apparent that a chemical change has occurred.
• Dispose of or recycle chemicals before the expiration date.

It is recommended that chemical inventories be maintained electronically with a minimum of the following information:

EXAMPLE: Smith Lab Chemical Inventory
May 1, 2008
2.4 Chemical Labeling Policy

2.4.1 Scope
This policy applies to all who purchase, use and store chemicals or commercial products containing chemicals including, but not limited to, paints, aerosol lubricants, cleaning agents, and other such non-laboratory products. This policy does not affect pharmaceuticals dispensed by the UTMB Pharmacy Department.

2.4.2 Purpose
The purpose of this policy is to communicate to employees the chemical identity and other pertinent hazard information for the chemicals in their work area.

2.4.3 Policy
The Texas HCA and UTMB Policy require that all containers of hazardous chemicals be labeled with certain information. The Texas HCA Chapter 502.007 further states that a label on an existing container of a hazardous chemical may not be removed or defaced unless it is illegible, inaccurate, or does not conform to the OSHA standard (29 CFR 1910.1200) or other applicable labeling requirements.

This policy is to be part of new employee HCA training before working with any chemicals or chemical products.

Labels can be printed or handwritten. Information can also be written directly on the container (e.g., permanent marker, wax or grease pencil). Some commercial labeling systems are allowed as well. The HMIS (Hazardous Materials Identification System) is acceptable. The NFPA (National Fire Protection Association) 704 labeling system is not acceptable. HMIS labels can be purchased through Scientific Alley or through lab supply catalogs.

2.4.4 Procedure

New Containers
Check each new chemical container upon delivery to make sure it is labeled. Original manufacturer container labels or new labels on original containers must contain:

- Chemical identity (use chemical names not abbreviations)
- Concentration
- Appropriate hazard warnings (e.g. HMIS numerical ratings)
- Manufacturer’s name and address

If the information is present, place the date received on the container along with the name of the owner. If the owner’s initials are used, they must be unique to that laboratory so that the owner may be located if necessary. Place the container in an appropriate storage place according to its hazards. When the chemical container is opened, place the date opened on the label as well.
Existing Containers
Containers used to prepare a solution or mixture must be labeled with:

• Chemical identity (use chemical names not abbreviations)
• Concentration
• Appropriate hazard warnings (e.g. HMIS numerical ratings)
• Date prepared
• Initials of the person who prepared the solution or mixture

For mixtures, assign the value of the most hazardous component in each category. Refer to a chemical catalog or the MSDS for the HMIS numerical ratings. If these sources do not have the information, see HMIS III HAZARD RATINGS below or contact EHS for assistance.

Pipeline Labeling Exemption
Labeling of pipelines carrying chemicals is not required, provided that employees have ready access (within their normal work shift) to documents to determine the contents of pipes at any time.

HMIS® III-HAZARD RATINGS
* Chronic Hazard Chronic (long-term) health effects may result from repeated overexposure

0 Minimal Hazard No significant risk to health
1 Slight Hazard Irritation or minor reversible injury possible
2 Moderate Hazard Temporary or minor injury may occur
3 Serious Hazard Major injury likely unless prompt action is taken and medical treatment is given
4 Severe Hazard Life-threatening, major or permanent damage may result from single or repeated overexposures

HMIS® III - FLAMMABILITY RATINGS
0 Minimal Hazard Materials that will not burn
1 Slight Hazard Materials that must be preheated before ignition will occur. Includes liquids, solids and semi solids having a flash point above 200 F. (Class IIIB)
2 Moderate Hazard Materials which must be moderately heated or exposed to high ambient temperatures before ignition will occur. Includes liquids having a flash point at or above 100 F but below 200 F. (Classes II & IIIA)
3 Serious Hazard Materials capable of ignition under almost all normal temperature conditions. Includes flammable liquids with flash points below 73 F and boiling points above 100 F. as well as liquids with flash points between 73 F and 100 F (Classes IB & IC)
4 Severe Hazard Flammable gases, or very volatile flammable liquids with flash points below 73 F, and boiling points below 100 F. Materials may ignite spontaneously with air. (Class IA)

HMIS® III - PHYSICAL HAZARD RATINGS (previously REACTIVITY)
0 Minimal Hazard Materials that are normally stable, even under fire conditions, and will NOT react with water, polymerize, decompose, condense, or self-react. Non-Explosives.
1 Slight Hazard Materials that are normally stable but can become unstable (self-react) at high temperatures and pressures. Materials may react non-violently with water or undergo hazardous polymerization in the absence of inhibitors.
2 Moderate Hazard Materials that are unstable and may undergo violent chemical changes at normal temperature and pressure with low risk for explosion. Materials may react violently with water or form peroxides upon exposure to air.

3 Serious Hazard Materials that may form explosive mixtures with water and are capable of detonation or explosive reaction in the presence of a strong initiating source. Materials may polymerize, decompose, self-react, or undergo other chemical change at normal temperature and pressure with moderate risk of explosion.

4 Severe Hazard Materials that are readily capable of explosive water reaction, detonation or explosive decomposition, polymerization, or self-reaction at normal temperature and pressure.

HMIS® III -HAZARD RATINGS

The HMIS coding for Personal Protective Equipment (PPE) is listed below. For any hazardous chemical, a minimum of safety glasses is required.

| A | Safety glasses only |
| B | Safety glasses + gloves |
| C | Safety glasses + gloves + chemically resistant apron |
| D | Face shield + gloves + chemically resistant apron |
| E | Safety glasses + gloves + dust mask |
| F | Safety glasses + gloves + dust mask |
| G | Safety glasses + vapor respirator |
| H | Safety goggles + gloves + vapor respirator |
| I | Safety glasses + gloves + dust and vapor respirator |
| J | Safety goggles + gloves + apron + dust and vapor respirator |
| K | Full face, supplied air respirator + gloves + protective suite + boots |
| X | Ask your supervisor for special handling instructions |

NOTE: Any respiratory protection use must be authorized by EHS. Personnel will have to comply with the UTMB Respiratory Protection Plan.


2.5 Material Safety Data Sheets (MSDSs)

The Texas HCA requires manufacturers or distributors of hazardous chemicals to assess the physical and health hazards of the chemicals or products. This information must be included in the Material Safety Data Sheet (MSDS), which must be provided to the purchaser of the product with at least the initial shipment of the chemical. MSDSs must be obtained and maintained for every chemical used in the workplace. The MSDSs must be accessible to all personnel during their work hours.

The ANSI (American National Standards Institute) 16 section format for MSDSs is recommended:

1. Substance identity and company contact information
2. Chemical composition and data on components
3. Hazards identification
4. First aid measures  
5. Fire-fighting measures  
6. Accidental release measures  
7. Handling and storage  
8. Exposure controls and personal protection  
9. Physical and chemical properties  
10. Stability and reactivity  
11. Toxicological information  
12. Ecological information  
13. Disposal considerations  
14. Transport information  
15. Regulations  
16. Other information

MSDSs are available electronically at http://www.utmb.edu/ehs/B&C/MSDS/MSDSlinks.htm. Employees must be instructed in how to interpret the information in each section of the MSDS.

2.6 Hazard Communication Training Policy

2.6.1 Scope
The Texas HCA requires specialized chemical training for all employees who may be exposed to hazardous chemicals. This training must be provided to all new or newly assigned employees before working with hazardous chemicals or within 10 days after beginning employment, whichever is shorter. Hazardous chemicals are defined in section 2.1 of this chapter. Employees designated as HCA Trainers must receive training from EHS B&C prior to performing this function.

2.6.2 Training Content
This training must include general information on how to interpret hazardous chemical labels and MSDSs as well as information on safe handling, spill cleanup and disposal of hazardous chemicals. The training must also include specific information on the chemicals used by the employees including chemical storage location, health and physical hazards, safe handling, spill cleanup, PPE and first aid treatment.

The general information is covered by on-line training assigned to all new employees that may be exposed to hazardous chemicals. The specific information is covered by training provided by departmental HCA Trainers. Principal Investigators and Department Managers are responsible for identifying HCA Trainers and notifying HCA Trainers of personnel requiring specific HCA training. HCA Trainers also provide retraining when new hazardous chemicals are introduced into the workplace or when new information is received on existing chemicals in the workplace.

2.6.3 Training Documentation
On-line general HCA training is documented electronically. Specific HCA training must be documented with the type of training provided, the training date, signature of the trained employee and signature of the trainer. This training documentation must be forwarded to EHS B&C. Principal Investigators and Department Managers are responsible for ensuring the completed documentation is sent to EHS B&C.

2.6.4 Employee Responsibilities
• Complete general and specific HCA training
• Become familiar with chemical labels & MSDSs for chemicals in their work area
• Use and dispose of hazardous chemicals per specific HCA training, MSDSs and UTMB policies and procedures
• Report any work-related changes or suspected changes in their health status to the Manager and/or Employee Health
• Report all spills, accidents and exposures to their Manager

3.0 CHEMICAL LABORATORY SAFETY (CLS)

3.1 Applicability

Chemical Laboratory Safety (CLS) encompasses those tenants outlined under the State of Texas Hazard Communication Act. CLS is comprised of standard operating procedures (SOPs) for equipment, (e.g., lab equipment, chemical fume hoods, PPE), training, occupational health and work practices for conducting laboratory chemical operations in a manner that protects people from harmful chemical exposures.

CLS applies where "laboratory use" of hazardous chemicals occurs. Laboratory use of hazardous chemicals is handling or use of such chemicals in which all of the following conditions are met: i) the handling or use of chemicals occurs on a "laboratory scale", that is, the work involves containers which can easily and safely be manipulated by one person, ii) multiple chemical procedures or chemical substances are used, and iii) protective laboratory practices and equipment are available and in common use to minimize the potential for employee exposures to hazardous chemicals.

At a minimum, this definition applies to all personnel handling hazardous chemicals in research, teaching, and clinical laboratories, at UTMB. It is the policy of the University that students will be given training commensurate with the level of hazard associated with their laboratory work.

Clinical laboratories must meet the requirements of their certifying bodies, including but not limited to the College of American Pathologists (CAP) and Joint Commission on the Accreditation of Healthcare Organizations (JCAHO).

3.2 Exclusions

Chemical Laboratory Safety (CLS) does not cover work with radiation-producing devices, radioactive materials, biological agents, or the disposal of these wastes. Use of radioactive materials and biological agents must have prior approval from the Radiation Safety Committee or Institutional Biosafety Committee. Permit forms and procedures can be obtained from EHS at (409)772-1781 or by visiting the safety link: http://intranet.utmb.edu/envcare/safetylinksframes.htm.

This standard does not apply where the use of hazardous chemicals provides no potential for employee exposure, such as in procedures using chemically impregnated test media.

3.3 General Lab Safety Information
3.3.1 General Guidelines for Chemical Handling

The following are general guidelines for handling hazardous chemicals. All personnel handling hazardous chemicals are responsible for knowing and following these general guidelines as well as any precautions that are specific to the chemicals with which they are working. Additional information can be found in Chapter 7 of the Safety Manual, General Laboratory Safety.

- Restrict access to hazardous chemicals to only authorized personnel.
- Ensure personnel handling hazardous chemicals have been trained in the hazards of the chemicals and precautions to take to protect themselves.
- Use the smallest amount and lowest concentration of chemical needed for the current task.
- Substitute less hazardous chemicals for more hazardous ones whenever possible.
- Work inside of a chemical fume hood when possible to minimize exposure.
- Wear all recommended PPE when working with hazardous chemicals. Ensure lab coats are buttoned. Ensure gloves selected are appropriate for the chemical. Contact EHS B&C for assistance in selecting appropriate gloves.
- Dispose of all hazardous chemicals as directed by EHS Environmental Protection Management (EPM). Do not pour hazardous chemicals down the drain. Please see section 5.4 for more information on proper chemical disposal.

3.3.2 Chemical Emergencies

3.3.2.1 Emergency Preparedness

- Know the location of safety showers, eyewash stations, fire extinguishers and spill kits in each work area and how to use this equipment.
- Conduct procedures that involve hazardous chemicals or that may result in the production of aerosols, vapors or dangerous gases in a properly functioning chemical fume hood.
- Consider any unlabeled chemical hazardous until identified.
- Discard chemicals that have changed in color or appearance.
- Never work alone when conducting tests involving high risk hazardous chemicals.
- Ensure standard operating procedure as well as emergency (i.e., spill response, exposure) procedures are available in the work area.
- Ensure personnel are aware of exits and evacuation routes.

3.3.2.2 First Aid Procedures

3.3.2.2.1 Chemical Exposure: Skin Contact

- Contact Employee Health (409) 747-9142 or Emergency Room after hours. Be prepared to give present location, the chemical name and extent of contact (bring MSDS if possible).
- Rinse exposed area with cool running water for twenty minutes.
- Gently remove contaminated clothing, shoes, and jewelry while flooding injured area, taking care not to contaminate yourself.
- Gently remove any rings, watches, belts or constricting clothing from injured area before area begins to swell.
- Cover the injured area loosely with sterile unmedicated dressing.
- DO NOT attempt to neutralize by adding another chemical.
- DO NOT remove anything that is sticking to the burn.
- DO NOT apply lotions, ointments or fat to the injury.
• DO NOT break blisters or otherwise interfere with the injured area.
• Report incident to EHS (409) 772-1781.

