Chemical Hygiene Plan

The University of North Carolina at Greensboro

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INTRODUCTION

On January 31, 1990 the Occupational Safety and Health Administration (OSHA) promulgated a final rule for occupational exposure to hazardous chemicals in laboratories. Included in the standard, which became effective on 1 May, 1990 is a requirement for all employers covered by the standard to develop and carry out the provisions of a Chemical Hygiene Plan (CHP).

A CHP is defined as, "a written program which sets forth procedures, equipment, personal protective equipment and work practices that are capable of protecting employees from the health hazards presented by hazardous chemicals used in that particular workplace". Components of the CHP must include standard operating procedures for safety and health, criteria for the implementation of control measures, measures to ensure proper operation of engineering controls, provisions for training and information dissemination, permitting requirements, provisions for medical consultation, designation of responsible personnel, and identification of particularly hazardous substances.

This document is the Chemical Hygiene Plan developed for UNCG. It contains the University policies and procedures for working with hazardous chemicals. This document was developed to comply with paragraph (e) of the referenced OSHA 1910.1450 standard. This CHP will be reviewed, evaluated and updated at least annually by the Environmental Health and Safety Department. The CHP will be readily available to employees, their representatives and any representative of the Assistant Secretary of Labor of OSHA.

In addition, each employee is expected to develop safe personal chemical hygiene habits aimed at the reduction of chemical exposures to themselves and co-workers.

LABORATORY SAFETY PLAN

A Laboratory Safety Plan (LSP) for individual laboratories is required by the Occupational Safety and Health Administration (OSHA) regulation, “Occupational Exposures to Hazardous Chemicals In Laboratories,” commonly referred to as the OSHA Lab Standard. This standard requires a written plan that sets forth procedures, equipment, personal protective equipment and work practices capable of protecting employees from health hazards presented by the chemicals used in the laboratory. To accomplish this, UNCG requires any Principal Investigator who uses chemicals in the laboratory space to complete a LSP and operate in accordance with the University’s Chemical Hygiene Plan. The LSP is designed to provide the Principal Investigator the ability to develop such a written plan specific to his or her laboratory. The LSP must be completed by new principal Investigators and updated on an annual basis or whenever significant changes occur in the laboratory.

The Laboratory Safety Plan provides the following:

- Identifies the hazards associated with a particular laboratory space (ie. Hazardous Chemicals, Biological Hazards, Radioactive Materials, X-Rays, Lasers);
- Describes specific procedures and precautions in place to account for the hazards identified;
- Identifies emergency procedures and contacts;

- Identifies personnel who are approved to work in the laboratory;
- Identifies training that has been conducted with approved personnel.

CHEMICAL HYGIENE RESPONSIBILITIES

Department of Environmental Health & Safety

The EH&S Department will:

- Work with administrators and other employees to develop and implement appropriate chemical hygiene policies and practices;
- Monitor procurement, use, storage, and disposal of chemicals at the University;
- Determine that facilities and training levels are adequate for the chemicals in use;
- Assist Supervisors and Principal Investigators in developing and maintaining adequate facilities and work practices, and determining appropriate training for workers;
- Perform regular, formal chemical hygiene and housekeeping inspections including inspections of emergency equipment;
- Maintain current knowledge concerning the legal requirements of regulated substances at the University;
- Review the Chemical Hygiene Program on an annual basis.

Principal Investigator

The Principal Investigator shall:

- Maintain overall responsibility for the laboratory operation;
- Manage procurement, storage, use, and disposal of chemicals in accordance with the CHP;
- Develop and maintain an accurate Laboratory Safety Plan (LSP);
- Plan each laboratory operation in accordance with the CHP;
- Ensure that lab workers and visitors know and follow the rules and procedures in the CHP & LSP;
- Determine the proper level of personal protective equipment (PPE) and ensure that such protective equipment is available and used properly by lab members;
- Ensure that appropriate training has been provided to employees;
- Ensure that lab facilities and equipment are maintained in good working condition.

Laboratory Workers

The laboratory workers are individually responsible for:

- Reading and understanding the safety rules and procedures (LSP) that apply to their work;
- Conducting each laboratory operation in accordance with the CHP & LSP,
- Developing good personal chemical hygiene habits and wearing appropriate PPE;
- Promoting good housekeeping practices in the laboratory area;
- Reporting hazardous conditions and incidents to the PI.

LABORATORY INSPECTION PROGRAM

There are a myriad of health and safety regulations impacting laboratory operations from training and recordkeeping requirements to safe material handling and storage procedures. The goal of the laboratory inspection program is to maintain safe and compliant laboratory environments through the early detection of regulatory deficiencies and potentially unsafe work practices and to serve as a resource to aide researchers in the development of necessary policies and procedures.

Each Principal Investigator's (PI's) laboratory will be inspected semiannually. PI's will be informed of the month of their laboratory inspections, which will otherwise be unannounced. Inspections will assess administrative, procedural, and operational compliance with internal and external regulatory standards in the following areas:

- Laboratory Safety & Protective Procedures
- Chemical Hygiene
- Biological Hazards
- Radiation Safety
- Hazardous Waste

Another primary component of the inspection program is a review of the accuracy of the Laboratory Safety Plan, as it serves to identify hazards to personnel and as a resource for required material handling and storage procedures.

The inspector will review any findings with the PI or lab personnel present during the inspection and will provide guidance on appropriate corrective measures. Items presenting an immediate safety risk shall be corrected as soon as feasible. A written report detailing any items of noncompliance or other safety concerns will be sent to the PI. For items not corrected during the inspection, a written response from the PI or their designee must be received, detailing corrective actions. If a written response is not received within two weeks, the escalated enforcement process will be initiated.

Escalated Enforcement Process

I. **2 weeks – Reminder.** If an adequate response is not received within two weeks of the initial inspection report, the PI will receive a reminder notice of the safety deficiencies and request for response.

II. **4 weeks – Second Reminder to Department Head.** If an adequate response is not received within four weeks, a second reminder will be sent to the PI and their Department Head.

III. **6 weeks – Notification to Dean & SSROC**. If an adequate response is not received by six weeks, the items of non-compliance will be communicated to the PI's Dean and the Safety and Scientific Research Oversight Committee.

STANDARD OPERATING PROCEDURES

Chemical Procurement

The decision to procure a chemical shall be a commitment to handle and use the chemical properly from initial receipt to ultimate disposal. Information on proper handling, storage and disposal shall be known to all involved personnel prior to the procurement of the chemical. Chemicals utilized in the laboratory shall be those which are appropriate for the ventilation system.

All chemicals shall be received in a central location. Personnel who receive chemical shipments shall be knowledgeable of the proper procedures for receipt. Chemical containers shall not be accepted without accompanying labels, safety data sheets (SDS), and packaging, in accordance with all appropriate regulations. All chemical shipments should be dated when received and opened.

Chemical Storage

- Received chemicals shall be immediately moved to their designated storage area. Large glass containers shall be placed in carrying containers or shipping containers during transportation.
- Storage areas shall be well illuminated, with all storage maintained below eye level. Large bottles shall be stored no more than two feet from ground level.
- Chemicals shall be segregated by hazard classification and compatibility in a well identified area, with local exhaust ventilation.
- Mineral acids should be separated from flammable and combustible materials. Separation is defined by NFPA 49 as storage within the same fire area, but separated by as much space as practicable or by intervening storage from incompatible materials.
- Acid-resistant trays shall be placed under bottles of mineral acids.
- Acid-sensitive materials such as cyanides and sulfides, shall be separated from acids or protected from contact with acids.
- Highly toxic chemicals or other chemicals whose containers have been opened, shall be stored in compatible secondary containment.
- Storage areas shall not be used as a preparation or repackaging area.
- When chemical containers are transported outside a lab room, they shall be placed in a transport container (bucket, bottle jockey, etc.).
- Storage of chemicals at the lab bench or other work areas shall be limited to those amounts necessary for one operation. The container size shall be the minimum convenient. The amounts of chemicals at the lab bench shall be as small as practical. Chemicals in the workplace shall not be exposed to sunlight or heat.
- Stored chemicals shall be examined at least annually for replacement, deterioration, and container integrity. The inspection should determine whether any corrosion, deterioration, or damage has occurred to the container or facility as a result of leaking chemicals.

