# Chemical Hygiene Plan

UNC Greensboro

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# 1. 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 May 1, 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 and evaluated for effectiveness, at least annually, and updated as necessary 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.

# 2. 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 changes occur in the laboratory personnel or hazards.

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.

# 3. Chemical Hygiene Responsibilities

## 3.1 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 use, storage, and disposal of chemicals at the University;
- 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 safety inspections;
- Maintain current knowledge concerning the legal requirements of regulated substances at the University;
- Review the Chemical Hygiene Program on an annual basis.

## 3.2 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, Lab Waste Management Plan, and other applicable UNCG policies;
- Maintain an accurate Laboratory Safety Plan (LSP);
- Plan each laboratory operation in accordance with the CHP and other applicable UNCG policies;
- 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;

- Determine that facilities and training levels are adequate for the chemicals in use;
- Ensure that appropriate training has been provided to lab workers;
- Ensure that lab facilities and equipment are maintained in good working condition.

### 3.3 Laboratory Workers

The laboratory workers are individually responsible for:

- Reading and understanding the applicable safety rules and procedures in their Lab Safety Plan (LSP) and Lab SOP's;
- 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.

## 4. 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 aid researchers in the development of necessary policies and procedures, as required by the OSHA Laboratory Standard.

Each Principal Investigator's (PI's) laboratory will be inspected annually. 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 immediately or lab operations suspended, as necessary, to mitigate

the hazard until the condition is corrected. 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 (may be accelerated for items posing an immediate safety risk):

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.

## 5. 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. General laboratory safety training can be completed through universal department or University training programs. Lab-specific training topics must be presented by the principal investigator or a senior laboratory supervisor.

Training shall include:

**General Laboratory Safety** (may be fulfilled by universal safety training):

- Location of UNCG Chemical Hygiene Plan and OSHA Laboratory Standard
- Hazard Communication Program Information (signs, labels, symbols)
- Storage, use, and disposal procedures for general chemical classifications
- Physical hazards and signs/symptoms of exposure to general chemical classifications
- Precautions to mitigate hazard exposure
- Response to spills, incidents, and emergencies
- Security considerations

**Lab-Specific Topics** (presented by PI or Lab Supervisor):

- Location and contents of the Lab Safety Plan and Lab SOP's
- Location of Chemical Inventory & Safety Data Sheets (SDS)

- Identify high hazard and restricted materials, equipment, or areas of the lab
- Information on particularly hazardous substances. Specify personnel and materials (Select Carcinogens, Reproductive Toxins, High Acute Toxicity, Nanomaterials, etc.)

Documentation of departmental safety training sessions shall be maintained by the department and a copy forwarded to the EH&S Department. Lab-specific training provided by the PI or supervisor shall be documented on the form in Appendix B or the equivalent and maintained in the Lab Safety Plan binder.

# 6. Hazard Communication

## 6.1 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 hazard classes present. Location signs for safety and emergency equipment shall be posted inconspicuously.

## 6.2 Labeling

All containers in the laboratory shall be labeled. Labels shall include, at a minimum, the full product or chemical name(s) and the associated hazards. Hazards can be identified by words, GHS pictograms, or NFPA labels.

- Portable containers shall be labeled by the individual using the container.
- Exemptions for labeling requirements shall be made for chemical transfers from a labeled container to a secondary container, which will be attended by the person that performed the transfer and depleted by the end of their work shift.
- The labeling program shall be periodically inspected by laboratory personnel to ensure that labels are accurate and legible.

## 6.3 Inventory

A list of all chemicals present in the workplace must be readily accessible to personnel at all times, in paper or electronic form. To ensure University compliance with regulatory reporting requirements, a current chemical inventory must be submitted to EHS at least annually, or within 30 days of acquiring new or additional quantities of DHS Chemicals of Interest (Appendix E).

## 6.4 Safety Data Sheets

Safety Data Sheets (SDS) for all chemicals 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

# 7. General Laboratory Safety Precautions

## 7.1 Personal Work Practices

- 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.
- 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.
- 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.
- Inspect personal protective equipment prior to use. Wear appropriate protective equipment as procedures dictate and when necessary to avoid exposure.
- Avoid unnecessary exposure to all chemicals by any route.
- Do not smell or taste any chemicals.
- Understand and use engineering controls appropriately.
- Only use chemicals which are compatible with the ventilation system.

## 7.2 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 workday 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 glass apparatus under pressure or vacuum shall be shielded to contain chemicals and glass fragments should explosion or implosion occur.
- All laboratory equipment shall be inspected on a periodic basis and replaced or repaired, as necessary.

### 7.3 Housekeeping

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

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

- All spills shall be immediately cleaned, including spills and splatter on waste containers, secondary containment devices, and on or within lab equipment. 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 the UNCG Lab Waste Management Plan.

## 8. Personal Protective Equipment

- Safety **GLASSES** meeting ANSI Z87.1 are required for all persons in a laboratory and must be worn at all times when a splash hazard is present.
- Safety **GOGGLES** and/or a full-face shield shall be worn when working with concentrated corrosives and when there is a hazard from large splashes or flying particles,

for example, when transferring large quantities of chemicals or working with glassware under pressure or vacuum.