3.3.2.2 Chemical Exposure: Eye Contact
• Contact Employee Health (409) 747-9142 or Emergency Room after hours. Be prepared to give present location, the chemical name and extent of contact (bring MSDS if possible).
• Immediately flush eyes with cool water for at least 20 minutes with eyewash.
• Assist employee by holding eyelids away from eyeballs and instruct them to rotate eyes so that all surfaces can be washed thoroughly.
• If eyewash is not available, pour water on the eyes for 20 minutes, rinsing from nose outward to avoid contamination of the unaffected eye.
• DO NOT attempt to neutralize by adding another chemical.
• Report incident to EHS (409) 772-1781.

3.3.2.3 Ingestion of Chemicals
• Contact Employee Health (409) 747-9142 or Emergency Room after hours. Be prepared to give present location, the chemical name and extent of contact (bring MSDS if possible).
• DO NOT induce vomiting.
• If conscious, drink two cups of water. If the chemical is corrosive, drink a cupful every 10 minutes.
• DO NOT neutralize by adding another chemical.
• If employee is unconscious, do not give anything by mouth. Perform CPR if necessary.
• Stay with employee until medical assistance arrives.
• Report incident to EHS (409) 772-1781.

3.3.2.4 Inhalation of Chemicals
• Contact Employee Health (409) 747-9142 or Emergency Room after hours. Be prepared to give present location, the chemical name and extent of contact (bring MSDS if possible).
• Evacuate to fresh air immediately.
• Secure area.
• If employee is not breathing, perform CPR until rescuers arrive.
• If employee is breathing but unconscious, loosen clothing and maintain airway.
• Stay with employee until medical assistance arrives.
• Report incident to EHS (409) 772-1781.

3.3.2.5 Spill Response Procedure
Clean up chemical spills promptly following the lab’s SOPs or instructions on the chemical MSDS.
• Small spills in a contained area (such as a chemical fume hood) or on absorbent material (such as a bench pad/diaper) can be cleaned up by lab personnel.
• Large spills require lab evacuation. If the spill involves a flammable or combustible material, turn off any ignition sources as well. After evacuation, contact EHS EPM for spill clean-up assistance.

3.3.2.4 Fire Response Procedure
• Ensure fire extinguishers appropriate for the chemicals in the work area are available.
• Ensure personnel are trained in extinguisher use.
• If a fire occurs in a chemical fume hood, close the sash and call the fire department at extension 2-1211.
• Review chemical MSDSs to determine if any special fire prevention/response procedures should be followed for a particular chemical.
• Always practice R.A.C.E: Rescue and assist people, Alarm by notifying the fire dept., Confine the fire and close doors, Evacuate (or extinguish if trained).

3.4 Laboratory-Specific CLS Elements

3.4.1 Laboratory Contact Information
List key contacts for the laboratory including the building, room number, lab phone number, Principal Investigator name and phone number, Lab Contact(s) name(s) and phone number(s) and other personnel who work in the lab. List any other rooms related to this lab including walk-in freezers/refrigerators, other storage locations and animal facilities. This information should all be on the lab sign posted at the entrance. To update the information or obtain a new lab sign, please contact EHS.

3.4.2 Laboratory-Specific Emergency Procedures
• Provide emergency contact information for key lab contacts (i.e., PI and Lab Contact home phone and mobile phone numbers).
• Provide a map or description of lab exits and evacuation routes.
• Provide emergency equipment locations (i.e., fire extinguishers, eyewash stations, safety showers, spill clean-up supplies/kits).
• Provide any special emergency information for hazardous materials used in the lab.

3.4.3 Chemical Inventory and MSDSs
Provide a chemical inventory for all hazardous chemicals used in the lab. See section 2.3 for more information. Include information on where to find MSDSs for the chemicals as well.

3.4.4 Laboratory-Specific Standard Operating Procedures (SOPs)
Develop and implement SOPs for lab equipment and hazardous materials including any materials or work requiring prior approval (e.g. High Risk Hazardous Chemicals, Select Agents, animal work). Include any additional special equipment instructions, experimental procedures or precautions/procedures associated with unique hazards. SOPs should include safe work practices (including storage conditions), exposure controls (i.e., use of chemical fume hoods, PPE), how to detect chemical presence or release, signs/symptoms of exposure, medical surveillance, waste disposal and spill response procedures.
For materials designated as “Particularly Hazardous Substances” (i.e., carcinogens, reproductive toxins, chemicals with a high degree of acute toxicity or unknown toxicity), special control measures are required. These materials must be handled in a “designated area”. A designated area may be a chemical fume hood, specific area of a bench top or an entire lab. The area must be labeled as a designated area and must be decontaminated after each use. Spills of particularly hazardous substances must be cleaned up using wet vs. dry methods. In addition, work surfaces should be covered with a disposable absorbent pad to contain small spills and aid in decontamination. This information should be incorporated into specific SOPs for work with these substances.

3.4.5 Training

All lab personnel must be trained in Chemical Laboratory Safety. This training must be documented. Training documentation must be provided to EHS B&C upon request during the annual Lab Audit.

4.0 CHEMICAL HAZARDS

4.1 High Risk Hazardous Chemicals

High Risk Hazardous Chemicals are those that require stringent controls for their containment because they are extremely hazardous to laboratory personnel, could cause toxic effects or disease if released to the environment, or are regulated as a Select Agent. Due to a combination of hazardous properties (e.g., vapor pressure, toxicity) these chemicals must be considered to be an extreme health hazard when used under any conditions. In general, an accidental exposure to one of these chemicals may result in cancer, serious illness or death.

4.1.1 High Risk Hazardous Chemical Definition

A chemical shall be considered for classification as a high risk hazardous chemical if at least one of the following criteria is met:

- the substance is acutely toxic (causing death or bodily harm) with an LD-50 of 100 µg/kg or less by any route of exposure
- the substance is chronically toxic (includes tumor incidence, birth defects, or other serious health effects) at levels below:
  a. 5.0 mg/kg per day oral exposure
  b. 30 mg/kg per week dermal exposure
  c. 5.0 mg/m³ by inhalation exposure based on long term studies and chronic exposures
- the substance is listed as a Select Agent toxin in Section 4.1.1.1 and aggregate quantity exceed limits found in Table 8.1.

Approval from the UTMB Chemical Safety Committee is required prior to purchase or use of any High Risk Hazardous Chemicals.

4.1.1.1 List of High Risk Hazardous Chemicals

The following chemicals are currently classified as High Risk Hazardous Chemicals. Contact UTMB EH&S B&C at 2-1781 prior to commencement of
work or purchase of materials if proposed research agents or toxins appears in the list below:

- Abrin*
- Aconitine (amorphous/crystalline)
- Aflatoxins
- Amanitin
- Batrachotoxin
- Bis (chloromethyl) ether, syn. Dichloromethyl ether
- Botulinum neurotoxin*
- Chloromethyl ether, methyl
- Clostridium perfringens epsilon toxin*
- Conotoxins*
- Ciguatoxin
- Diacetoxyscirpenol*
- Diclopropyl fluorophosphate
- Diphtheria toxin
- Haitotoxin
- Microcystin
- Phalloidin
- Ricin*
- Sarin
- Saxitoxin*
- Shiga-like ribosome inactivating proteins*
- Shigatoxin*
- Soman
- Staphylococcal enterotoxins*
- Tabun
- Taipoxin
- Tetrachlorodibenzo-p-dioxin
- Tetanus toxin
- Tetrodotoxin*
- Textilotoxin
- VX
- T-2 Toxin*

* = Select Agent – In addition to the HRHCSP, these agents also require approval by the CDC/APHIS Select Agent Program prior to commencement of work.

At any time, if an aggregate amount of the *Select Agents and Toxins found in the above list and under the control of the Principal Investigator exceeds the listed ‘Exemption Quantities’ listed in Table 8.1, provided below, then a complete High Risk Chemical Plan and registration with HHS/CDC, Division of Select Agents and Toxins is required.

Table 8.1 Exemption Quantities for Select Agents and Toxins

<table>
<thead>
<tr>
<th>Select Agents and Toxins</th>
<th>Exemption Quantity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Abrin</td>
<td>&lt; 100 mg</td>
</tr>
<tr>
<td>Conotoxins</td>
<td>&lt; 100 mg</td>
</tr>
<tr>
<td>Diacetoxyscirpenol</td>
<td>&lt; 1,000 mg</td>
</tr>
<tr>
<td>Ricin</td>
<td>&lt; 100 mg</td>
</tr>
<tr>
<td>Saxitoxin</td>
<td>&lt; 100 mg</td>
</tr>
<tr>
<td>Shiga-like ribosome inactivating proteins</td>
<td>&lt; 100 mg</td>
</tr>
<tr>
<td>Tetrodotoxin</td>
<td>&lt; 100 mg</td>
</tr>
<tr>
<td>Botulinum neurotoxins</td>
<td>&lt; 0.5 mg</td>
</tr>
<tr>
<td>Clostridium perfringens epsilon toxin</td>
<td>&lt; 100 mg</td>
</tr>
<tr>
<td>Shigatoxin</td>
<td>&lt; 100 mg</td>
</tr>
<tr>
<td>Staphylococcal enterotoxins</td>
<td>&lt; 100 mg</td>
</tr>
<tr>
<td>T-2 toxin</td>
<td>&lt; 5 mg</td>
</tr>
</tbody>
</table>

4.1.2 Approval for Use of High Risk Hazardous Chemicals
Principal Investigators are required to submit a detailed “Safety Plan for the Use and Storage of High Risk Hazardous Chemicals” to the Chemical Safety Committee prior to obtaining, storing, or using the high risk hazardous chemical. This plan will be updated annually. EHS B&C will
assist the Principal Investigator in the preparation of this written plan. The “Safety Plan for the Use and Storage of High Risk Hazardous Chemicals” instructions and form are in Appendix 8A and 8B, respectively.

### 4.1.3 Work Procedures for High Risk Hazardous Chemicals

All work with high risk hazardous chemicals will be performed according to the procedures established in the approved Safety Plan. The Safety Plan specifies facilities, equipment, work practices (including use of engineering controls such as chemical fume hoods and required PPE), decontamination, storage, shipping/transfers and disposal for the high risk hazardous chemical.

### 4.1.4 Chemical Hygiene Plan for Select Toxins

A Chemical Hygiene Plan (CHP) is required for use of select agent toxins exceeding quantities listed in Table 8.1 titled “Exemption Quantities for Select Agents and Toxins” located in “Chemical Hazards” section of Chapter 8. The Chemical Hygiene Plan shall include each of the following elements and shall indicate specific measures that the PI will take to ensure laboratory employee protection. The following sections are required with a non-exempted quantity:

- Develop and include written standard operating procedures for the use, handling, storage and disposal of select agent toxins as required in Chapter 8, section titled “Laboratory – Specific Standard Operating Procedures (SOPs)”. These procedures must include relevant to safety and health considerations to be followed when laboratory work involves the use of select agent toxins;
- Criteria that the PI will use to determine and implement control measures to reduce laboratory personnel exposure to select agent toxins including engineering controls, the use of personal protective equipment and hygiene practices;
- Reference information in Chapter 8, section titled “Chemical Fume Hoods”, for fume hood requirements and Chapter 9 for Biological Safety Cabinets, section title “Biological Safety Cabinets” for biological safety cabinet requirements. All laboratory personnel must be trained on proper and adequate performance of such equipment;
- Provisions for laboratory personnel information and training;
- Contact EHS for details on provisions for medical consultation and medical examinations within the CHP;
- Designation that the PI is responsible for implementation of the Chemical Hygiene Plan and serves as the Chemical Hygiene Officer for the lab;

### 4.1.5 Recordkeeping Requirements for High Risk Hazardous Chemicals

The Principal Investigator is required to keep an Inventory Control log book for the chemical. This book will contain the name of the agent, the name of the Principal Investigator, date of receipt, how and where the agent is used and stored, and the method and date of disposal. All of the agent must be accounted for in the record. This log book will be reviewed by EHS B&C during the annual Lab Audit.

### 4.1.6 Signage Requirements for High Risk Hazardous Chemicals

All doors to the work area where these chemicals are used or stored shall be posted with a sign stating “Caution Hazardous Chemicals Authorized Personnel Only”. The sign will be yellow with black lettering and at least four by six inches in size. These signs are available from EHS B&C.

### 4.1.7 Training Requirements for High Risk Hazardous Chemicals
All personnel working with a high risk hazardous chemical must be included in the Safety Plan and approved by the Chemical Safety Committee. These employees must be trained in the hazards of the chemical, the approved Safety Plan and any other special procedures required for working with the chemical. All training must be documented and provided for review by EHS B&C or the Chemical Safety Committee upon request.