Safety Data Sheets

Safety Data Sheets (SDS) provide important information about the safe handling, storage, and incident response for chemicals in the workplace. SDS for all chemicals and chemical containing products present in the workplace must be readily accessible to personnel at all times. SDS can be kept in paper or electronic form. Electronic SDS can be accessed at MSDS Online via the EH&S website **https://safety.uncg.edu**.

SDS will include information organized into the following sections:

1. Identification
2. Hazard(s) identification
3. Composition/information on ingredients
4. First-aid measures
5. Firefighting measures
6. Accidental release measures
7. Handling and storage
8. Exposure control/personal protection
9. Physical and Chemical properties
10. Stability and reactivity
11. Toxicological information
12. Ecological information
13. Disposal considerations
14. Transport information
15. Regulatory information
16. Other information

SIGNS AND LABELING

Signs

Signs shall be posted at entryways to areas containing hazardous materials. Entry signs shall include telephone numbers for emergency personnel, supervisors and other workers, as deemed appropriate, and hazard symbols for all hazardous materials present. Location signs for safety and emergency equipment shall be posted inconspicuously.

Labeling

- All containers in the laboratory shall be labeled. This includes chemical containers and waste containers. The label shall be informative and durable, and at a minimum, will identify contents, chemical name(s), and hazard(s).
- Portable containers shall be labeled by the individual using the container.
- Exemptions for labeling requirements shall be made for chemical transfers to a secondary container intended for the immediate use by the individual performing the transfer.
- The labeling program shall be periodically inspected to ensure that labels remain legible and secured to containers.

LABORATORY EQUIPMENT AND GLASSWARE

Each employee shall keep the work area clean and uncluttered. All chemicals and equipment shall be properly labeled in accordance with the labeling section of this plan. At the completion of each work day or operation, the work area shall be thoroughly cleaned and all equipment properly cleaned and stored.

In addition, the following procedures shall apply to the use of laboratory equipment:

- All laboratory equipment shall be used only for its intended purpose.
- All glassware will be handled and stored with care to minimize breakage; all broken glassware will be immediately taken out of service.
- All evacuated glass apparatus shall be shielded to contain chemicals and glass fragments should implosion occur.
- All laboratory equipment shall be inspected on a periodic basis and replaced or repaired as necessary.

CHEMICAL HANDLING

Each laboratory employee shall be trained and provided the resources by their supervisor develop and implement work habits consistent with this CHP to minimize personal and co-worker exposure to chemicals in the laboratory. Given that all chemicals inherently present hazards in certain conditions, exposure to all chemicals shall be minimized.

General precautions for the handling and use of all chemicals:

- Skin contact with all chemicals shall be avoided.
- All employees shall hands prior to leaving the laboratory.
- Mouth suction for pipetting or starting a siphon is prohibited.
- Eating, drinking, smoking, gum chewing, or application of cosmetics in areas where laboratory chemicals are present, shall be prohibited. Hands shall be thoroughly washed prior to performing these activities.
- Storage, handling, or consumption of food or beverages shall not occur in storage areas or refrigerators also used for laboratory materials or operations.
- Risk determinations shall be conservative in nature.
- Any chemical mixture shall be assumed to be as hazardous as its most hazardous component.
- New substances with undetermined hazards shall be assumed to be hazardous.
- Laboratory employees shall be familiar with the symptoms of exposure for the chemicals with which they work and the precautions necessary to prevent exposure.
- Neither the Permissible Exposure Limits (PELs) of OSHA or the Threshold Limit Values (TLVs) of the American Conference of Governmental Industrial Hygienists (ACGIH) shall be exceeded at any time while working with chemicals.
- The engineering controls and safety equipment in the laboratory shall be inspected regularly

to ensure proper function and protection of personnel.

Personal Protective Equipment

- SAFETY GLASSES meeting ANSI Z87.1 are required for all persons in a laboratory and must be worn when a splash hazard is present.
- Chemical goggles and/or a full face shield shall be worn during chemical transfer and handling operations as procedures dictate.
- Sandals, perforated shoes, and bare feet are prohibited. Safety shoes, per ANSI 47 are required where employees routinely lift heavy objects.
- LAB COATS are recommended for use in the laboratory. Laboratory coats will be laundered on a periodic basis, at least monthly. Laboratory coats shall be removed from service immediately upon discovery of significant contamination. Short pants may not be worn in a laboratory.
- Appropriate chemical-resistant GLOVES based on the table in Appendix A shall be worn at all times when handling hazardous materials, chemicals of unknown toxicity,. Used gloves shall be inspected and washed prior to re-use. Damaged or deteriorated gloves will be immediately replaced. Reusable Gloves shall be washed prior to removal from the hands. Disposable, single use gloves shall not be reused.
- Thermal-resistant gloves shall be worn for operations involving the handling of heated or cryogenic materials or exothermic reaction vessels. Thermal-resistant gloves shall be non-asbestos and shall be replaced when damaged or deteriorated.
- RESPIRATOR usage shall comply with the OSHA Respiratory Protection Standard, 29 CFR 1910.134, and the UNCG Respiratory Protection Program.

Personal Work Practices

Department Heads and laboratory supervisors must ensure that each employee knows and follows the rules and procedures established in this plan, including, but not limited to:

- All employees shall remain vigilant to unsafe practices and conditions in the laboratory and shall immediately report such practices and conditions to the laboratory supervisor. The supervisor must correct unsafe practices and conditions promptly.
- Long hair and loose-fitting clothing shall be confined close to the body to avoid being caught in moving equipment/parts, or contact with flames or hazardous materials.
- Use only those chemicals appropriate for the ventilation system.
- Avoid unnecessary exposure to all chemicals by any route.
- Do not smell or taste any chemicals.
- Encourage safe work practices in co-workers by setting the proper example. Horseplay is strictly forbidden.
- Seek information and advice from knowledgeable persons, standards, and codes about the hazards present in the laboratory. Plan operations, equipment and protective measures accordingly.
- Use engineering controls, as designed, when necessary to mitigate hazards.
- Inspect personal protective equipment prior to use. Wear appropriate protective equipment as procedures dictate and when necessary to avoid exposure.

Housekeeping

Each laboratory worker is directly responsible for the cleanliness of his or her work space, and jointly responsible for common areas of the laboratory. The laboratory supervisor shall insist on the maintenance of housekeeping standards.

The following procedures apply to the housekeeping standards of the laboratory:

- All spills on lab benches or floors shall be immediately cleaned and properly disposed of. The laboratory supervisor must be informed of any large spills (> 1 L) or spills of particularly hazardous substances.
- Lab bench work areas shall be kept clear of equipment and chemicals except those necessary for the work currently being performed.
- The work area shall be cleaned at the end of each operation and each day.
- All apparatus shall be thoroughly cleaned and returned to storage upon completion of usage.
- All floors, aisles, exits, fire extinguishing equipment, eyewashes, showers, electrical panels and other emergency equipment shall remain unobstructed.
- All labels shall face forward.
- Chemical containers shall be clean, properly labeled and returned to storage upon completion of usage.
- All chemical wastes will be disposed of in accordance with UNCG Hazardous Waste Disposal Procedures.

EMERGENCY EQUIPMENT & ENGINEERING CONTROLS

Emergency Equipment

Fire Extinguishers

All laboratory personnel will be trained in the proper use of fire extinguishers when hired and annually thereafter. Prior to the procurement of new chemicals, the laboratory supervisor shall verify that existing extinguisher and other emergency equipment are appropriate for such chemicals.

Emergency Showers and Eyewashes

All employees who might be exposed to chemical splashes shall be instructed in the location and proper usage of emergency showers and eyewashes. The eyewash should be activated weekly and shall be inspected monthly by laboratory personnel. These inspections shall be in accordance with ANSI Z358.1 and manufacturer's specifications. Inspection records shall be maintained on inspection tags or log sheets kept on or adjacent to the equipment.

Engineering Controls

Intent - The engineering controls installed in the laboratory are intended to minimize employee exposure to chemical and physical hazards in the workplace. These controls must be maintained in proper working order for this goal to be realized.

Modification – Engineering controls are not to be altered unless testing indicates that worker protection will continue to be adequate.

Improper Function - Improper function of engineering controls must be reported to the Principal Investigator or lab supervisor immediately. The system shall be taken out of service until proper repairs have been executed.

Usage - All employees shall be trained on and adhere to proper work practices when using the engineering controls.

Laboratory Hoods

The laboratory hoods shall be utilized for all chemical procedures which might result in release of hazardous chemical vapors or dust. As a general rule, the hood shall be used for all chemical procedures involving substances which are appreciably volatile and have a permissible exposure limit (PEL) less than 50 ppm.

The following work practices shall apply to the use of hoods:

- Confirm adequate hood ventilation performance prior to opening chemical containers inside the hood. An inward flow of air can be confirmed by holding a piece of paper at the face of the hood and observing the inward movement of the paper.
- Keep the hood sash closed when not in use. When working in the hood, maintain the sash height as low as possible.
- Storage of chemicals and equipment inside the hood shall be kept to a minimum. Stored items or other obstructions can disrupt the airflow and limit the effectiveness of the hood.
- Leave the hood operating when it is not in active use if hazardous chemicals are contained inside the hood or if it is uncertain whether adequate general laboratory ventilation will be maintained when the hood is non-operational.
- The ventilation system shall be inspected annually. The hood face velocity shall be maintained between 75 and 125 feet per minute. The EH&S Department will conduct inspections annually or as necessary following alterations to the system. Face velocity shall be posted on the hood and a record of each inspection shall be maintained by the EH&S Department.
- The hood shall not be used as a means of disposal for volatile chemicals.
- Prior to the introduction of new chemicals, the adequacy of hood ventilation systems shall be determined by the Principal Investigator.

Local Exhaust Ventilation

The following procedures shall apply to the use of local exhaust ventilation:

- Openings of hoods shall be placed as close as possible to sources of the air contaminant.
- Clear the screen on the face of the hood prior to usage.
- After using hoods, operate the fan for an additional period of time sufficient to clear residual contaminants from the duct work.
- Prior to a change in chemicals or procedures, the adequacy of the ventilation system shall be determined by the Principal Investigator or lab supervisor.

Glove Boxes and Isolation Rooms

The exhaust air from a glove box or isolation room will pass through scrubbers or other treatment before release into the regular exhaust system.

Cold Rooms and Warm Rooms

Prior to the storage of any temperature sensitive materials, emergency procedures must be developed

and documented in the Laboratory Safety Plan to ensure the safety of the materials in the event of a cold room or warm room failure.

Chemical Storage Cabinets
Storage cabinets for flammable and hazardous chemicals will remain closed and latched except when removing or replacing chemicals.

TRAINING

All lab workers will be apprised of the hazards present in the laboratory. Each worker shall receive training at the time of initial assignment to the laboratory, prior to assignments involving new exposure situations, and annually thereafter. This training shall include the physical and health hazards of chemicals in the lab, measures employees can take to protect themselves from these hazards, and methods of detecting the presence of a hazardous chemical. The training shall present the details of the Chemical Hygiene Plan and Lab Safety Plan, and shall include:

- the location and availability of the Chemical Hygiene and Lab Safety Plans;
- signs and symptoms associated with exposure to the chemicals present in the laboratory;
- location and availability of reference material on chemical hygiene (Safety Data Sheets); including the permissible exposure limits for OSHA regulated substances ~~or~~ and recommended exposure values for other hazardous chemicals present in the laboratory;
- Laboratory Safety Training documentation must be maintained in the department and forwarded to the EH&S Department.

PRIOR APPROVAL OF LABORATORY ACTIVITIES

Permit System

A permit system shall be used for laboratory activities which present greater risk to workers or visitors. These activities include off-hours work, sole occupancy of building, hazardous operations and unattended operations. The permit entitled Chemical Hygiene Permit is included in Appendix B to this plan and shall be executed prior to the performance of these activities.

Sole Occupancy and Off-hours Work
Laboratory work, involving hazardous chemicals, shall not be performed when the only person in the building is the lab worker, unless a permit has been issued. The Principal Investigator shall determine when a permit is necessary, considering the hazards associated with the activity and the need for emergency assistance.

Hazardous Work
All hazardous operations are to be performed during a time when at least two people are present at the laboratory. The determination of hazardous operations shall be made by the Principal Investigator or lab supervisor.

Unattended Operations

When laboratory operations are performed which will be unattended by laboratory personnel (continuous operations, overnight reactions, etc.), the following procedures will be employed:

- The permit system shall be utilized. The Principal Investigator or lab supervisor shall issue a permit, based on the hazards and risks associated with the unattended operation.
- The laboratory supervisor will review work procedures to ensure the safe completion of the operation.
- A sign will be posted at all entrances to the laboratory, indicating an unattended operation is underway and identifying the name and phone number(s) of the person to be contacted in an emergency.
- The overhead lights in the laboratory will be left on.
- Precautions shall be made for the interruption of utility service during the unattended operation (loss of water pressure, electricity, etc.)
- The person responsible for the operation will return to the laboratory at the conclusion of the operation to assist in the dismantling of the apparatus.

Children and Unauthorized Personnel in Hazardous Environments

Access to areas identified as laboratories where hazardous chemicals and equipment are maintained is limited to authorized University staff and students and other persons on official, related business. This requirement is intended to protect the health and well-being of all University employees and to avoid exposing unauthorized individuals to a hazardous environment. Measures should be taken to ensure that persons entering these areas be appropriately trained and adequately protected from hazards and informed about the safety and emergency procedures relevant to their activities.

Children under the age of 18 are prohibited from entering laboratory areas or other areas where hazardous materials or conditions may be present unless:

- Such entry is in the context of a scheduled open house or tour;
- The minor is a UNCG student performing the normal duties of a student, student worker or intern who has been deemed competent to handle those risk factors by the lab supervisor;
- There exists written documentation by the department chair or director that approval has been given and appropriate training provided, per the UNCG Policy on Minors in Research Laboratories.

MEDICAL CONSULTATIONS AND EXAMINATIONS

Opportunity for Medical Attention

An opportunity to receive medical attention is available to all employees who work with hazardous chemicals in the laboratory. The opportunity for medical attention will be made available to employees under the following circumstances:

- Whenever an employee develops signs or symptoms associated with a hazardous chemical to which the employee may have been exposed in the laboratory;
- Medical surveillance programs will be established where exposure monitoring reveals an

exposure level above the action level for an OSHA regulated substance for which there are exposure monitoring and medical surveillance requirements;

- Whenever an event takes place in the laboratory such as a spill, leak, explosion or other occurrence resulting in the likelihood of an exposure to hazardous materials, the employee will be provided an opportunity for medical consultation for the purpose of determining the need for medical examination and monitoring.

Seeking Medical Attention

University students and employees shall seek medical attention at Gove University Health Center for injuries or hazardous material exposures during normal working hours. If immediate medical attention is needed after-hours, individuals should report to the nearest emergency room or call campus police at 334-4444.

Cost

These medical consultations and examinations shall be provided without cost to the employees, without loss of pay, and at a reasonable time and place. The cost of any medical surveillance will be the responsibility of the department. Any injury of illness must be reported in accordance with the UNCG Occupational Injury Reporting Procedures.