4.2 Moderate Risk Hazardous Chemicals

Moderate risk hazardous chemicals present a moderate to severe health hazard if not handled properly. They include confirmed or suspected carcinogens, reproductive toxins, chronic toxins and acute poisons that do not fall into the high risk category. Moderate risk hazardous chemicals should be handled as “particularly hazardous substances” as described in section 3.2.4.

4.3 Hazardous Chemical Properties

4.3.1 Flammable & Combustible Liquids

4.3.1.1 Definition/General Information

The degree of flammability of a chemical is determined by the temperature at which the chemical gives off enough vapors to form an ignitable mixture with air to support combustion in the presence of an ignition source. This is known as the chemical’s Flash Point. Flammable liquids have flash points below 100°F and vapor pressure at or below 40 pounds per square inch at 100°F. Combustibles have flash points at or above 100°F and below 200°F. A chemical’s flash point can be found in the MSDS in the Fire Fighting section.

4.3.1.2 Special Precautions for working with Flammable & Combustible Liquids

Many flammable and combustible liquids are solvents with high vapor pressures. Working with them creates an inhalation exposure hazard. To minimize exposure potential, it is recommended that work be done inside a chemical fume hood. Solvents also tend to defat the skin causing dermatitis. Some can be absorbed through the skin, another exposure source. For this reason, it is important to select and use gloves appropriate for the chemical.

Ignition sources should be eliminated in the work area when working with flammables and combustibles. Flammable vapors can travel a considerable distance and ignite when an ignition source is found. For this reason, control of vapor accumulation by working in a chemical fume hood is good practice. Fire extinguishers appropriate for the materials being used should be available.

Store flammable liquids in National Fire Protection Association (NFPA) approved safety cabinets or safety cans. Label each safety cabinet with the maximum gallon capacity rated or allowed. The cabinet below the laboratory hood is considered suitable for storage if it is vented and labeled for flammable storage. Containers should be kept tightly closed at all times when not in use. Refrigeration equipment for storage of flammables must be rated for flammable storage (i.e., must not have any exposed ignition sources such as lights or switches inside the unit). Equipment used in the transfer of flammable materials must be grounded. During transfer containers must be bonded as well.
4.3.2 Peroxides

4.3.2.1 Definition/General Information
Organic peroxides are compounds with a bivalent O-O structure. Organic peroxides can be present intentionally as initiators for free radical reactions or unintentionally as contaminants in peroxide-forming chemicals. The latter case usually occurs when these chemicals are exposed to air after opening. Peroxides, especially in the dry crystalline state, are unstable, shock-sensitive and can detonate upon contact with heat, friction, impact, light and other chemicals such as strong oxidizers or reducing agents. Some chemicals known to form peroxides have stabilizers or free-radical scavengers to inhibit peroxide formation. Some examples of common peroxide formers are ethers and aldehydes.

In contrast, inorganic peroxides are not combustible, but react vigorously with water to release oxygen. Reaction with organic and oxidizable substances may cause fire.

4.3.2.2 Special Precautions for Working with Peroxides Storage
Inherent to the safe use of these chemicals is the dating of all chemicals as soon as received and again when opened. Testing and disposal procedures for peroxides should be based on the opening date according to the following table. These procedures should be part of the laboratory’s Chemical Hygiene Plan.

Table 8.2: Disposal Procedures for Peroxides

<table>
<thead>
<tr>
<th>Class I: Unsaturated materials, may polymerize violently and hazardously</th>
<th>Class II: Hazard upon concentration</th>
<th>Class III: Peroxides derived may explode without concentration</th>
</tr>
</thead>
<tbody>
<tr>
<td>styrene butadiene*</td>
<td>ethyl ether tetrahydrofuran dioxane acetal dicyclopentadiene cumene cyclohexene</td>
<td>isopropyl ether divinyl acetylene vinylidene chloride potassium sodium amide</td>
</tr>
</tbody>
</table>
| vinyl acetyle
| vinyl aceta
| vinyl chloride chlo
| chloroprene* tetrafluoroethylene* |

Discard at 12 Months Discard at 12 Months Discard at 3 Months

* When stored as a liquid, the peroxide-forming potential increases and the chemical should then be considered a Class III.

Store at the lowest possible temperature consistent with solubility and freezing point. DO NOT STORE LIQUID PEROXIDES/SOLUTIONS BELOW FREEZING PRECIPITATION POINTS. Store in a cool, dark, well-ventilated area.

For those materials with a high potential for peroxide formation, consider storage in inert atmospheres (nitrogen or argon) or under vacuum. Also, explore the possibility of purchasing the chemical under nitrogen in septum-capped bottles.
Glass containers that have screw-cap lids or glass stoppers should not be used due to the potential for friction or grinding. Polyethylene bottles with screw tops may be used. Never return unused chemical to the original container due to the potential for contamination.

**Peroxide Testing**

Chemicals known to form peroxides should be tested periodically (every 3 to 6 months is recommended until the expiration time frame listed in Table 8.2 is reached or exceeded). Testing should be conducted immediately if the presence of peroxides is suspected (for example: a chemical concentration increase is either suspected or intended, or color or consistency change observed). Testing date should be written on the bottle or label. The following three tests are available for use:

- **Peroxide test strips:** Available commercially. A color change occurs in the presence of peroxides. Follow manufacturer’s instructions.
- **Test using acetic acid and potassium iodide:** Add one to three milliliters of the peroxide suspected test liquid to an equal volume of acetic acid, add a few drops of 5% potassium iodide solution, and mix gently. A yellow to brown color indicates the presence of peroxides.
- **Test using potassium iodide:** Add one milliliter of freshly prepared 10% potassium iodide solution to ten milliliters of the peroxide suspected test liquid in a 25-milliliter glass cylinder. A yellow color will indicate the presence of peroxides.

If any of these peroxide tests are positive or the expiration date reached, contact EHS EPM for proper handling and disposal.

### 4.3.3 Oxidizers

#### 4.3.3.1 Definition/General Information
An oxidizer is a substance that gives up oxygen easily to stimulate combustion of other materials. Oxidizers can react violently when they come in contact with reducing agents, metals and sometimes ordinary combustibles. This group includes peroxides, permanganates, nitrates and chromates. Some common oxidizers include perchloric acid and the chromic acid solution used to clean glassware. Besides the fire hazard, many oxidizers are corrosive as well.

#### 4.3.3.2 Special Precautions for working with Oxidizers

**Storage**
Store oxidizers in inert, unbreakable containers. Do not use rubber or cork stoppers as they are potentially oxidizable substances. Store away from reducing agents, flammables and combustible materials.

**Equipment**
Use of lab apparatus should be reviewed carefully to ensure contaminants are not inadvertently added. For example, magnetic stirring bars can add metal traces to a solution causing violent unexpected reactions.

### 4.3.4 Pyrophorics
4.3.4.1 Definition/General Information
Pyrophorics are materials that can spontaneously combust upon exposure to air without the addition of external heat. Ignition may be delayed or instantaneous depending on the material. Some common pyrophorics include alkyl lithums, alkali metals (sodium, potassium), trialkylaluminum reagents, alkylboranes, finely divided metals (calcium, zirconium), metal powders (magnesium, zinc) and metal/nonmetal hydrides.

4.3.4.2 Special Precautions for working with Pyrophorics
Pyrophorics should be stored under an atmosphere of inert gas or as otherwise recommended by the manufacturer. Pyrophorics should be isolated from oxidizing materials, ignition sources, heat and flammable or combustible materials.

4.4 Health Hazards

4.4.1 Corrosives & Irritants

4.4.1.1 Definition/General Information
Corrosives are substances that cause visible destruction or irreversible alterations in human tissue at the site of contact. Corrosive chemicals typically have a pH >12 or < 2. Common corrosives are acids and bases.

Irritants are substances that cause a reversible inflammatory effect on living tissue by chemical action at the site of contact. Irritants typically have a pH between 2 and 12. A common irritant used at UTMB is formalin.

4.4.1.2 Special Precautions for working with Corrosives & Irritants
Precautions when working with corrosives and irritants are primarily to prevent exposure via inhalation, ingestion and skin contact, to the extent possible. This includes working inside of a chemical fume hood, practicing good hygiene (e.g., hand washing) and wearing appropriate PPE for the chemical(s) in use.

4.4.2 Sensitizers

4.4.2.1 Definition/General Information
A substance that may cause no reaction in a person during initial exposures, but upon further exposures will cause an allergic response to the substance. Sensitization may be caused via respiratory and/or skin exposure, depending on the chemical. Prevalence of sensitization varies in a population repeatedly exposed to a given chemical sensitizer. Some individuals are more likely to become sensitized than others. Common sensitizers include formaldehyde, hydroquinone, chromic acid, acrylates and isocyanates.

4.4.2.2 Special Precautions for working with Sensitizers
Precautions when working with sensitizers are primarily to prevent exposure via inhalation, ingestion and skin contact, to the extent possible. This includes working inside of a chemical fume hood, practicing good hygiene (e.g., hand washing) and wearing appropriate PPE for the chemical(s) in use. If sensitization
is suspected, the employee should report to Employee Health for medical evaluation since severe cases may require removal from areas using the chemical in question.

4.4.3 Toxic Chemicals

4.4.3.1 Definition/General Information
Toxic chemicals are substances that can cause severe illness, poisoning, disease, or death when ingested, inhaled, or absorbed by living organisms. The most common work-related exposure routes for toxic chemicals are inhalation, ingestion and skin absorption (for chemicals that can be absorbed through the skin). Toxic chemicals may have systemic effects or target particular organs of the body. Some common toxic chemicals include benzene, formaldehyde and ethylene oxide.

4.4.3.2 Special Precautions for working with Toxic Chemicals
Precautions when working with toxic chemicals are primarily to prevent exposure via inhalation, ingestion and skin contact, to the extent possible. This includes working inside of a chemical fume hood, practicing good hygiene (e.g., hand washing) and wearing appropriate PPE for the chemical(s) in use. For moderate and high risk hazardous chemicals, see sections 4.2 and 4.1, respectively, for additional information.

4.4.4 Reproductive Hazards

4.4.4.1 Definition/General Information
Reproductive toxins affect male and/or female reproductive capabilities, cause chromosomal damage (mutagens) and/or affect the fetus (teratogens). Examples of reproductive toxins are provided in Table 8.2.

Table 8.3: Examples of Reproductive Toxins

<table>
<thead>
<tr>
<th>Hazard</th>
<th>Risk</th>
</tr>
</thead>
<tbody>
<tr>
<td>Formaldehyde</td>
<td>Reduced birth weight, spontaneous abortions</td>
</tr>
<tr>
<td>Ethylene oxide</td>
<td>Malformed fetuses, miscarriages, decreased sperm count</td>
</tr>
<tr>
<td>Nitrous oxide</td>
<td>Low birth weight, impaired development, spontaneous abortion, decreased fertility</td>
</tr>
<tr>
<td>Antineoplastic drugs</td>
<td>Malformations, fetal loss, sterility</td>
</tr>
<tr>
<td>Alcohol</td>
<td>Congenital malformations, fetal alcohol syndrome, reduced birth weight, increased stillbirth rate</td>
</tr>
<tr>
<td>Radiation</td>
<td>Chromosomal aberrations, genetic mutations, fetal death</td>
</tr>
<tr>
<td>Aminopterin</td>
<td>Skeletal and CNS abnormalities</td>
</tr>
<tr>
<td>Anesthetic gases</td>
<td>Spontaneous abortion, decreased birth weight, stillbirth, increased frequency of cardiovascular birth defects</td>
</tr>
<tr>
<td>Carbon disulfide</td>
<td>Premature births</td>
</tr>
<tr>
<td>Lead</td>
<td>Decreased birth weight, premature labor, stillbirths</td>
</tr>
</tbody>
</table>

4.4.4.2 Special Precautions for working with Reproductive Toxins
Precautions when working with reproductive toxins are primarily to prevent exposure via inhalation, ingestion and skin contact, to the extent possible. This includes working inside of a chemical fume hood, practicing good hygiene (e.g., hand washing) and wearing appropriate PPE for the chemical(s) in use. These chemicals generally fall into the moderate risk category. See section 4.2 for additional information.

4.4.5 Carcinogens

4.4.5.1 Definition/General Information
A carcinogen is a substance that may cause cancer in animals or humans. Some examples of known human carcinogens are aflatoxins, asbestos, arsenic, benzene, ethylene oxide, Hepatitis B virus, Hepatitis C virus, mustard gas and 2-naphthylamine.

4.4.5.2 Special Precautions for working with Carcinogens
Precautions when working with carcinogens are primarily to prevent exposure via inhalation, ingestion and skin contact, to the extent possible. This includes working inside of a chemical fume hood, practicing good hygiene (e.g., hand washing) and wearing appropriate PPE for the chemical(s) in use. These chemicals generally fall into the moderate risk category. See section 4.2 for additional information.

4.4.5.3 Asbestos
The UTMB Asbestos Operations and Maintenance Program provides a consistent approach to maintenance and repair activities which might disturb asbestos as required by the Texas Administrative Code. It also provides guidance for asbestos issues in renovation/construction projects as part of a comprehensive plan for the control of asbestos hazards on the UTMB campus.