LABORATORY CLOSURE OR RELOCATION

Appropriate security and storage of chemicals and other hazardous materials must be maintained during the closure, relocation or renovation of a laboratory. These procedures/responsibilities are designed to facilitate the relocation or closeout process while keeping the safety of employees, students, contractors, as well as the environment in mind. Lab personnel should contact the EH&S Department, if needed, at least four weeks prior to the date of change.

Responsibilities

Department/Researchers

- Label all hazardous waste with a UNCG Hazardous Waste Label and request a pickup using Chemical Waste Removal Form. Please allow at least four weeks for complete removal of chemicals.
- Move all wanted equipment, glassware, supplies and any chemical or other materials to their new designated location.
- Request a radiation exit-survey (if applicable) from the EH&S Department. EH&S will remove or deface all radiation warning signs and labels following successful completion of the survey.
- Disinfect all lab surfaces or remaining equipment potentially contaminated with biohazardous material. Consult EH&S or commercial vendor for guidance on disinfection of biosafety cabinets. Remove or deface all biohazard warning signs and labels following disinfection.
- Ensure all equipment, benchtops, shelving, storage cabinets, fume hoods, and other accessible surfaces are free of visible chemical residue. Clean (detergent wipe down) surfaces/equipment as necessary and manage cleaning materials as hazardous waste (if

applicable).

EH&S Department

- Collect hazardous waste upon request
- Perform contamination survey(s) upon request.
- Provide guidance on appropriate decontamination/disinfection methods.
- Perform a survey to identify hazardous materials or other hazards upon request from project manager.
- May only communicate with construction managers through the University project managers.
- Relocate and amend Laboratory Hazard Warning Signs as needed.

Project Managers

- Request a hazardous materials survey of building from EH&S Department prior to construction activity.
- Notify contractors of all hazardous materials or conditions present in their work area.
- Keep departments, researchers, and EH&S appraised of construction schedule.
- Cease any work that may present hazardous work conditions until corrected.
- Work with EH&S to remove any hazardous materials found after work has commenced.

Researcher Precautions/Procedures Prior to Relocation or Closure

Chemicals (Solids, Liquids, Gases)

- Ensure that all containers are securely closed to prevent leaks and free of chemical residue on the exterior surface.
- Ensure all chemical containers are properly labeled with complete chemical name and associated hazards.
- Segregate incompatible materials.
- Identify, label, and properly store all hazardous waste and request removal by EH&S
- Contact the EH&S department for assistance with transport to new location, if desired.
- Commercial vendor arrangements, if used, must be coordinated with University project manager and EH&S. The hazardous materials manifest created by hazardous materials transporter may only be signed by EH&S Department personnel.
- Identify usable chemicals which are in like new condition and offer to EH&S Orphan Chemical Program.
- Arrange to have unwanted cylinders returned to the supplier.
- Remove pressure regulators from wanted cylinders and secure cylinder caps. Use a drum dolly fitted with cylinder straps to transport cylinders.
- Researchers who possess DEA License must notify Greensboro DEA Agency to terminate or amend license, as necessary. Contact EH&S to ensure proper disposal of scheduled drugs.

HIGHLY HAZARDOUS MATERIALS

Particularly Hazardous Substances

Particularly hazardous substances require additional planning and precautions. Such materials include select carcinogens, reproductive toxins, and substances which have a high degree of acute toxicity. Use of these materials requires additional planning and precautions detailed in written Standard Operating Procedures. The SOP should include provisions to limit exposure and contamination of personnel and equipment through appropriate containment, personal protective equipment, decontamination procedures, and waste collection.

Select Carcinogens
OSHA defines select carcinogens as chemicals:

- Regulated by OSHA as a carcinogen; or
- Listed as "known to be carcinogen" in the Annual Report on Carcinogens published by the National Toxicology Program (NTP); or
- Listed as "Group 1" ("carcinogenic to humans") by the International Agency for Research on Cancer Monographs (IARC); or
- Listed in either Group 2A or 2B by the IARC or as "reasonably anticipated to be carcinogens" by the NTP, and causes statistically significant tumor incidence in experimental animals in accordance with any of the following criteria:
    - Inhalation of <10 mg/m3 for 6-7 hours per day for 5 days a week for a significant portion of lifetime
    - Repeated skin application of <300 mg per kg of body weight per week
    - Oral dose of <50 mg per kg of body weight per day

Reproductive Toxins
Reproductive toxins are defined as materials that affect the reproductive capabilities, including adverse effects on sexual function and fertility in males and females, as well as adverse effects on the development of the offspring. Materials that may cause adverse reproductive effects include chemical, biological, and radiological agents.

UNCG is committed to providing additional protection for the conceptus by implementation of specific procedures or accommodations to protect pregnant personnel. Protective considerations for declared pregnancies may include specific PPE, containment equipment, procedure alterations, or work assignment changes, at no cost or loss of job opportunity to the individual. Pregnancy declarations can be made confidentially to the supervisor, department head or UNCG Laboratory Safety Manager.

Highly Toxic Materials
Chemicals with a high acute toxicity have the ability to cause harmful effects, which can be local or systemic, after a single exposure. The parameters for assessing the acute toxicity of a chemical are its

LD50 and LC50, the mean lethal dose or concentration causing death in experimental animals. OSHA defines highly toxic substances by the following criteria.

- Oral LD50 for albino rats of <50 mg/kg; or
- Topical LD50 for albino rabbits of <200 mg/kg; or
- LC50 in albino rats of <200 ppm for one hour.

Working with PHS:

- Develop and document a written procedure identifying the special precautions for personnel protection and designated areas of use for all particularly hazardous substances used in the lab.
- Areas where these chemicals are stored and used are of restricted access and have special warning signs.
- HVAC systems must be configured to maintain negative pressure in the lab room.
- Exhaust air from the work area or primary containment equipment must discharge directly to the outdoors, clear of buildings and air intakes. Exhaust air from the work area must not recirculate.
- Exhaust air from glove boxes must filter through high-efficiency particulate air (HEPA) and charcoal filters.
- Exhaust systems for highly toxic substances must contain engineered fail-safes to prevent loss of containment due to utility outages.
- A laboratory coat and compatible gloves must be worn when working with highly toxic chemicals or select carcinogens. Protective clothing is to be provided by the Principal Investigator and shall not be worn outside of the lab. Contaminated items shall be decontaminated prior to laundering.
- Hands and exposed arms will be washed immediately after working with these chemicals.
- The supervisor will be notified of spills and other exposure incidents. A physician will be consulted when appropriate.
- All transfer and work with these substances shall be in a designated area: a restricted access hood, glove box or portion of lab.
- Vacuum systems must have protection via an absorbent or liquid trap and a high efficiency particulate air (HEPA) filters. Use vacuum pumps in an appropriate hood.
- Any contaminated equipment or glassware will be decontaminated in the hood before removing them from the designated area.
- Containers will be stored in a ventilated limited access area, in labeled, unbreakable, compatible secondary containment.
- Women of child-bearing age will handle reproductive toxins only in a hood with confirmed satisfactory performance and will use protective equipment to prevent skin contact as prescribed by the supervisor.
- Two people will always be present during work with these chemicals.
- For powders, a wet mop or vacuum with a HEPA filter will be used for cleanup.
- The designated area will be marked with warning and restricted access signs.

Working with Animals and Chemicals of High Chronic Toxicity

- Hazardous chemical operating procedures and SDS shall be included with IACUC protocols.
- Animals exposed to highly toxic materials will be housed in designated rooms posted for

toxic materials.

- Compatible gloves and fully buttoned lab coats will be worn in the designated animal room.
- The substance will be administered by injection or gavage when possible rather than by diet. When diet is used, a caging system under negative pressure or under laminar air flow directed toward HEPA filters will be used.
- Procedures will be used to minimize contaminated aerosols and dust from food, urine and feces:
    - HEPA filtered vacuum equipment for cleaning.
    - Moisten contaminated bedding before removal from cage.
    - Mix diets in closed containers in hood

Organic Compounds that form Hazardous Peroxides

Some organic compounds, such as ethers, can react with oxygen from the air, forming unstable peroxides. Peroxide formation can occur under conditions of normal storage when compounds become concentrated by evaporation or mixed with other compounds. The accumulated peroxides can then violently explode when exposed to shock, friction, or heat. Pure compounds will accumulate peroxides more readily than compounds containing impurities.

Examples of organic compounds that form hazardous peroxides:

- aldehydes, ketones, ethers
- Compounds with allylene (CH2=CHCH2R) structure
- Alkali metals, alkoxides, amines
- Vinyl and vinylidene compounds
- Compounds with benzylic hydrogen atom

Examples of chemicals which form hazardous peroxides upon exposure to air:

- cyclohexane
- tetrahydrofuran
- decalin
- ethyl ether
- tetralin
- isopropyl ether
- dioxane (1,4)
- potassium metal
- sodium amide
- divinyl acetylene
- vinyl ethers
- cumene
- diazine
- cyclopentene

Storage and Handling:

- Additional labeling of these compounds must include “PEROXIDE FORMING CHEMICAL”.

- Discard OPENED containers of peroxide forming chemicals after 6 months. Discard UNOPENED containers of peroxide forming chemicals after 12 months. Contact the Office of Safety for disposal.
- Order peroxide-forming chemicals in small amounts and use quickly.
- Include the DATE OF PURCHASE on label.
- After opening, note the DATE OF USE on label.
- Store in cool, dry, well-ventilated area, out of direct sunlight. Protect from extreme temperatures and rapid temperature changes.
- Containers should be tightly sealed. DO NOT use corks or rubber stoppers to cap containers.
- Store in amber glass or inert containers, preferably unbreakable.
- Before opening glass bottles, look for the presence of solids (crystals) or viscous liquid at the bottom of the bottle. These are good indicators of peroxide formation. If either are present – DO NOT OPEN OR HANDLE the container. Call the EH&S Department at 336-334-4357 for assistance and possible deactivation of the material.

Nanomaterials

Nanoparticles are still a bit of a gray area from a regulatory standpoint because they are still a relatively new material and their properties are not well understood. For now, our (informal) policy is to conduct a review/risk assessment prior to use. Three sources are reviewed:

- SDS of the base material
- SDS of the specific nanomaterial (if available)
- Search for additional information on the potential hazards of the specific material.

To err on the side of safety, the material is then considered to present the highest hazards identified from those three sources and material use and handling precautions are assigned accordingly. However, the higher hazard information may be deemed non-applicable if the composition of the material (ie. in suspension or mixture) would eliminate such hazards.

Chemicals Requiring Initial Monitoring

A list of chemicals requiring initial monitoring is found in Appendix C. Sampling for evaluating employee exposure to chemical substances shall be conducted periodically or as specified by specific codes or regulations. The Department is responsible for identifying chemicals that require initial monitoring and arranging through the EH&S Department to have monitoring conducted. The results of air sampling studies are maintained by the EH&S department.

Department of Homeland Security Chemicals of Interest

On November 22, 2007, the Department of Homeland Security passed 6 CFR Part 27 “Appendix A to Chemical Facility Anit-Terrorism Standard Final Rule. This rule requires that any “Chemical Facility” report amounts of “Chemicals of Interest (COI’s)” inventoried at these facilities. Under the rule Universities were established as “Chemical Facilities”. Appendix D contains a list of COI’s and amounts that are required to be reported within 60 days from the time they are received or produced. Because of this reporting requirement, inventories of these chemicals on campus at any time require particular attention.

The laboratory supervisor shall be responsible for reporting the amount of these chemicals on an annual basis. Reports should be directed to the EH&S Department, which will keep a master list of COI's and quantities on file.

CHEMICAL SPILL, RELEASES

Small spills (< 1 L) shall be cleaned immediately by laboratory personnel and/or the lab supervisor. EH&S Emergency Response personnel are available at any hour for consultation or assistance with spill clean-up. Emergency response personnel can be reached at 336-334-4357 or after-hours via campus police at 336-334-4444.

Large spills (> 1 L) or spills of particularly hazardous substances must be reported to the lab supervisor immediately. Spills may be cleaned by trained lab personnel or by contacting EH&S Emergency Response personnel for assistance. An incident report must be submitted to the EH&S Department upon the conclusion of the event.

Notify the EH&S Department immediately of any release of:

- Chemicals to the sanitary or storm sewer;
- Hazardous chemical fumes or vapors to unrestricted areas of the building;
- Select carcinogens, reproductive toxins, or highly toxic materials to the environment without appropriate filtration;

RECORDKEEPING

- Accident reports will be retained indefinitely by the EH&S Department.
- Exposure records for hazardous chemicals and harmful physical agents will be maintained for 30 years per 29 CFR 1910.1020. These records will be forwarded to the EH&S Department by the lab supervisor.
- Medical records for employees exposed to hazardous chemicals and harmful physical agents will be maintained for the duration of employment plus 30 years per 29 CFR 1910.1020. These records will be forwarded to the EH&S Department by the lab supervisor.
- Inventory and usage records for high risk substances (amounts of substances on-hand, amounts used and names of workers involved) shall be maintained for three years by the lab supervisor. After three years, the records will be forwarded to the EH&S Department by the lab supervisor, for indefinite storage.
- Records of inspections of equipment will be maintained for three years by the lab supervisor. After three years, the records will be forwarded to the EH&S Department by the lab supervisor, for indefinite storage.
- Records of employee training will be maintained for three years by the lab supervisor. Upon the completion of training, records will be immediately forwarded to the EH&S Department for indefinite storage.

ANNUAL CHEMICAL HYGIENE PLAN AUDIT

Each lab supervisor shall conduct an audit of all phases of the Chemical Hygiene Plan each year. Results will be provided to the Department Head and the EH&S Department. Department Heads are responsible for taking corrective action.

REFERENCES AND RECOMMENDED READING

National Research Council, Prudent Practices for Handling Hazardous Chemicals in Laboratories, National Academy Press, Washington, D.C. 1981.

National Research Council, Prudent Practices for Disposal of Chemicals from Laboratories, National Academy Press, Washington, D.C., 1983.

Freeman, N.T., Introduction to Safety in the Chemical Laboratory, Academy Press, 1982.

Manufacturing Chemists Association, Inc., Guide For Safety In The Chemical Laboratory, D. Van Nostrand Company, Inc., 1954.

Green, Michael E., Safety in Working With Chemicals, MacMillan Publishing co., Inc. 1978.

Pipitone, David A., Safe Storage of Laboratory Chemicals, Wiley & Sons, Inc. 1984.

Code of Federal Regulations, 29 CFR Part 1910 Subpart Z section 1910.1450, Occupational Exposure to Hazardous to Hazardous Chemicals in Laboratories, 1990.