The procedures detailed in the program manual cover repair, maintenance and renovation activities at UTMB owned or maintained facilities. The scope includes small scale, short duration operation and maintenance projects as well as larger scale abatement projects for renovation. Procedures applicable to housekeeping/custodial and vehicle maintenance activities are also included.

4.5 Department of Homeland Security “Chemicals of Interest”

The U.S. Dept. of Homeland Security (DHS) issued a Federal regulation 6 CFR Part 27 "Chemical Facility Anti-Terrorism Standards" in 2007. UTMB is subject to this regulation. Integral to this regulation is a list of "Chemicals of Interest" with threshold quantities. Within sixty days of acquiring any “Chemicals of Interest” above the threshold quantities, we must file a report with the Dept. of Homeland Security.

Since quantities are cumulative campus-wide, although a particular PI may be purchasing a quantity below the threshold, the total possession quantity of the chemical for the entire campus must be evaluated to determine if a threshold will be exceeded. This is similar to our UTMB Radioactive Material Use License which also has UTMB campus limits per radionuclide. **Because of this, prior to acquiring any quantity of a “Chemical of Interest”, EHS must be**
contacted to determine if the acquisition will trigger a reporting requirement. If we are required to report possession of a Chemical of Interest above a threshold, this report will trigger a risk assessment by Dept. of Homeland Security. Based on their risk assessment, we may be required to take further security measures. Failure to comply with this regulation could result in penalties up to $25,000 for each day of non-compliance. Due to these requirements, acquisition of these chemicals must be limited to the extent possible. Appendix C contains the list of DHS “Chemicals of Interest”.

5.0 ORDERING, STORING, SHIPPING & DISPOSING OF CHEMICALS

5.1 Guidelines for Ordering

5.1.1 General Guidelines

• Always order the smallest amounts of the needed chemicals. Be familiar with disposal requirements before ordering chemicals.
• Check your inventory regularly and dispose of outdated or unnecessary chemicals. Avoid a stockpile of unused chemicals.
• Consider ordering solvents in safety tins rather than glass bottles. The metal containers are more expensive, but do provide protection against breakage and spillage. Such purchase orders should state that the more expensive containers are requested for safety purposes.
• If the compound is a High Risk Hazardous Chemical/Select Agent or Department of Public Safety (DPS) Controlled Item, special procedures are required (see sections 5.1.2 or 5.1.3, respectively).
• If the chemical compound is labeled/tagged with radioactive material, refer to the Radiation Safety Manual for additional ordering information.

5.1.2 High Risk Hazardous Chemicals/Select Agents

5.1.2.1 High Risk Hazardous Chemicals

• The maximum quantity of the agent to be possessed by the Principal Investigator at any time shall not exceed the minimum amount needed to complete the project.
• The package containing the hazardous agent shall be inspected for leakage or damage upon receipt. EHS B&C shall be notified if leakage or damage is noted.

5.1.2.2 Select Agents

The following agents fall under the Health and Human Services (HHS)/Center for Disease Control and Prevention (CDC) Select Agent regulations and are strictly controlled.

- Abrin
- Conotoxins
- Saxitoxin
- Shigatoxin
- Shiga-like ribosome inactivating proteins
- Botulinum neurotoxin producing species of Clostridium
- Diacetoxyscirpenol
- Ricin
- T-2 toxin
- Staphylococcal enterotoxins
- Clostridium perfringens epsilon toxin
- Tetrodotoxin
If you are ordering or transferring on/off campus any of these agents, please contact EHS at ext. 21781 for further information. These chemicals have specific shipping and receiving criteria that must be addressed in order to stay compliant with DOT/IATA, CDC/DSAT regulations.

5.1.3 Controlled Substances, Precursor Chemicals & Controlled Lab Apparatus

A Memorandum Of Understanding (MOU) was issued jointly by the Texas Higher Education Coordinating Board and the Texas Department of Public Safety (MOU on Controlled Substances, 1995 Health and Safety Code, 481.0621 (b), Texas Controlled Substance Act) to comply with a statutory requirement to implement and maintain a program for reporting information concerning controlled substances, controlled substance analogues, chemical precursors and chemical laboratory apparatus used in educational or research activities of institutions of higher education.

5.1.3.1 Requirements

Records of purchase and external transfer are required. The sale, furnishing or transfer of controlled items off campus is strictly prohibited unless the recipient holds a DPS permit, waiver or is exempt. Off campus transfers require the completion of DPS Form Nar-22. Contact EHS B&C at extension 21781 for more information.

To implement this policy, individual faculty members (research and clinical laboratories) are required to maintain records of purchase of the items from a list of precursor chemicals and laboratory apparatus (see Table Three). A suggested way to accomplish this is to perform a screen print of the purchase requisition. Highlight any controlled items on the requisition and maintain in a file for future DPS audit.

Table 8.4: Control Precursor Chemicals and Laboratory Apparatus

<table>
<thead>
<tr>
<th>Precursor Chemicals</th>
<th>Laboratory Apparatus</th>
</tr>
</thead>
<tbody>
<tr>
<td>Methylamine</td>
<td>Condensers</td>
</tr>
<tr>
<td>Ethylamine</td>
<td>Distilling apparatus</td>
</tr>
<tr>
<td>D-Lysergic Acid</td>
<td>Vacuum dryers</td>
</tr>
<tr>
<td>Ergotamine tartrate</td>
<td>Three-necked flasks</td>
</tr>
<tr>
<td>Diethyl malonate</td>
<td>Distilling flasks</td>
</tr>
<tr>
<td>Malonic acid</td>
<td>Tableting machines</td>
</tr>
<tr>
<td>Ethyl malonate</td>
<td>Encapsulating machines</td>
</tr>
<tr>
<td>Barbituric acid</td>
<td>Filter, buchner, separatory funnels</td>
</tr>
<tr>
<td>Piperidine</td>
<td>Erlenmeyer, two-necked, single, round bottom, thermometer, filtering flasks</td>
</tr>
<tr>
<td>N-acetylanthranilic acid</td>
<td>Soxhlet extractors</td>
</tr>
<tr>
<td>Pyrrolidine</td>
<td>Transformers</td>
</tr>
<tr>
<td>Phenylacetic acid</td>
<td>Flask heaters</td>
</tr>
<tr>
<td>Anthranilic acid</td>
<td>Heating mantles</td>
</tr>
<tr>
<td>Ephedrine</td>
<td>Adapter tubes</td>
</tr>
<tr>
<td>Pseudoephedrine</td>
<td></td>
</tr>
</tbody>
</table>
Norpseudoephedrine
Phenylpropanolamine

Sale, furnishing or transfer of controlled items off campus is strictly prohibited unless the recipient holds a DPS permit, waiver or is exempt (contact EHS-B&C prior to off campus transactions). In addition, off campus transactions require the completion of DPS Form Nar-22. Although transfer of any of the controlled items can be performed internally without documentation, it is recommended should any future questions arise.

The MOU requires that any laboratory that discovers an unacceptable discrepancy, loss, pilferage, or theft of a controlled item is responsible for submitting a written report of the incident to the University Police no later than 5 business days after the day of discovery.

Department chairmen are responsible for instituting departmental procedures for ensuring the security of controlled items. University Police may be contacted for assistance regarding this matter.

Researchers are also reminded that they are not exempt from annual registration with the Federal Drug Enforcement Agency under the Federal Controlled Substances Act for the purchase and possession of controlled substances and controlled substance analogues. Registration applications may be obtained from the regional DEA office and must be submitted to Washington, D.C. Processing takes about 8 weeks. The address of the closest regional office is:

DEA Diversion Group (Registrations)
333 West Loop North, Suite 300
Houston, TX 77024-7707
(713) 613-7661

5.2 Storage Locations

Do not store hazardous chemicals in alphabetical order. This may place incompatible chemicals next to one another, (i.e., acetic acid and ammonium hydroxide, an acid and a base) or may cause large sized, glass bottles to be stored on a top shelf. Chemicals should be segregated according to compatibilities and hazards.

The following guidelines should be used when storing any chemical:
- Every chemical should have a specific storage location and should be returned immediately after use.
- Be sure to read the label on every container for storage instructions and follow those instructions carefully.
- Except for those chemicals in use, do not use a chemical fume hood as a storage area for chemicals or solvents. The cabinet below the chemical fume hood is suitable for storage if it is vented and labeled.
- Chemicals cannot be stored under sinks.
- Volatile and odoriferous chemicals need to be stored in a ventilated cabinet.
5.2.1 Related and Compatible Storage Groups

Certain related chemical compounds can be stored together. Several individual inorganic and organic compatible storage groups are provided in Table 8.4. Examples of utilization of this table’s information are as follows: (1) inorganic metals and hydrides may be stored together and should not stored with incompatibles (see Table 8.5); (2) Organic acids, anhydrides, and peracids may be stored together and should not stored with incompatibles (see Table 8.5).

Table 8.5: Individual Compatible Storage Groups

<table>
<thead>
<tr>
<th>Inorganic Family</th>
<th>Organic Family</th>
</tr>
</thead>
<tbody>
<tr>
<td>Metals, hydrides</td>
<td>Acids, anhydrides, peracids</td>
</tr>
<tr>
<td>Halides, sulfates, sulfites, thiosulfates, halogens, phosphates</td>
<td>Alcoholys, glycols, amines, amides, imines, imides</td>
</tr>
<tr>
<td>Amides, nitrates (except ammonium nitrate), nitrates, azides</td>
<td>Hydrocarbons, esters, aldehydes</td>
</tr>
<tr>
<td>Hydroxides, oxides, silicates, carbonates, carbon</td>
<td>Ethers, ketones, ketenes, halogenated hydrocarbons, ethylene oxide</td>
</tr>
<tr>
<td>Sulfides, selenides, phosphides, carbides, nitriles</td>
<td>Epoxy compounds, isocyanates</td>
</tr>
<tr>
<td>Chlorates, perchlorates, perchloric acid chlorites, hypochlorites, peroxides, hydrogen peroxide</td>
<td>Peroxides, hydroperoxides, azides</td>
</tr>
<tr>
<td>Arsenates, cyanides, cyanates</td>
<td>Sulfides, polysulfides, sulfoxides, nitrites</td>
</tr>
<tr>
<td>Borates, chromates, manganates, permanganates</td>
<td>Phenols, cresols</td>
</tr>
<tr>
<td>Nitric acid, other inorganic acids</td>
<td>Sulfur, phosphorus, arsenic, phosphorus pentoxide</td>
</tr>
</tbody>
</table>

5.2.2 Incompatible Storage Groups

Table 8.6: Incompatible Storage Groups

<table>
<thead>
<tr>
<th>Chemical</th>
<th>Avoid</th>
</tr>
</thead>
<tbody>
<tr>
<td>Acetic acid</td>
<td>Chromic acid, nitric acid, hydroxyl-containing compounds, ethylene glycol, perchloric acid, peroxides and permanganates</td>
</tr>
<tr>
<td>Acetic anhydride</td>
<td>Ethylene glycol, perchloric acid</td>
</tr>
<tr>
<td>Acetone</td>
<td>Concentrated nitric acid sulfuric acid</td>
</tr>
<tr>
<td>Acetylene</td>
<td>Chlorine, bromine, copper, silver, fluorine, mercury</td>
</tr>
<tr>
<td>Alkali and alkaline earth metals, such as potassium, lithium, magnesium, calcium (powdered)</td>
<td>Carbon dioxide, carbon tetrachloride, other chlorinated hydrocarbons (do not use water, foam, or dry chemical on fires involving these metals). Dry sand should be available.</td>
</tr>
<tr>
<td>Ammonia (anhydrous)</td>
<td>Mercury, chlorine, calcium, hypochlorite, iodine, bromine and hydrogen fluoride</td>
</tr>
<tr>
<td>Ammonium nitrate</td>
<td>Acids, metal powders, flammable liquids, chlorates, nitrate, sulfur, finely divided organics or combustibles</td>
</tr>
<tr>
<td>Aniline</td>
<td>Nitric acid, hydrogen peroxide</td>
</tr>
<tr>
<td>Bromine</td>
<td>Ammonia, acetylene, butadiene, butane and other petroleum gases, sodium carbide.</td>
</tr>
<tr>
<td>Calcium oxide</td>
<td>Water</td>
</tr>
<tr>
<td>Carbon (activated)</td>
<td>Calcium hypochlorite</td>
</tr>
</tbody>
</table>
### Chemicals to Avoid

<table>
<thead>
<tr>
<th>Chemical</th>
<th>Avoid</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chlorates</td>
<td>Ammonium salts, acids, metal powders, sulfur, finely divided organics, combustibles</td>
</tr>
<tr>
<td>Chromic acid and chromium trioxide</td>
<td>Acetic acid, naphthalene, glycerol, turpentine, alcohol and other flammable liquids</td>
</tr>
<tr>
<td>Chlorine</td>
<td>Ammonia, acetylene, butadiene, butane and other petroleum gases, hydrogen, sodium carbide, turpentine, benzene and finely divided metals</td>
</tr>
<tr>
<td>Chlorine dioxide</td>
<td>Ammonia, methane, phosphine, and hydrogen sulfide</td>
</tr>
<tr>
<td>Copper</td>
<td>Acetylene, hydrogen peroxide</td>
</tr>
<tr>
<td>Fluorine</td>
<td>Isolate</td>
</tr>
<tr>
<td>Hydrazine</td>
<td>Hydrogen peroxide, nitric acid, other oxidants</td>
</tr>
<tr>
<td>Hydrocarbons (benzene, propane, gasoline, turpentine)</td>
<td>Fluorine, chlorine, formine, butane, chromic acid, peroxides</td>
</tr>
<tr>
<td>Hydrocyanic acid</td>
<td>Nitric acid, alkalies</td>
</tr>
<tr>
<td>Hydrofluoric acid, anhydrous (hydrogen fluoride)</td>
<td>Ammonia (aqueous or anhydrous)</td>
</tr>
<tr>
<td>Hydrogen peroxide</td>
<td>Copper, chromium, iron, most metals or their salts, any flammable liquid, combustible materials, aniline, nitromethane</td>
</tr>
<tr>
<td>Hydrogen sulfide</td>
<td>Fuming nitric acid, oxidizing gases</td>
</tr>
<tr>
<td>Iodine</td>
<td>Acetylene, ammonia (anhydrous or aqueous)</td>
</tr>
<tr>
<td>Mercury</td>
<td>Acetylene, fulminic acid, ammonia</td>
</tr>
<tr>
<td>Nitric acid (concentrated)</td>
<td>Acetic acid, acetone, alcohol, aniline, chromic acid, hydrocyanic acid, hydrogen sulfide</td>
</tr>
<tr>
<td>Nitroparaffins</td>
<td>Inorganic bases, amines</td>
</tr>
<tr>
<td>Oxalic acid</td>
<td>Silver, mercury</td>
</tr>
<tr>
<td>Oxygen</td>
<td>Oils, grease, hydrogen, flammable liquids, solids or gases</td>
</tr>
<tr>
<td>Perchloric acid</td>
<td>Acetic anhydride, bismuth and its alloys, alcohol, paper, wood, grease, oils</td>
</tr>
<tr>
<td>Peroxides (organic)</td>
<td>Acids (organic or mineral), avoid friction, store cold</td>
</tr>
<tr>
<td>Phosphorus (white)</td>
<td>Air, oxygen</td>
</tr>
<tr>
<td>Phosphorus pentoxide</td>
<td>Alcohols, strong bases, water</td>
</tr>
<tr>
<td>Picric acid (trinitrophenol)</td>
<td>Copper, lead, zinc concrete, ammonia, calcium, bases</td>
</tr>
<tr>
<td>Potassium chloride</td>
<td>Acids (see also chlorates)</td>
</tr>
<tr>
<td>Potassium permanganate</td>
<td>Glycerol, ethylene glycol, benzaldehyde, sulfuric acid</td>
</tr>
<tr>
<td>Silver</td>
<td>Acetylene, oxalic acid, tartaric acid, fulminic acid, ammonium compounds</td>
</tr>
<tr>
<td>Sodium</td>
<td>See alkali metals</td>
</tr>
<tr>
<td>Sodium nitrite</td>
<td>Ammonium nitrate and other ammonium salts</td>
</tr>
<tr>
<td>Sodium peroxide</td>
<td>Any oxidizable substance, such as ethanol, methanol, glacial acetic acid, acetic anhydride, benzaldehyde, carbon disulfide, glycerol, ethylene glycol, ethyl acetate, methyl acetate, furfural</td>
</tr>
<tr>
<td>Sulfuric acid</td>
<td>Chlorates, perchlorates, permanganates</td>
</tr>
</tbody>
</table>

### 5.3 Shipping Chemicals Off Campus
The shipment of hazardous materials is strictly regulated. Failure to adhere to applicable regulations can result in fines and/or punitive actions against the university and the person placing the material into shipment. In addition to violating state and federal transportation laws, personal liabilities can be associated with failure to follow the appropriate shipping and handling requirements.

The Department of Transportation (DOT) regulations regarding the shipment of hazardous materials state that “…no person may offer or accept a hazardous material for transportation in commerce unless…the hazardous material is properly classed, described, packaged, marked, labeled and in condition for shipment.” (HM-171.2)

In agreement with the Civil Aviation Security Field Office and the Federal Aviation Administration, UTMB has established a system to meet these requirements. No UTMB employee will be permitted to ship hazardous materials without having completed certified DOT/IATA training. Retraining is required every two years. If hazardous chemical shipments are planned, notify EHS prior to shipment (including Select Agent toxins). Any such shipment must be reviewed by a representative from EHS prior to shipment. Select members of the EHS staff and Materials Management group have successfully completed the training course in order to oversee shipping of hazardous materials. Any UTMB employee shipping hazardous materials without the required current training is acting as their own agent and assumes all liability as such.

5.4 Transporting Chemicals On Campus

Chemicals being transported on campus must be secured inside a leak proof secondary transport container, such as a plastic ice chest or sealed plastic container. For liquids, line secondary container with absorbent material.

5.5 Disposal

For detailed information on hazardous waste disposal, see Chapter 10 in the Safety Manual. For chemical (and radioactive) waste pick-up, complete the on-line request form at [http://www.utmb.edu/ehs/EPM/EPM.html](http://www.utmb.edu/ehs/EPM/EPM.html). After completing the on-line web-based form, submit it electronically to EHS and the request will be processed for pick-up the next pick-up day. Chemical pick-up days are Wednesdays and Fridays. Radioactive waste pick-up days are Tuesdays and Thursdays. Once submitted, you will receive electronic confirmation of your request.

6.0 CHEMICAL EXPOSURE ASSESSMENT

The most common method for assessing chemical exposures is by air monitoring, usually to determine chemical concentrations in an employee’s breathing zone. EHS B&C group conducts routine exposure monitoring as well as exposure monitoring by request. Besides chemical air monitoring, exposure monitoring may include noise monitoring, radiation monitoring and indoor air quality investigations. In addition to monitoring, other assessments may include ergonomic, biological or physical hazard evaluations.
Industrial hygiene\(^1\) sampling and analytical methods used by UTMB are established primarily by the National Institute for Occupational Safety & Health (NIOSH) and OSHA. Equipment used for monitoring is calibrated according to manufacturer recommendations. Field pre- and post-calibration is also done as required.

7.0 CHEMICAL EXPOSURE CONTROLS

7.1 Chemical Fume Hoods

Chemical fume hoods are the primary engineering control for chemical exposures in a laboratory environment. A chemical fume hood is an enclosed ventilated cabinet to contain and exhaust contaminated air away from the worker. Employees work with chemicals inside the chemical fume hood. Air is drawn into the cabinet from the room through a space between the cabinet and the sash opening on the front of the cabinet. This draws contaminated away from the worker’s breathing zone and exhausts it outside of the building.

For a chemical fume hood to provide the designed protection, it must be maintained and used properly.

7.1.1 Hood Maintenance

Certification of a chemical fume hood is based upon the average face velocity and the overall condition of the hood. To be certified for use, hoods must have an average face velocity of 100 fpm with a minimum of 80 fpm at any test point. In addition, the overall condition of the hood must be acceptable per other inspection criteria (i.e., no damage to any components, components functioning properly).

If the above certification criteria are met, then the hood will be labeled with the operating sash height, designated with an arrow (operating sash height is the height at which optimum face velocities are achieved for capture of contaminants), and the certification date as well as the due date. If the certification criteria cannot be met with minor adjustments, the hood will be labeled “Danger – Hood Not Working – Do Not Use”. Facilities Operations And Maintenance (FOAM) and EHS B&C will notify the user what is needed to certify the hood, or if necessary, to replace it.

7.1.2 Proper Hood Use

The following work practices must be followed to ensure optimum protection of a chemical fume hood:

- Maintain the sash at the optimum operating height as designated by the arrow label.
- Keep the inside of the hood clean and uncluttered. To the extent possible, do not store chemicals or equipment inside the hood as this may adversely affect air flow and containment of the hood. Equipment that must go in the hood should be raised to allow air flow on all sides and must not block the slots in the back of the hood.
- Check baffles to ensure they are clean, open and unobstructed.
- Ensure all chemicals and equipment are used at least six inches behind the sash.
- Ensure the flow monitoring device indicates adequate flow before each use.
- Do not put your face or head inside the hood.

\(^1\) Industrial hygiene is the science/art devoted to the anticipation, recognition, evaluation and control of workplace environmental stressors that may cause sickness, impaired health/well-being or significant discomfort to workers.
• Wear all required PPE, including eye protection when working in the hood. Use of the hood does not eliminate the need for PPE.
• Make movements slowly to decrease air turbulence as this can compromise the hood’s performance (i.e., move hands in and out of the hood slowly, open and close the sash slowly).
• Try to minimize foot traffic behind the person working at the hood as this can compromise the hood’s performance.

If the hood malfunctions in any way, discontinue use and report it immediately to EHS B&C. EHS B&C works closely with FOAM to repair and maintain chemical fume hoods.

7.2 Personal Protective Equipment (PPE)
When working with hazardous materials (chemical, biological or radioactive), the minimum personal protective equipment worn should be a lab coat, eye protection, closed toed shoes and appropriate chemical resistant gloves. If working with physical hazards (e.g., temperature extremes, sharp objects or tools), then appropriate work gloves (e.g., Kevlar, leather) should be worn. Additional PPE should be worn as deemed necessary by a hazard assessment of each task. For assistance with hazard assessment and PPE selection, contact EHS B&C.

7.2.1 Glove Selection
Some factors that should be considered when selecting gloves include the following:
• Gloves may have pinholes or tears in them right out of the packaging. Inspect gloves for pinholes and tears before use.
• Disposable chemical gloves must not be reused. Once a glove comes in contact with a chemical, even after removal, the chemical continues to permeate the glove material. Dispose of disposable gloves immediately after removal. Wash hands after removing gloves.
• Although latex is the glove of choice when working with biological materials and infectious substances, the potential for latex allergies should be considered. In general, any waterproof glove is acceptable for this work, so alternatives to latex are available.
• If a bulky glove is needed for chemical protection, but this compromises manual dexterity, a glove with better dexterity can sometimes be placed over the bulky glove improving dexterity while still providing the necessary chemical resistance.
• When wearing gloves, be cognizant of not contaminating items that may be handled by personnel not wearing gloves (e.g., door knobs, elevator buttons, telephones, computers).

Choosing appropriate chemical resistant gloves depends on the glove material and the chemical’s ability to degrade or permeate that material. In addition, manual dexterity for the task should be taken into account. Chemical glove selection charts listing most common chemicals are readily available (e.g., www.bestglove.com, or www.ansellpro.com/download/Ansell_7thEditionChemicalResistanceGuide.pdf). Most glove manufacturers have this information available on their website. It is best to use the website for your glove manufacturer because the same glove material used by different manufacturers may offer different levels of protection based on glove thickness and material formulation. The time it takes for a chemical to permeate a glove material is known as the breakthrough time. Note that if working in temperatures above room temperature, permeation rates may increase resulting in shorter breakthrough times. Ideally a glove material that is not degraded by the chemical, and that has a long permeation time (at least longer than the task involving the chemical), should be selected. When activities involve a combination of hazards, protection for each hazard should be taken into account. Double gloving may be appropriate in some cases.
8.0 REFERENCES

American Conference of Governmental Industrial Hygienists. *Threshold Limit Values (TLVs) for Chemical Substances and Physical Agents and Biological Exposure Indices (BEIs).* Cincinnati: ACGIH, 1999.


APPENDIX 8A INSTRUCTIONS FOR COMPLETING HIGH RISK HAZARDOUS CHEMICAL SAFETY PLAN
Instruction Guide for Completing the Safety Plan for the Use and Storage of High Risk Hazardous Chemicals

BACKGROUND
High Risk Hazardous Chemicals (HRHC) are those that require stringent controls for their containment because they are extremely hazardous to laboratory personnel or could cause toxic effects or disease if released to the environment. Due to a combination of hazardous properties, these chemicals must be considered an extreme health hazard when used under any conditions. In general, one accident with one of these chemicals is likely to result in death, cancer or serious illness to one or more people. Very few chemicals are currently classified as High Risk Hazardous Chemicals by the UTMB Chemical Safety Committee (CSC). They are as follows:

- Abrin*
- Aconitine (amorphous/crystalline)
- Aflatoxins
- Amanitin
- Batrachotoxin
- Bis (chloromethyl) ether, syn. Dichloromethyl ether
- Botulinum neurotoxin*
- Chloromethyl ether, methyl
- Clostridium perfringens epsilon toxin*
- Conotoxins*
- Ciguatoxin
- Diacetoxyscirpenol*
- Diisopropyl fluorophosphate
- Diphtheria toxin
- Maitotoxin
- Microcystin
- Sarin
- Saxitoxin*
- Shiga-like ribosome inactivating proteins*
- Shigatoxin*
- Soman
- Staphylococcal enterotoxins*
- Tabun
- Taipoxin
- Tetrodotoxin*
- Textilotoxin
- VX
- T-2 Toxin*

* = Select Agent – NOTE: In addition to the HRHCSP, these agents also require approval by the CDC Select Agent Program.