APPENDIX A: GLOVE COMPATIBILITY CHART

THE UNIVERSITY of NORTH CAROLINA GREENSBORO	**Resistance To Chemicals of Common Glove Materials**			Page 1 of 2
Chemical	**Natural Rubber**	**Neoprene Rubber**	**Nitrile**	**Vinyl**
Acetaldehyde	G	G	E	G
Acetic Acid	E	E	E	E
Acetone	G	G	G	F
Acrylonitrile	P	G	--	F
Ammonium Hydroxide (sat)	G	E	E	E
Aniline	F	G	E	G
Benzaldehyde	F	F	E	G
Benzene^a	P	F	G	F
Benzyl Chloride^a	F	P	G	P
Bromine	G	G	--	G
Butane	P	E	--	P
Butyarldehyde	P	G	--	G
Calcium Hypochlorite	P	G	G	G
Carbon Disulfide	P	P	G	F
Carbon Tetrachloride^a	P	F	G	F
Chlorine	G	G	--	G
Chloroacetone	F	E	--	P
Chloroform^a	P	F	G	P
Chromic Acid	P	F	F	E
Cyclohexane	F	E	--	P
Dibensyl Ether	F	G	--	P
Dibutyl Phtalate	F	G	--	P
Diethanolamine	F	E	--	E
Diethyl Ether	F	G	E	P
Dimethyl Sulfoxide^b	--	--	--	--
Ethyl acetate	F	G	G	F
Ethylene Dichloride^a	P	F	G	P
Ethylene Glycol	G	G	E	E
Ethylene Trichloride^a	P	P	--	P
Fluorine	G	G	--	G
Formaldehyde	G	E	E	E
Formic Acid	G	E	E	E
Glycerol	G	G	E	E
Hexane	P	E	--	P
Hydrobromic Acid (40%)	G	E	--	E
Hydrochloric acid (conc)	G	G	G	E
Hydrofluoric Acid (30%)	G	G	G	E
Hydrogen peroxide	G	G	G	E
Iodine	G	G	--	G
Methylamine	G	G	E	E

THE UNIVERSITY of NORTH CAROLINA GREENSBORO

Resistance To Chemicals of Common Glove Materials

Chemical	Natural Rubber	Neoprene Rubber	Nitrile	Vinyl
Methyl Cellosolve	F	E	--	P
MethylChloride^a	P	E	--	P
Methylethylketone	F	G	G	P
MethyleneChloride^a	F	F	G	F
Monoethanolamine	F	E	--	E
Morpholine	F	E	--	E
Napthalene^a	G	G	E	G
NitricAcid(conc)	P	P	P	G
PerchloricAcid	F	G	F	E
Phenol	G	E	--	E
PhosphoricAcid	G	E	--	E
PotassiumHydroxide(sat)	G	G	G	E
ProplyleneDichloride^a	P	F	--	P
SodiumHydroxide	G	F	G	E
SodiumHypochlorite	G	P	F	G
SulfuricAcid(conc)	G	G	F	G
Toluene^a	P	F	G	F
Trichloroethylene^a	P	F	G	F
TricresylPhosphate	P	F	--	F
Triethanolamine	F	E	E	E
Trinitrotoluene	P	E	--	P

E = excellent G = Good F = Fair P = Poor

^a Aromatic and halogenated hydrocarbons will attack all types of natural and synthetic glovematerials. Should swelling occur, the user should change to fresh gloves and allow the swollen gloves to dry and return to normal.

^b No data on the resistance to dimethyl sulfoxide of natural rubber neoprene, nitrile rubber, or vinyl materials are available; the manufacturer of the substance recommends the use of butyl rubber gloves.

APPENDIX B: CHEMICAL HYGIENE PERMIT

THE UNIVERSITY of NORTH CAROLINA GREENSBORO

Chemical Hygiene Permit

Date(s):	Time:	Location:
Personnel Affected:		
Description of Activities Requiring Permit:		

Potential Hazards and Required Controls

Safety Hazards: Precautions	Y	N	NA	Health Hazards: Precautions	Y	N	NA	Fire Hazards: Precautions	Y	N	NA
Provide guards				Possible Oxygen Deficiency				Fire Extinguishers			
Personal protective equip.				Special Ventilation				Open flame permit			
Special safety training				Toxic materials				Explosion protection			
Special safety procedures				Personal Protective Equip.				Remove combustibles			
Lockouts required				Special rescue procedures				Test atmosphere			
Unattended operation				Lockouts required				Emergency Egress			
Work alone				Exceed PELs				Pyrophorics			
Sole Occupancy								Unattended operation			
Special Considerations:				Special considerations:				Special considerations:			

Additional Comments:		
Approval of Supervisor:	Name:	Date:

APPENDIX C: CHEMICALS REQUIRING INITIAL MONITORING

THE UNIVERSITY of NORTH CAROLINA GREENSBORO	**List of Chemicals Requiring Initial Monitoring**	Page 1 of 1

If your lab uses any of the following chemicals, initial monitoring is required. Contact the UNCG office of Safety for more information.

Acrylonitrile
Arsenic (Inorganic)
Asbestos
Benzene
Cadmium
Chromium (Inorganic)
Creosote
Crystalline Silica
1, 2 Dibromo- 3- chloropropane
Isocyanates
Ethylene Oxide
Formaldehyde
Lead
Mercury (Inorganic)
4,4'-Methylene bis (2-chloroaniline)
Methylene Dianiline
Methylene Chloride
Vinyl Chloride

APPENDIX D: DEPARTMENT OF HOMELAND SECURITY CHEMICALS OF INTEREST

Department of Homeland Security Chemicals of Interest

Chemical	Synonym	CAS#
Acetaldehyde		75-07-0
Acetone cyanohydrin, stabilized		75-86-5
Acetyl bromide		506-96-7
Acetyl chloride		75-36-5
Acetyl iodide		507-02-8
Acetylene	[Ethyne]	74-86-2
Acrolein	[2-Propenal] or Acrylaldehyde	107-02-8
Acrylonitrile	[2-Propenenitrile]	107-13-1
Acrylyl chloride	[2-Propenoyl chloride]	814-68-6
Allyl alcohol	[2-Propen-1-ol]	107-18-6
Allylamine	[2-Propen-1-amine]	107-11-9
Allyltrichlorosilane, stabilized		107-37-9
Aluminum (powder)		7429-90-5
Aluminum bromide, anhydrous		7727-15-3
Aluminum chloride, anhydrous		7446-70-0
Aluminum phosphide		20859-73-8
Ammonia (anhydrous)		7664-41-7
Ammonia (conc. 20% or greater)		7664-41-7
Ammonium nitrate, [with more than 0.2 percent combustible substances, including any organic substance calculated as carbon, to the exclusion of any other added substance]		6484-52-2
Ammonium nitrate, solid [nitrogen concentration of 23% nitrogen or greater]		6484-52-2
Ammonium perchlorate		7790-98-9
Ammonium picrate		131-74-8
Amyltrichlorosilane		107-72-2
Antimony pentafluoride		7783-70-2
Arsenic trichloride	[Arsenous trichloride]	7784-34-1
Arsine		7784-42-1
Barium azide		18810-58-7
1,4-Bis(2-chloroethylthio)-n-butane		142868-93-7
Bis(2-chloroethylthio)methane		63869-13-6
Bis(2-chloroethylthiomethyl)ether		63918-90-1
1,5-Bis(2-chloroethylthio)-n-pentane		142868-94-8
1,3-Bis(2-chloroethylthio)-n-propane		63905-10-2
Boron tribromide		10294-33-4
Boron trichloride	[Borane, trichloro]	10294-34-5
Boron trifluoride	[Borane, trifluoro]	7637-07-2
Boron trifluoride compound with methyl ether(1:1)	[Boron, trifluoro [oxybis (methane)],T-4-]	353-42-4
Bromine		7726-95-6
Bromine chloride		13863-41-7
Bromine pentafluoride		7789-30-2
Bromine trifluoride		7787-71-5
Bromotrifluorethylene	[Ethene, bromotrifluoro-]	598-73-2
1,3-Butadiene		106-99-0