At any time, if an aggregate amount of the *Select Agents and Toxins found in above list and is under the control of the Principal Investigator exceeds the listed ‘Exemption Quantities’ listed in Table 8.A, provided below, then a complete High Risk Chemical Plan and registration with HHS/CDC, Division of Select Agents and Toxins is required to be submitted to EHS.

<table>
<thead>
<tr>
<th>Select Agents and Toxins</th>
<th>Exemption Quantity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Abrin</td>
<td>&lt; 100 mg</td>
</tr>
<tr>
<td>Conotoxins</td>
<td>&lt; 100 mg</td>
</tr>
<tr>
<td>Diacetoxyscirpenol</td>
<td>&lt; 1,000 mg</td>
</tr>
<tr>
<td>Ricin</td>
<td>&lt; 100 mg</td>
</tr>
<tr>
<td>Saxitoxin</td>
<td>&lt; 100 mg</td>
</tr>
<tr>
<td>Shiga-like ribosome inactivating proteins</td>
<td>&lt; 100 mg</td>
</tr>
<tr>
<td>Tetrodotoxin</td>
<td>&lt; 100 mg</td>
</tr>
<tr>
<td>Botulinum neurotoxins</td>
<td>&lt; 0.5 mg</td>
</tr>
<tr>
<td>Clostridium perfringens epsilon toxin</td>
<td>&lt; 100 mg</td>
</tr>
<tr>
<td>Shigatoxin</td>
<td>&lt; 100 mg</td>
</tr>
<tr>
<td>Staphylococcal enterotoxins</td>
<td>&lt; 5 mg</td>
</tr>
<tr>
<td>T-2 Toxin</td>
<td>&lt; 1,000 mg</td>
</tr>
</tbody>
</table>
Other chemicals may be considered HRHCs by the CSC if they meet certain criteria (refer to Chapter 8, Chemical Safety in the UTMB Safety Manual).

**SAFETY PLAN SUBMISSION**
A High Risk Hazardous Chemical Safety Plan (HRHCSP) must be submitted to the CSC for review and approval prior to **ALL** use of the UTMB HRHC(s).

Following are detailed instructions for completing each section of the safety plan document. Environmental Health and Safety (EHS) will assist you in completing this HRHCSP (Call x21781).

**CHANGES TO APPROVED SAFETY PLANS AND ANNUAL UPDATE**
Approved HRHCSPs must be amended prior to any changes in quantities or procedures outlined in the original approved plan. **An annual update is required.** If no changes are made, documentation to this effect must be submitted and added to the plan.

**TRAINING OF LAB PERSONNEL**
The completed, approved HRHCSP is to be used as a training aid for laboratory personnel using the HRHC.

**INSTRUCTIONS**
The following instructions should be used as a guide to complete this form. Proper development of this High Risk Hazardous Chemical Safety Plan will ensure prompt review and evaluation by the Chemical Safety Committee. Failure to provide requested information may result in a delay in approval of the High Risk Hazardous Chemical Safety Plan. Complete all questions. If a question is not relevant to your plan, indicate it by answering with “Not applicable”. Please contact EHS at extension 21781 with questions and for support in the development of this High Risk Hazardous Chemical Safety Plan.

**First Page: Safety Plan Cover Page**
Fill in the blanks on the cover page of the safety plan document. Include the “PI Name” and “Chemical Name” in the header at the top of the page (double click on header to add requested information).

Type of Submission check boxes are activated by double clicking and changed “not checked” to “checked” in the pop up window that appears. Check “**Update**” if you are updating any information (e.g., quantities used) in an approved safety plan. Check “**Renewal**” if you are submitting an approved safety plan for the required renewal review every three years.

A list of applicable “Select Agents” is provided on Page A-1 of this appendix.

The following pages provides details on each section and the information necessary for completion.
Appendix 8A: Instructions for Completing Safety Plan Form

Print Date: 3/24/2010

Section I. PROJECT DESCRIPTION

<table>
<thead>
<tr>
<th>Question #</th>
<th>Detail Needed</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>List the High Risk Hazardous Chemical to be addressed in this High Risk Hazardous Chemical Safety Plan. Ensure it is also included in the header.</td>
</tr>
<tr>
<td>2.</td>
<td>Provide a brief description of the project or use of the chemical, include purpose, objectives and methodology. Attach an additional sheet if necessary.</td>
</tr>
<tr>
<td>3-5.</td>
<td>Self explanatory.</td>
</tr>
</tbody>
</table>

Section II. CHEMICAL SPECIFIC INFORMATION

<table>
<thead>
<tr>
<th>Question #</th>
<th>Detail Needed</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Check all that apply. This information can be found on the chemical’s material safety data sheet (MSDS).</td>
</tr>
<tr>
<td>2.</td>
<td>Provide information on how often the chemical will be used (daily, weekly).</td>
</tr>
<tr>
<td>3.</td>
<td>Provide information on the quantity of the agent to be used at any one time, include units (for example: mg, ml, etc).</td>
</tr>
<tr>
<td>4-9.</td>
<td>Self explanatory.</td>
</tr>
</tbody>
</table>

Section III. TRANSFERRING/SHIPPING OF HIGH RISK HAZARDOUS CHEMICALS

<table>
<thead>
<tr>
<th>Question #</th>
<th>Detail Needed</th>
</tr>
</thead>
<tbody>
<tr>
<td>1-2.</td>
<td>Outside of receiving shipment from the supplier/vendor and on-campus hazardous waste pick-up, this question must encompass all other shipments or on campus transfers.</td>
</tr>
</tbody>
</table>

Section IV. GENERAL LABORATORY INFORMATION

This section includes requests for information to be included in Attachments at the end of Section X. If an Attachment is not relevant to your plan, check the box indicating “not applicable” on the Attachment cover page.

<table>
<thead>
<tr>
<th>Question #</th>
<th>Detail Needed</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Include diagram(s) showing: building name, room number, and laboratory detail (refrigerator, cabinet, chemical fume hood, biological safety cabinet, bench top, balance, satellite accumulation areas, secured areas) for each storage and each use location; location/type of spill kits; location of emergency equipment (eyewash, safety shower, fire extinguisher); and, location of personal protective equipment (PPE) in Attachment A.</td>
</tr>
</tbody>
</table>
2. Attach work process flow diagrams showing: the work process steps used and the safety precautions taken during each step of the experiment, Include as Attachment B.


4. Records are required for receipt, how /where the agent is used, and method/date of disposal. All of the agent must be accounted for. A log in/out book, accident/spill records, and monitoring results will be kept. State the method for keeping records, including the record location and person responsible for maintaining the records. Include as Attachment C.

5. Include SOP’s as Attachment D including: measures to prevent unauthorized laboratory entry/use, including warning signs and labels; the steps taken to maintain a clean work area, which includes procedures for decontaminating non-disposable labware, bench tops, and analytical instruments; safety and health precautions followed, PPE to be used, precautionary techniques.

6. If a chemical tracer/label is required, describe the tracer/label to be applied, the procedure and frequency for monitoring, instrumentation to be used, the detection limits, and the frequency and method for calibration of measurement instruments. Include as Attachment E.

7. If this plan includes a Select Agent or Toxin under control of the Principal Investigator which (1) is listed in Table 8.A (found on the first page of this appendix), AND (2) exceeds the listed ‘Exemption Quantities’ provided in Table 8.A then include the chemical hygiene plan as Attachment F.

8. Example: Diluting the stock solution requires ten minutes. The procedure is conducted once a week inside a certified laboratory hood in room 101.

9. Provide information on personnel with access to the locked storage areas. Access should be limited. Please provide information on additional sheet of paper, if needed.

10. Self-explanatory.

Section V. SAFETY TRAINING
The Texas Hazard Communication Act requires that all employees be given training about the specific chemical hazards they work with. The Principal Investigator is responsible for the content and effectiveness of this training. Employees should illustrate ongoing competence in the areas of training. Failure to show a familiarity with this material should result in prompt "refresher" training in the deficient areas.

The High Risk Hazardous Chemical Safety Plan (HRHCS) will serve as a safety training outline and a ready written reference for actions to be taken in the event of an accident or release involving this
agent. A copy of this HRHCSP shall be given to and discussed with each employee involved in the study.

<table>
<thead>
<tr>
<th>Question #</th>
<th>Detail Needed</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Train all personnel working with the HRHC on the HRHCSP, as well as the HRHC Material Safety Data Sheet (MSDS). This training must occur prior to any work with the HRHC. At a minimum, any time changes are made to the HRHCSP or new information becomes available on the HRHC, personnel must be retrained. Include documentation of chemical specific training as <strong>Attachment G</strong>.</td>
</tr>
<tr>
<td>2.</td>
<td>Include a copy of the MSDS as <strong>Attachment H</strong>.</td>
</tr>
<tr>
<td>3-4.</td>
<td>Self explanatory. If a respirator is used, it will require a consultation from EHS to ensure personnel have met respirator use requirements.</td>
</tr>
<tr>
<td>5.</td>
<td>Check all that apply.</td>
</tr>
<tr>
<td>6.</td>
<td>If yes, indicate location and type of spill kits available in <strong>Attachment A</strong>.</td>
</tr>
</tbody>
</table>

**Section VI. EMERGENCY AND DISASTER PREPAREDNESS**

<table>
<thead>
<tr>
<th>Question #</th>
<th>Detail Needed</th>
</tr>
</thead>
<tbody>
<tr>
<td>1-2.</td>
<td>Self explanatory.</td>
</tr>
<tr>
<td>3.</td>
<td>For example, if the refrigerated storage were to fail or emergency power not supplied.</td>
</tr>
<tr>
<td>4.</td>
<td>The P.I. can contact EHS at ext. 21781 to arrange for short term storage.</td>
</tr>
<tr>
<td>5.</td>
<td>Self explanatory.</td>
</tr>
</tbody>
</table>

**Section VII. PERSONNEL**

Provide a listing of personnel involved with this project. Include name, work location, extension, home telephone number, education and work experience. Describe the specific duties and extent of involvement of each person and include in **Attachment I**. A current Curriculum Vitae or resume containing this information can be attached.

**Section VIII. EXPERIMENTAL ANIMAL USE**

If animals are used, attach a description which includes IACUC #, the labels placed on cages indicating hazards, hazards associated with animal waste, bedding, and carcasses and proper precautions taken during handling. Complete questions provided in **Attachment J**.

**NOTE:** Investigators are reminded that when planning experiments with animals which includes hazardous agents, please contact ARC staff (at extension 21275) two weeks prior to use of the agents to coordinate animal housing and husbandry concerns.
Section IX. HAZARDOUS MATERIALS DISPOSAL

General procedures are set forth in the UTMB Safety Manual, Chapter 10 “Hazardous Waste Disposal.” for disposal of all (non-radioactive) hazardous wastes, including medical and chemical wastes. Removal and disposal of radioactive waste shall be in accordance procedures in the UTMB Radiation Safety Manual or by EHS-Radiation Safety.

<table>
<thead>
<tr>
<th>Question #</th>
<th>Detail Needed</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Explain how the material will be treated/neutralized (for example: acid/base neutralization, oxidation, or reduction, and precipitation of toxic ions as insoluble solids) and collected or sent down the drain. Consider solid waste (pipettes, needles, paper towels) and liquid waste (solutions, biological material). Provide detail on collection, storage, and treatment, if applicable. Available reference: Hazardous Laboratory Chemicals Disposal Guide, Second Edition Margaret-Ann Armour, 1996 or call EPM at 70515 for assistance.</td>
</tr>
<tr>
<td>2.</td>
<td>If question 1 is not applicable to your process then explain the process of waste collection, type of container used for collection (size and construction), location of collection until pickup, labeling for waste container, and other information used in the capture and storage of associated chemical waste (consider solid waste (pipettes, needles, paper towels) and liquid waste (solutions, biological material)).</td>
</tr>
<tr>
<td>3.</td>
<td>Provide detail on type, concentration, and quantity of any associated chemical waste planned for disposal down a laboratory sink or drain.</td>
</tr>
<tr>
<td>4.</td>
<td>Indicate the plan for unused and unwanted agent/compound proposed for your agent/compound. If it will be stored until disposal can occur, indicate storage location.</td>
</tr>
<tr>
<td>5.</td>
<td>Answer using the information found in the laboratory identified in Section I, Question #3 on the form. Utilize this link to help with requirements of a “Satellite Accumulation Area” which is defined as any area, system, or structure used for temporary accumulation and storage of hazardous waste.</td>
</tr>
<tr>
<td>6.</td>
<td>Utilize the reference information provided in the Peroxides section of the UTMB Safety Manual, Chapter 8, Section 4.3, to assist with identifying peroxides utilized or generated as part of this research.</td>
</tr>
<tr>
<td>7.</td>
<td>UTMB personnel working with processes that generate hazardous chemicals or wastes are encouraged to examine and apply pollution prevention principles. These concepts are based on efficient use of resources. Source reduction is any practice that reduces the amount of waste or any hazardous substance by either replacing it with non-hazardous substances or refraining from using the hazardous material. Waste minimization is any practice that reduces the amount of hazardous wastes entering the waste stream. See Chapter 10, Section 8.0 of the UTMB Safety Manual for pollution prevention principles.</td>
</tr>
</tbody>
</table>
## Section X. MEDICAL CONSULTATION / EXAMINATION

<table>
<thead>
<tr>
<th>Question #</th>
<th>Detail Needed</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Include training documentation as <strong>Attachment K.</strong></td>
</tr>
<tr>
<td>2.</td>
<td>Information from the MSDS may be used; however, procedures that may produce exposure must also be described.</td>
</tr>
</tbody>
</table>
APPENDIX 8B  FORM: SAFETY PLAN FOR THE USE AND STORAGE OF HIGH RISK HAZARDOUS CHEMICALS
Safety Plan for the Use and Storage of High Risk Hazardous Chemicals

The purpose of this document is to ensure adequate review of occupational safety and health precautions and procedures for the use, handling, storage, and disposal of hazardous chemical materials associated with the agent listed in this Safety Plan for the Use and Storage of High Risk Hazardous Chemicals (High Risk Hazardous Chemical Safety Plan or HRHCSP). As the Principal Investigator (P.I.) or Supervisor, you should be fully aware of the specific or potential hazards associated with the agents used in your work area. Clarification and instructions for this form are provided in Appendix 8A.

Chemical Agent: ____________________________ CAS#: ________________

Type of Submission (to check box: double click on box):

☐ New  ☐ Update  ☐ Renewal

Select Agent: ☐ Yes  ☐ No

The information provided in this document is accurate to the best of my knowledge. I acknowledge that upon approval, and before commencing any work, I accept responsibility for training all laboratory workers involved in the research project described in this High Risk Hazardous Chemical Safety Plan and for the evaluation of the effectiveness of this training.

I am familiar with, and agree to abide by the provisions set forth in this document upon approval by the UTMB Chemical Safety Committee. I further agree to abide by the provisions set forth by the UTMB Safety Manual and the UTMB Institutional Handbook of Operating Procedures.

P.I. Responsible for Research (Signature) ____________________________ Title ____________________________ Extension ____________________________ Date Submitted ____________________________

P.I. (Printed Name) ____________________________ Department ____________________________ Route ____________________________

CHEMICAL SAFETY COMMITTEE USE ONLY

Approved: ☐ as written ☐ with stipulations as noted

Date Approved: ____________________________ Date for re-submission: ____________________________

Chairman (Signature) ____________________________ Chairman (Printed Name) ____________________________

HRHCSP NUMBER (for OEHS use only)

Revised September 2009
Section I. PROJECT DESCRIPTION

1. Chemical Agent:

2. Description of the project or use of the chemical:
Enter description here:

3. Project Location: Building: Room #:

4. Estimated start date: Estimated end date:

5. Are any extended periods of inactivity anticipated? No Yes

Section II. CHEMICAL SPECIFIC INFORMATION

1. Physical/chemical properties:
   - Gas
   - Liquid
   - Solid (describe physical appearance (i.e., powder, pellet, etc.):
   - Explosive
   - Flammable
   - Reactive
   - Volatile
   - Unstable

2. Frequency of use:

3. Quantity of agent to be used at any one time:

4. Highest concentration to be used:

5. List solvent(s) or diluent(s) for chemical, if any:
   Describe any new hazards created after these chemicals are combined:

6. Maximum amount of agent ever expected to be on hand:

7. Total amount to be used in project:

8. Major known human toxic effects or symptoms associated with agent or hazardous metabolite:
### Section III.TRANSFER/SHIPPING OF HIGH RISK HAZARDOUS CHEMICALS

1. Will on campus shipments/transfers of the agent be conducted?  
   No  Yes  
   If yes, describe (include type of primary and secondary containment, method of transport and route to be used):  

2. Will off campus shipments/transfers of the agent be conducted?  
   No  Yes  
   If yes, describe:  

### Section IV. GENERAL LABORATORY INFORMATION

1. Room diagram (Include in Attachment A).

2. Work Process Flow diagram (Include in Attachment B).

3. Describe the manner of labeling the container(s) to identify the chemical as a hazardous agent (e.g. carcinogen, toxic):  

4. Record keeping requirements (Include in Attachment C)

5. Standard Operating Procedures (Include in Attachment D)

6. Chemical tracer procedures (Include in Attachment E, if applicable)

7. Chemical Hygiene Plan (Include as Attachment F, if applicable)
8. Describe that part of research activity that produces the greatest risk of personal exposure:

9. Name and phone number of the personnel who have access to the secured storage location.

<table>
<thead>
<tr>
<th>Name:</th>
<th>Work number:</th>
<th>Pager number:</th>
<th>Home number</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

10. Is the laboratory locked when unoccupied? No □ Yes □

**Section V. SAFETY TRAINING**

1. Have laboratory personnel been trained on this HRHCSP as well as the HRHC Material Safety Data Sheet (MSDS)? (Include training documentation in Attachment G)

   □ No □ Yes

2. Is the most current MSDS available to personnel? (Include MSDS in Attachment H)

   □ No □ Yes

3. Check the required personal protective equipment (PPE) and safety equipment for handling the chemical:

   - Safety Glasses
   - Labcoat/gown/apron
   - Booties
   - Gloves (list type):
   - Respirator (list type):
   - Chemical Fumehood – Building/Room#/ID#:
   - Biological Safety Cabinet – Building/Room#/ID#:
   - Other (specify):

4. Have the laboratory personnel been informed and trained in the use of PPE when handling this chemical? If wearing a respirator, have they met the medical, fit-testing and training requirements for that particular respirator model?

   □ No □ Yes □ No □ Yes

5. Are the following readily available?
Section VI. EMERGENCY AND DISASTER PREPAREDNESS

1. Name and phone number of the primary contact and alternate responsible for securing the laboratory in an emergency:
   - Primary:
     - Name:
     - Work number:
     - Pager number:
     - Home number:
   - Secondary:

2. Is the laboratory susceptible to flooding, broken windows or destruction? ☐ No ☐ Yes

3. With loss of electricity, would the agent create a potentially hazardous situation? ☐ No ☐ Yes
   If yes, describe to be taken to eliminate or reduce the hazard:

4. Manner and location of safely storing the agent at the time of disaster preparation:

5. When preparing for hurricanes, describe the plan for securing (or sacrificing) the animal and the method for disposal of waste product to avoid environmental contamination:
**Section VII. PERSONNEL** (Attach as Attachment I)

**Section VIII. EXPERIMENTAL ANIMAL USE** (Attach as Attachment J)

**Section IX. HAZARDOUS MATERIALS DISPOSAL**

1. Describe the method used for on-site neutralization of associated waste chemicals, contaminated materials, and unused/unwanted chemical:

2. If not waste is not neutralized, describe the plan for disposal of this chemical and chemically contaminated materials, including any unused chemical:

3. If applicable, list chemical and concentration planned for lab sink or drain disposal (i.e., lab equipment connected to water supply?):

4. Will unused, unwanted waste agent be stored? [ ] No [ ] Yes

   If yes, state manner and location of storage:

5. Is there a “Satellite Accumulation Area” in the laboratory? [ ] No [ ] Yes

6. List potential peroxide-forming chemicals utilized or generated while using this compound:

7. List Source Reduction and Waste Minimizations steps you plan to use as part of the experiment.

**Section X. MEDICAL CONSULTATION/EXAMINATION**
Safety Plan for the Use and Storage of High Risk Hazardous Chemicals

PI Name: | Chemical Name: |
---|---|
| |

Print Date: 3/24/2010

1. Are employees aware of reporting and first aid procedures for occupational exposures to hazardous chemicals. Please provide documentation of training (Attach as Attachment K).

<table>
<thead>
<tr>
<th>No</th>
<th>Yes</th>
</tr>
</thead>
</table>

2. Check all potential routes of exposure that apply for this experiment:

- Parenteral/Injection
- Inhalation
- Ingestion
- Skin
- Other (describe):

3. Describe the conditions or procedures under which these laboratory exposures may occur:
ATTACHMENT A
ROOM DIAGRAM
☐ Check this box if this attachment is NOT applicable to this HRHCSP

ATTACHMENT B
WORK PROCESS FLOW DIAGRAM
☐ Check this box if this attachment is NOT applicable to this HRHCSP

ATTACHMENT C
RECORDKEEPING REQUIREMENTS
☐ Check this box if this attachment is NOT applicable to this HRHCSP

ATTACHMENT D
STANDARD OPERATING PROCEDURES
☐ Check this box if this attachment is NOT applicable to this HRHCSP

ATTACHMENT E
CHEMICAL TRACER GAS PROCEDURES
☐ Check this box if this attachment is NOT applicable to this HRHCSP

ATTACHMENT F
CHEMICAL HYGIENE PLAN (for select agents)
☐ Check this box if this attachment is NOT applicable to this HRHCSP

ATTACHMENT G
TRAINING DOCUMENTATION
☐ Check this box if this attachment is NOT applicable to this HRHCSP

ATTACHMENT H
MATERIAL SAFETY DATA SHEET (MSDS)

☐ Check this box if this attachment is NOT applicable to this HRHCSP

ATTACHMENT I
PERSONNEL

☐ Check this box if this attachment is NOT applicable to this HRHCSP
## ATTACHMENT J
### EXPERIMENTAL ANIMAL USE

1. Have ARC personnel been informed of the appropriate handling and decontamination procedures required for contact with the animal and bedding?  
   - [ ] No  
   - [ ] Yes

2. IACUC Protocol#:  
   Date of Approval:

3. Species of animal:

4. Approximate number of animals per experiment:

5. Concentration and number of doses per animal:

6. State wording for cage label describing hazard:

7. Method of administering the agent:

8. Location of animal housing after dosing:

9. Length of time the animals will be maintained after dosing:

10. Would an animal carcass, bedding, and/or animal waste product contain any level of a potentially hazardous chemical or metabolite of the chemical agent?  
   - [ ] No  
   - [ ] Yes
   
   If yes, provide levels and identify the metabolite and associated ARC staff:

12. Check required PPE and safety equipment needed to safely handle exposed/dosed animal (in addition to the minimum required gloves, booties and gown):
   - [ ] Apron  
   - [ ] Goggles  
   - [ ] Face shield  
   - [ ] Labcoat
   
   - [ ] Respirator, Type:
   - [ ] Biological Safety Cabinet - Rm#/ ID#:
   - [ ] Chemical Fumehood - Rm#/ ID#:
   - [ ] Other (specify):
ATTACHMENT K
MEDICAL CONSULTATION/EXAMINATION

☐ Check this box if this attachment is NOT applicable to this HRHCSP
## APPENDIX 8C  Department of Homeland Security “Chemicals of Interest”