Butane		106-97-8
Butene		25167-67-3
1-Butene		106-98-9
2-Butene		107-01-7
2-Butene-cis		590-18-1
2-Butene-trans	[2-Butene, (E)]	624-64-6
Butyltrichlorosilane		7521-80-4
Calcium hydrosulfite	[Calcium dithionite]	15512-36-4
Calcium phosphide		1305-99-3
Carbon disulfide		75-15-0
Carbon oxysulfide	[Carbon oxide sulfide (COS); carbonyl sulfide]	463-58-1
Carbonyl fluoride		353-50-4
Carbonyl sulfide		463-58-1
Chlorine		7782-50-5
Chlorine dioxide	[Chlorine oxide, (ClO2)]	10049-04-4
Chlorine monoxide	[Chlorine oxide]	7791-21-1
Chlorine pentafluoride		13637-63-3
Chlorine trifluoride		7790-91-2
Chloroacetyl chloride		79-04-9
2-Chloroethylchloro-methylsulfide		2625-76-5
Chloroform	[Methane, trichloro-]	67-66-3
Chloromethyl ether	[Methane, oxybis(chloro-)]	542-88-1
Chloromethyl methyl ether	[Methane, chloromethoxy-]	107-30-2
1-Chloropropylene	[1-Propene, 1-chloro-]	590-21-6
2-Chloropropylene	[1-Propene, 2-chloro-]	557-98-2
Chlorosarin	[o-Isopropyl methylphosphonochloridate]	1445-76-7
Chlorosoman	[o-Pinacolyl methylphosphonochloridate]	7040-57-5
Chlorosulfonic acid		7790-94-5
Chromium oxychloride		14977-61-8
Crotonaldehyde	[2-Butenal]	4170-30-3
Crotonaldehyde, (E)-	[2-Butenal], (E)-]	123-73-9
Cyanogen	[Ethanedinitrile]	460-19-5
Cyanogen chloride		506-77-4
Cyclohexylamine	[Cyclohexanamine]	108-91-8
Cyclohexyltrichlorosilane		98-12-4
Cyclopropane		75-19-4
DF	Methyl phosphonyl difluoride	676-99-3
Diazodinitrophenol		87-31-0
Diborane		19287-45-7
Dichlorosilane	[Silane, dichloro-]	4109-96-0
N,N-(2-diethylamino)ethanethiol		100-38-9
Diethyldichlorosilane		1719-53-5
o,o-Diethyl S-[2-(diethylamino)ethyl] phosphorothiolate		78-53-5
Diethyleneglycol dinitrate		693-21-0
Diethyl methylphosphonite		15715-41-0
N,N-Diethyl phosphoramidic dichloride		1498-54-0
N,N-(2-diisopropylamino)ethanethiol	N,N-diisopropyl-(beta)-aminoethane thiol	5842-07-9
Difluoroethane	[Ethane, 1,1-difluoro-]	75-37-6
N,N-Diisopropyl phosphoramidic dichloride		23306-80-1

1,1-Dimethylhydrazine	[Hydrazine, 1, 1-dimethyl-]	57-14-7
Dimethylamine	[Methanamine, N-methyl-]	124-40-3
N,N-(2-dimethylamino)ethanethiol		108-02-1
Dimethyldichlorosilane	[Silane, dichlorodimethyl-]	75-78-5
N,N-Dimethyl phosphoramidic dichloride	[Dimethylphosphoramido-dichloridate]	677-43-0
2,2-Dimethylpropane	[Propane, 2,2-dimethyl-]	463-82-1
Dingu	[Dinitroglycoluril]	55510-04-8
Dinitrogen tetroxide		10544-72-6
Dinitrophenol		25550-58-7
Dinitroresorcinol		519-44-8
Diphenyldichlorosilane		80-10-4
Dipicryl sulfide		2217-06-3
Dipicrylamine [or] Hexyl	[Hexanitrodiphenylamine]	131-73-7
N,N-(2-dipropylamino)ethanethiol		5842-06-8
N,N-Dipropyl phosphoramidic dichloride		40881-98-9
Dodecyltrichlorosilane		4484-72-4
Epichlorohydrin	[Oxirane, (chloromethyl)-]	106-89-8
Ethane		74-84-0
Ethyl acetylene	[1-Butyne]	107-00-6
Ethyl chloride	[Ethane, chloro-]	75-00-3
Ethyl ether	[Ethane, 1,1-oxybis-]	60-29-7
Ethyl mercaptan	[Ethanethiol]	75-08-1
Ethyl nitrite	[Nitrous acid, ethyl ester]	109-95-5
Ethyl phosphonyl difluoride		753-98-0
Ethylamine	[Ethanamine]	75-04-7
Ethyldiethanolamine		139-87-7
Ethylene	[Ethene]	74-85-1
Ethylene oxide	[Oxirane]	75-21-8
Ethylenediamine	[1,2-Ethanediamine]	107-15-3
Ethyleneimine	[Aziridine]	151-56-4
Ethylphosphonothioic dichloride		993-43-1
Ethyltrichlorosilane		115-21-9
Fluorine		7782-41-4
Fluorosulfonic acid		7789-21-1
Formaldehyde (solution)		50-00-0
Furan		110-00-9
Germane		7782-65-2
Germanium tetrafluoride		7783-58-6
Guanyl nitrosaminoguanylidene hydrazine		
Hexaethyl tetraphosphate and compressed gas mixtures		757-58-4
Hexafluoroacetone		684-16-2
Hexanitrostilbene		20062-22-0
Hexolite	[Hexotol]	121-82-4
Hexyltrichlorosilane		928-65-4
HMX	[Cyclotetramethylene-tetranitramine]	2691-41-0
HN1 (nitrogen mustard-1)	[Bis(2-chloroethyl)ethylamine]	538-07-8
HN2 (nitrogen mustard-2)	[Bis(2-chloroethyl)methylamine]	51-75-2
HN3 (nitrogen mustard-3)	[Tris(2-chloroethyl)amine]	555-77-1
Hydrazine		302-01-2
Hydrochloric acid (conc. 37% or greater)		7647-01-0

Hydrocyanic acid		74-90-8
Hydrofluoric acid (conc. 50% or greater)		7664-39-3
Hydrogen		1333-74-0
Hydrogen bromide (anhydrous)		10035-10-6
Hydrogen chloride (anhydrous)		7647-01-0
Hydrogen cyanide	[Hydrocyanic acid]	74-90-8
Hydrogen fluoride (anhydrous)		7664-39-3
Hydrogen iodide, anhydrous		10034-85-2
Hydrogen peroxide (concentration of at least 35%)		7722-84-1
Hydrogen selenide		7783-07-5
Hydrogen sulfide		7783-06-4
Iodine pentafluoride		7783-66-6
Iron, pentacarbonyl-	[Iron carbonyl (Fe (CO)5), (TB5-11)-]	13463-40-6
Isobutane	[Propane, 2-methyl]	75-28-5
Isobutyronitrile	[Propanenitrile, 2-methyl-]	78-82-0
Isopentane	[Butane, 2-methyl-]	78-78-4
Isoprene	[1,3-Butadiene, 2-methyl-]	78-79-5
Isopropyl chloride	[Propane, 2-chloro-]	75-29-6
Isopropyl chloroformate	[Carbonochloridic acid, 1-methylethyl ester]	108-23-6
Isopropylamine	[2-Propanamine]	75-31-0
Isopropylphosphonothioic dichloride		1498-60-8
Isopropylphosphonyl difluoride		677-42-9
Lead azide		13424-46-9
Lead styphnate	[Lead trinitroresorcinate]	15245-44-0
Lewisite 1	[2-Chlorovinyldichloroarsine]	541-25-3
Lewisite 2	[Bis(2-chlorovinyl)chloroarsine]	40334-69-8
Lewisite 3	[Tris(2-chlorovinyl)arsine]	40334-70-1
Lithium amide		7782-89-0
Lithium nitride		26134-62-3
Magnesium (powder)		7439-95-4
Magnesium diamide		7803-54-5
Magnesium phosphide		12057-74-8
MDEA	[Methyldiethanolamine]	105-59-9
Mercury fulminate		628-86-4
Methacrylonitrile	[2-Propenenitrile, 2-methyl-]	126-98-7
Methane		74-82-8
2-Methyl-1-butene		563-46-2
3-Methyl-1-butene		563-45-1
Methyl chloride	[Methane, chloro-]	74-87-3
Methyl chloroformate	[Carbonochloridic acid, methyl ester]	79-22-1
Methyl ether	[Methane, oxybis-]	115-10-6
Methyl formate	[Formic acid Methyl ester]	107-31-3
Methyl hydrazine	[Hydrazine, methyl-]	60-34-4
Methyl isocyanate	[Methane, isocyanato-]	624-83-9
Methyl mercaptan	[Methanethiol]	74-93-1
Methyl thiocyanate	[Thiocyanic acid, methyl ester]	556-64-9
Methylamine	[Methanamine]	74-89-5
Methylchlorosilane		993-00-0
Methyldichlorosilane		75-54-7
Methylphenyldichlorosilane		149-74-6