<table>
<thead>
<tr>
<th>Chemical Name</th>
<th>Chemical Name</th>
<th>Chemical Name</th>
<th>Chemical Name</th>
</tr>
</thead>
<tbody>
<tr>
<td>Acetaldehyde</td>
<td>Bromine chloride</td>
<td>Cyanogen chloride</td>
<td>Ethyl ether</td>
</tr>
<tr>
<td>Acetone cyanohydrin, stabilized</td>
<td>Bromine pentafluoride</td>
<td>Cyclohexylamine</td>
<td>Ethyl mercaptan</td>
</tr>
<tr>
<td>Acetyl bromide</td>
<td>Bromine trifluoride</td>
<td>Cyclohexyltrichlorosilane</td>
<td>Ethyl nitrite</td>
</tr>
<tr>
<td>Acetyl chloride</td>
<td>Bromotrifluoreylene</td>
<td>Cyclopropane</td>
<td>Ethyl phosphonyl difluoride</td>
</tr>
<tr>
<td>Acetyl iodide</td>
<td>1,3-Butadiene</td>
<td>DF</td>
<td>Ethylamine</td>
</tr>
<tr>
<td>Acetylene</td>
<td>Butane</td>
<td>Diazodinitrophenol</td>
<td>Ethyldiethanolamine</td>
</tr>
<tr>
<td>Acrolein</td>
<td>Butene</td>
<td>Diborane</td>
<td>Ethylene</td>
</tr>
<tr>
<td>Acrylonitrile</td>
<td>1-Butene</td>
<td>Dichlorosilane</td>
<td>Ethylene oxide</td>
</tr>
<tr>
<td>Acryl chloride</td>
<td>2-Butene</td>
<td>N,N-(2-diethylamino)ethanethiol</td>
<td>Ethylenediamine</td>
</tr>
<tr>
<td>Allyl alcohol</td>
<td>2-Butene-cis</td>
<td>Diethylchlorosilane</td>
<td>Ethylenimine</td>
</tr>
<tr>
<td>Allylamine</td>
<td>2-Butene-trans</td>
<td>o,o-Diethyl S-[2-(diethylamino)ethyl] phosphorothiolate</td>
<td>Ethylphosphonothioic dichloride</td>
</tr>
<tr>
<td>Allytrichlorosilane, stabilized</td>
<td>Butyltrichlorosilane</td>
<td>Diethyleneglycol dinitrate</td>
<td>Ethyltrichlorosilane</td>
</tr>
<tr>
<td>Aluminum (powder)</td>
<td>Calcium hydrosulphite</td>
<td>Diethyl methylphosphonite</td>
<td>Fluorine</td>
</tr>
<tr>
<td>Aluminum bromide, anhydrous</td>
<td>Calcium phosphate</td>
<td>N,N-Diethyl phosphoramidic dichloride</td>
<td>Fluorosulfonic acid</td>
</tr>
<tr>
<td>Aluminum chloride, anhydrous</td>
<td>Carbon disulfide</td>
<td>N,N-(2-diisopropylamino)ethanethiol</td>
<td>Formaldehyde (solution)</td>
</tr>
<tr>
<td>Aluminum phosphide</td>
<td>Carbon oxysulfide</td>
<td>Difluoroethane</td>
<td>Furane</td>
</tr>
<tr>
<td>Ammonia (anhydrous)</td>
<td>Carboxyl fluoride</td>
<td>N,N-Diisopropyl phosphoramidic dichloride</td>
<td>Germane</td>
</tr>
<tr>
<td>Ammonia (conc. 20% or greater)</td>
<td>Carboxylic acid</td>
<td>1,1-Dimethylydrazine</td>
<td>Germanium tetrafluoride</td>
</tr>
<tr>
<td>Ammonium nitrate</td>
<td>Chlorine</td>
<td>Dimethylamine</td>
<td>Guanyl nitrosaminoguanidinidene hydrazine</td>
</tr>
<tr>
<td>Ammonium nitrate, solid</td>
<td>Chlorine dioxide</td>
<td>N,N-(2-dimethylamino)ethanethiol</td>
<td>Hexaethyl tetraphosphate</td>
</tr>
<tr>
<td>Ammonium perchlorate</td>
<td>Chlorine monoxide</td>
<td>Dimethylchlorosilane</td>
<td>Hexafluoroacetone</td>
</tr>
<tr>
<td>Ammonium picrate</td>
<td>Chlorine pentafluoride</td>
<td>N,N-Dimethyl phosphoramidic dichloride</td>
<td>Hexanitrostilbene</td>
</tr>
<tr>
<td>Amyl chloride</td>
<td>Chlorine trifluoride</td>
<td>2,2-Dimethylpropane</td>
<td>Hexpolit</td>
</tr>
<tr>
<td>Antimony pentfluoride</td>
<td>Chloroacetyl chloride</td>
<td>Digu</td>
<td>Hexyltrichlorosilane</td>
</tr>
<tr>
<td>Arsenic trichloride</td>
<td>2-Chloroethylchloromethylsulfide</td>
<td>Dinitrogen tetroxide</td>
<td>HMX</td>
</tr>
<tr>
<td>Arsine</td>
<td>Chloroform</td>
<td>Dinitrophenol</td>
<td>HN1 (nitrogen mustard-1)</td>
</tr>
<tr>
<td>Barium azide</td>
<td>Chloromethyl ether</td>
<td>Dinitorosorcinol</td>
<td>HN2 (nitrogen mustard-2)</td>
</tr>
<tr>
<td>1,4-Bis(2-chloroethylthio)-n-butane</td>
<td>Chloromethyl methyl ether</td>
<td>Diphenylchlorosilane</td>
<td>HN3 (nitrogen mustard-3)</td>
</tr>
<tr>
<td>Bis(2-chloroethylthio)methane</td>
<td>1-Chloropropylene</td>
<td>Dipropyldichlorosilane</td>
<td>Hydrocholic acid (conc. 37% or greater)</td>
</tr>
<tr>
<td>Bis(2-chloroethylthio)eth ether</td>
<td>2-Chloropropylene</td>
<td>Dipropylylamine [or] Hexyl</td>
<td>Hydrocyanic acid</td>
</tr>
<tr>
<td>1,5-Bis(2-chloroethylthio)n-pentane</td>
<td>Chlorosarin</td>
<td>N,N-(2-dipropylamino)ethanethiol</td>
<td>Hydrofluoric acid (conc. 50% or greater)</td>
</tr>
<tr>
<td>1,3-Bis(2-chloroethylthio)n-propane</td>
<td>Chlorosoman</td>
<td>N,N-Dipropyl phosphoramidic dichloride</td>
<td>Hydrogen</td>
</tr>
<tr>
<td>Boron tribromide</td>
<td>Chlorosulfonic acid</td>
<td>Dodecytrichlorosilane</td>
<td>Hydrogen</td>
</tr>
<tr>
<td>Boron trichloride</td>
<td>Chromium oxychloride</td>
<td>Epichlorohydrin</td>
<td>Hydrogen bromide (anhydrous)</td>
</tr>
<tr>
<td>Chemical Name</td>
<td>Chemical Name</td>
<td>Chemical Name</td>
<td>Chemical Name</td>
</tr>
<tr>
<td>---------------</td>
<td>---------------</td>
<td>---------------</td>
<td>---------------</td>
</tr>
<tr>
<td>Boron trifluoride</td>
<td>Methane</td>
<td>Oxygen difluoride</td>
<td>Sesquimustard</td>
</tr>
<tr>
<td>Boron trifluoride w/methyl ether (1:1)</td>
<td>2-Methyl-1-butene</td>
<td>1,3-Pentadiene</td>
<td>Silane</td>
</tr>
<tr>
<td>Bromine</td>
<td>3-Methyl-1-butene</td>
<td>Pentolite</td>
<td>Silicon tetrachloride</td>
</tr>
<tr>
<td>Crotonaldehyde</td>
<td>Methyl chloride</td>
<td>Peracetic acid</td>
<td>Silicon tetrafluoride</td>
</tr>
<tr>
<td>Crotonaldehyde, (E)-</td>
<td>Methyl chloroformate</td>
<td>Perchloromethylmercaptan</td>
<td>Sodium azide</td>
</tr>
<tr>
<td>Cyanogen</td>
<td>Methyl ether</td>
<td>Perchloryl fluoride</td>
<td>Sodium chloride</td>
</tr>
<tr>
<td>Ethane</td>
<td>Methyl formate</td>
<td>PETN</td>
<td>Sodium cyanide</td>
</tr>
<tr>
<td>Ethyl acetylene</td>
<td>Methyl hydrazine</td>
<td>Phenyltrichlorosilane</td>
<td>Sodium hydrosulfite</td>
</tr>
<tr>
<td>Ethyl chloride</td>
<td>Methyl isocyanate</td>
<td>Phosgene</td>
<td>Sodium nitrate</td>
</tr>
<tr>
<td>Hydrogen chloride (anhydrous)</td>
<td>Methyl mercaptan</td>
<td>Phosphine</td>
<td>Sodium phosphide</td>
</tr>
<tr>
<td>Hydrogen cyanide</td>
<td>Methyl thiocyanate</td>
<td>Phosphorus</td>
<td>Soman</td>
</tr>
<tr>
<td>Hydrogen fluoride (anhydrous)</td>
<td>Methylamine</td>
<td>Phosphorus oxychloride</td>
<td>Stibine</td>
</tr>
<tr>
<td>Hydrogen iodide, anhydrous</td>
<td>Methylchlorosilane</td>
<td>Phosphorus pentaboride</td>
<td>Strontium phosphide</td>
</tr>
<tr>
<td>Hydrogen peroxide</td>
<td>Methyl dichlorosilane</td>
<td>Phosphorus pentachloride</td>
<td>Sulfur dioxide (anhydrous)</td>
</tr>
<tr>
<td>Hydrogen selenide</td>
<td>Methylphenyldichlorosilane</td>
<td>Phosphorus pentasulfide</td>
<td>Sulfur tetrafluoride</td>
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<tr>
<td>Hydrogen sulfide</td>
<td>Methylphosphonothioic dichloride</td>
<td>Phosphorus trichloride</td>
<td>Sulfur trioxide</td>
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<tr>
<td>Iodine pentafluoride</td>
<td>2-Methylpropene</td>
<td>Picrite</td>
<td>Sulfuryl chloride</td>
</tr>
<tr>
<td>Iron, pentacarbonyl-</td>
<td>Methyltrichlorosilane</td>
<td>Piperidine</td>
<td>Tabun</td>
</tr>
<tr>
<td>Isobutylamine</td>
<td>Sulfur mustard (Mustard gas (H))</td>
<td>Potassium chloride</td>
<td>Tellurium hexafluoride</td>
</tr>
<tr>
<td>Isobutylonitrile</td>
<td>O-Mustard (T)</td>
<td>Potassium cyanide</td>
<td>Tetrafluoroethylene</td>
</tr>
<tr>
<td>Isopentane</td>
<td>Nickel Carbonyl</td>
<td>Potassium nitrate</td>
<td>Tetramethyllead</td>
</tr>
<tr>
<td>Isoprene</td>
<td>Nitric acid</td>
<td>Potassium perchlorate</td>
<td>Tetramethylsilane</td>
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<tr>
<td>Isopropyl chloride</td>
<td>Nitric oxide</td>
<td>Potassium permanganate</td>
<td>Tetranitroaniline</td>
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<td>Isopropyl chloroformate</td>
<td>Nitrobenzene</td>
<td>Potassium phosphide</td>
<td>Tetranitromethane</td>
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<td>Isopropylamine</td>
<td>5-Nitrobenzotriazol</td>
<td>Propadiene</td>
<td>Tetrazene</td>
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<td>Isopropylphosphonothioic dichloride</td>
<td>Nitrocellulose</td>
<td>Propane</td>
<td>1H-Tetrazole</td>
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<tr>
<td>Isopropylphosphonofluoride</td>
<td>Nitrogen mustard hydrochloride</td>
<td>Propionitrile</td>
<td>Thioglycolic acid</td>
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<td>Lead azide</td>
<td>Nitrogen trioxide</td>
<td>Propyl chloroformate</td>
<td>Trifluorochloroethylene</td>
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<td>Lead styrphate</td>
<td>Nitroglycerine</td>
<td>Propylene</td>
<td>Trimethylamine</td>
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<td>Lewisite 1</td>
<td>Nitromannite</td>
<td>Propylene oxide</td>
<td>Trinethylchlorosilane</td>
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<td>Lewisite 2</td>
<td>Nitromethane</td>
<td>Propyleneimine</td>
<td>Trimethyl phosphate</td>
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<td>Lewisite 3</td>
<td>Nitrostarch</td>
<td>Proplyphosphonothioic dichloride</td>
<td>Trinitroaniline</td>
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<tr>
<td>Lithium amide</td>
<td>Nitrosyl chloride</td>
<td>Propylphosphonyl difluoride</td>
<td>Trinitroanisole</td>
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<td>Lithium nitride</td>
<td>Nitrotriazolone</td>
<td>Propyltrichlorosilane</td>
<td>Trinitrobenzene</td>
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<tr>
<td>Magnesium (powder)</td>
<td>Nonyltrichlorosilane</td>
<td>Propyne</td>
<td>Trinitrobenzenesulfonic acid</td>
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<tr>
<td>Magnesium diamide</td>
<td>Octadecyltrichlorosilane</td>
<td>QL</td>
<td>Trinitrobenzoic acid</td>
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<tr>
<td>Magnesium phosphide</td>
<td>Octolite</td>
<td>RDX</td>
<td>Trinitrocubobenzene</td>
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<tr>
<td>MDEA</td>
<td>Octonal</td>
<td>RDX and HMX mixtures</td>
<td>Trinitrofluorone</td>
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<tr>
<td>Mercury fulminate</td>
<td>Octyltrichlorosilane</td>
<td>Sarin</td>
<td>Trinitro-meta-cresol</td>
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<tr>
<td>Methacrylonitrile</td>
<td>Oleum (Fuming Sulfuric acid)</td>
<td>Selenium hexafluoride</td>
<td>Trinitronaphthalene</td>
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<tr>
<td>Chemical</td>
<td>Chemical</td>
<td>Chemical</td>
<td>Chemical</td>
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<td>-----------</td>
</tr>
<tr>
<td>Thionyl chloride</td>
<td>Triethyl phosphite</td>
<td>Vinyl acetate monomer</td>
<td>Vinylidene fluoride</td>
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<tr>
<td>Titanium tetrachloride</td>
<td>Trifluoroacetyl chloride</td>
<td>Vinyl acetylene</td>
<td>Vinyltrichlorosilane</td>
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<td>TNT</td>
<td>Trinitrophenetole</td>
<td>Vinyl chloride</td>
<td>VX</td>
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<td>Torpex</td>
<td>Trinitrophenol</td>
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<td>Zinc hydrosulfite</td>
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<td>Vinylidene chloride</td>
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<td>Triethanolamine</td>
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<td>Vinyl methyl ether</td>
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<td>Triethanolamine hydrochloride</td>
<td>Tungsten hexafluoride</td>
<td>Vinylidene chloride</td>
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