Methylphosphonothioic dichloride		676-98-2
2-Methylpropene	[1-Propene, 2-methyl-]	115-11-7
Methyltrichlorosilane	[Silane, trichloromethyl-]	75-79-6
Sulfur mustard (Mustard gas (H))	[Bis(2-chloroethyl)sulfide]	505-60-2
O-Mustard (T)	[Bis(2-chloroethylthioethyl)ether]	63918-89-8
Nickel Carbonyl		13463-39-3
Nitric acid		7697-37-2
Nitric oxide	[Nitrogen oxide (NO)]	10102-43-9
Nitrobenzene		98-95-3
5-Nitrobenzotriazol		2338-12-7
Nitrocellulose		9004-70-0
Nitrogen mustard hydrochloride	[Bis(2-chloroethyl)methylamine hydrochloride]	55-86-7
Nitrogen trioxide		10544-73-7
Nitroglycerine		55-63-0
Nitromannite	[Mannitol hexanitrate, wetted]	15825-70-4
Nitromethane		75-52-5
Nitrostarch		9056-38-6
Nitrosyl chloride		2696-92-6
Nitrotriazolone		932-64-9
Nonyltrichlorosilane		5283-67-0
Octadecyltrichlorosilane		112-04-9
Octolite		57607-37-1
Octonal		78413-87-3
Octyltrichlorosilane		5283-66-9
Oleum (Fuming Sulfuric acid)	[Sulfuric acid, mixture with sulfur trioxide]	8014-95-7
Oxygen difluoride		7783-41-7
1,3-Pentadiene		504-60-9
Pentane		109-66-0
1- Pentene		109-67-1
2-Pentene, (E)-		646-04-8
2-Pentene, (Z)-		627-20-3
Pentolite		8066-33-9
Peracetic acid	[Ethaneperoxic acid]	79-21-0
Perchloromethylmercaptan	[Methanesulfenyl chloride, trichloro-]	594-42-3
Perchloryl fluoride		7616-94-6
PETN	[Pentaerythritol tetranitrate]	78-11-5
Phenyltrichlorosilane		98-13-5
Phosgene	[Carbonic dichloride] or [carbonyldichloride]	75-44-5
Phosphine		7803-51-2
Phosphorus		7723-14-0
Phosphorus oxychloride	[Phosphoryl chloride]	10025-87-3
Phosphorus pentabromide		7789-69-7
Phosphorus pentachloride		10026-13-8
Phosphorus pentasulfide		1314-80-3
Phosphorus trichloride		7719-12-2
Picrite	[Nitroguanidine]	556-88-7
Piperidine		110-89-4
Potassium chlorate		3811-04-9

Potassium cyanide		151-50-8
Potassium nitrate		7757-79-1
Potassium perchlorate		7778-74-7
Potassium permanganate		7722-64-7
Potassium phosphide		20770-41-6
Propadiene	[1,2-Propadiene]	463-49-0
Propane		74-98-6
Propionitrile	[Propanenitrile]	107-12-0
Propyl chloroformate	[Carbonchloridic acid, propylester]	109-61-5
Propylene	[1-Propene]	115-07-1
Propylene oxide	[Oxirane, methyl-]	75-56-9
Propyleneimine	[Aziridine, 2-methyl-]	75-55-8
Propylphosphonothioic dichloride		2524-01-8
Propylphosphonyl difluoride		690-14-2
Propyltrichlorosilane		141-57-1
Propyne	[1-Propyne]	74-99-7
QL	[o-Ethyl-o-2-diisopropylaminoethyl methylphosphonite]	57856-11-8
RDX	[Cyclotrimethylenetrinitramine]	121-82-4
RDX and HMX mixtures		121-82-4
Sarin	[o-Isopropyl methylphosphonofluoridate]	107-44-8
Selenium hexafluoride		7783-79-1
Sesquimustard	[1,2-Bis(2-chloroethylthio)ethane]	3563-36-8
Silane		7803-62-5
Silicon tetrachloride		10026-04-7
Silicon tetrafluoride		7783-61-1
Sodium azide		26628-22-8
Sodium chlorate		7775-09-9
Sodium cyanide		143-33-9
Sodium hydrosulfite	[Sodium dithionite]	7775-14-6
Sodium nitrate		7631-99-4
Sodium phosphide		12058-85-4
Soman	[o-Pinacolyl methylphosphonofluoridate]	96-64-0
Stibine		7803-52-3
Strontium phosphide		12504-16-4
Sulfur dioxide (anhydrous)		7446-09-5
Sulfur tetrafluoride	[Sulfur fluoride (SF4), (T-4)-]	7783-60-0
Sulfur trioxide		7446-11-9
Sulfuryl chloride		7791-25-5
Tabun	[o-Ethyl-N,N-dimethylphosphoramido-cyanidate]	77-81-6
Tellurium hexafluoride		7783-80-4
Tetrafluoroethylene	[Ethene, tetrafluoro-]	116-14-3
Tetramethyllead	[Plumbane, tetramethyl-]	75-74-1
Tetramethylsilane	[Silane, tetramethyl-]	75-76-3
Tetranitroaniline		53014-37-2
Tetranitromethane	[Methane, tetranitro-]	509-14-8
Tetrazene	[Guanyl nitrosaminoguanyltetrazene]	109-27-3
1H-Tetrazole		288-94-8
Thiodiglycol	[Bis(2-hydroxyethyl)sulfide]	111-48-8
Thionyl chloride		7719-09-7

Titanium tetrachloride	[Titanium chloride (TiCl4) (T-4)-]	7550-45-0
TNT	[Trinitrotoluene]	118-96-7
Torpex	[Hexotonal]	67713-16-0
Trichlorosilane	[Silane, trichloro-]	10025-78-2
Triethanolamine		102-71-6
Triethanolamine hydrochloride		637-39-8
Triethyl phosphite		122-52-1
Trifluoroacetyl chloride		354-32-5
Trifluorochloroethylene	[Ethene, chlorotrifluoro]	79-38-9
Trimethylamine	[Methanamine, N,N-dimethyl-]	75-50-3
Trimethylchlorosilane	[Silane, chlorotrimethyl-]	75-77-4
Trimethyl phosphite		121-45-9
Trinitroaniline		26952-42-1
Trinitroanisole		606-35-9
Trinitrobenzene		99-35-4
Trinitrobenzenesulfonic acid		2508-19-2
Trinitrobenzoic acid		129-66-8
Trinitrochlorobenzene		88-88-0
Trinitrofluorenone		129-79-3
Trinitro-meta-cresol		602-99-3
Trinitronaphthalene		55810-17-8
Trinitrophenetole		4732-14-3
Trinitrophenol		88-89-1
Trinitroresorcinol		82-71-3
Tritonal		54413-15-9
Tungsten hexafluoride		7783-82-6
Vinyl acetate monomer	[Acetic acid ethenyl ester]	108-05-4
Vinyl acetylene	[1-Buten-3-yne]	689-97-4
Vinyl chloride	[Ethene, chloro-]	75-01-4
Vinyl ethyl ether	[Ethene, ethoxy-]	109-92-2
Vinyl fluoride	[Ethene, fluoro-]	75-02-5
Vinyl methyl ether	[Ethene, methoxy-]	107-25-5
Vinylidene chloride	[Ethene, 1,1-dichloro-]	75-35-4
Vinylidene fluoride	[Ethene, 1,1-difluoro-]	75-38-7
Vinyltrichlorosilane		75-94-5
VX	[o-Ethyl-S-2-diisopropylaminoethyl methyl phosphonothiolate]	50782-69-9
Zinc hydrosulfite	[Zinc dithionite]	7779-86-4