- Sandals, perforated shoes, and bare feet are prohibited. Safety shoes, per ANSI 47 are required where employees routinely lift heavy objects.
- Short pants may not be worn when working with hazardous materials in a laboratory.
- Appropriate chemical-resistant **GLOVES** based on the table in Appendix A shall be worn at all times when handling corrosive or otherwise hazardous materials and chemicals of unknown toxicity. 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, and 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.
- **LAB COATS** are strongly encouraged when working with any hazardous material, and required when working with highly hazardous materials, unsealed radioactive materials, or biological materials requiring BSL-2 containment. Lab coats shall be laundered on a periodic basis and removed from services immediately upon discovery of significant contamination. Monthly laundering is recommended, when appropriate, with consideration for the impact of frequent laundering on the integrity of the lab coat and fire protective qualities.

**Lab Coat Fire Resistance**

**Nomex -** Highly fire-resistant because the fabric thickens, carbonizes, and remains intact under fire conditions. Used widely in occupations where fire is a real hazard and can be laundered without losing fire-resistant properties.

**Fire-Resistant Cotton -** Cotton coats are available that are treated with a fire-resistant material. Fire-resistance may dissipate after repeated laundering.

**100% Cotton -** Superior to synthetic blends for fire-resistance, but inferior to Nomex and fire-resistant cotton.

**Synthetic/Cotton Blends -** 100% polyester coats, or cotton/polyester blends are the most combustible and are not considered appropriate for working with flammables.

# 9. Chemical Storage and Use

## 9.1 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. A risk assessment and implementation of required risk mitigation equipment must be completed prior to the procurement of the chemical. Chemicals utilized in the laboratory shall be compatible with related lab facilities, such as storage cabinets and ventilation systems. Personnel who receive chemical shipments shall be knowledgeable of the proper procedures for receipt.

## 9.2 Chemical Handling

Each laboratory employee shall be trained and provided the resources by their supervisor to 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.
- Immediately wash any areas of contaminated skin.
- 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 is prohibited. Hands shall be thoroughly washed prior to performing these activities.
- Storage or handling of food or beverages shall not occur in storage areas or refrigerators also used for laboratory materials or operations.
- Any chemical mixture shall be assumed to be as hazardous as its most hazardous component.
- Substances of unknown toxicity shall be assumed to be toxic.
- Laboratory employees shall be familiar with the symptoms of exposure for the chemicals with which they work and the precautions necessary to prevent exposure.
- In all cases of chemical 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.
- Understand and use engineering controls appropriately.
- Implement and adhere to special precautions for particularly hazardous materials, as described in the Highly Hazardous Materials section of this plan.

## 9.3 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.
- Storage areas shall not be used as a preparation or repackaging area.
- Chemicals transported outside of laboratory areas shall be placed in a secondary container, such as a bottle jockey, bucket, or cart capable of containing a spill.
- 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 storage shall not be exposed to sunlight or heat.
- Stored chemicals shall be examined periodically, at least annually, by the Principal Investigator or supervisor for expiration, chemical deterioration or stability, and container integrity. The inspection should also determine whether any corrosion, deterioration, or damage has occurred to the storage facility, including shelf hardware, as a result of leaking chemicals or vapors.

## 9.4 Compressed Gas

Cylinders must be stored in an upright position and secured to a wall or laboratory bench using chains or straps. Cylinder caps must remain on the cylinder at all times unless a regulator is in place. Cylinders must be stored in areas where they will not become overheated. Avoid storage near radiators, areas in direct sunlight, steam pipes and heat releasing equipment such as sterilizers. Transport compressed gas cylinders on equipment designed for this function. Never carry or "walk" cylinders by hand.

Hazard assessment for work with compressed gases should assure that all staff understands proper use and handling precautions; that all pressurized equipment is properly shielded; regulators are not interchanged between different gas types; all hose connections are properly secured and are appropriate for the pressure(s) used.

**Engineering/Ventilation Controls:** Manipulation of compressed gases should typically be carried out in a fume hood if the compressed gas is an irritant, oxidizer, asphyxiant, or has other hazardous properties.

**PPE:** Eye protection in the form of safety glasses or goggles must be worn at all times when handling compressed gases.

**Emergency Procedures:** In the event of a release of a compressed gas that is an irritant, oxidizer, asphyxiant, or has other hazardous properties, all personnel in the area should be alerted. Vacate the laboratory immediately and call the UNCG Police 336-334-4444 to alert the fire department.

# 10. High Hazard & Regulated Materials

Some substances used in the laboratory pose a higher risk to health and safety and require additional precautions, monitoring, or reporting.

## 10.1 Particularly Hazardous Substances

OSHA defines particularly hazardous substances as select carcinogens, reproductive toxins, and substances which have a high degree of acute toxicity. Particularly hazardous substances require additional planning and precautions, detailed in written standard operating procedures (SOP). The SOP shall include provisions to limit exposure and contamination of personnel and equipment through appropriate containment, personal protective equipment, decontamination procedures, and waste collection. The safety provisions shall be documented using the SOP templates in Appendices C - D or otherwise incorporated into the written lab procedures or Lab Safety Plan.

### Select Carcinogens

OSHA defines select carcinogens as chemicals:

- Regulated by OSHA as a carcinogen; or
- Listed as “known to be a human carcinogen” in the latest edition of the 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 $LD_{50}$ for albino rats of <50 mg/kg; or
- Topical $LD_{50}$ for albino rabbits of <200 mg/kg; or
- Inhalation $LC_{50}$ in albino rats of <200 ppm or 2 mg/L for one hour.

**Working with Particularly Hazardous Substances:**

- 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.
- All storage, transfer and work with these substances shall be in a designated area (cabinet, hood, glove box, benchtop) of a restricted access lab room.
- The designated area(s) will be marked with warning and restricted access signs.
- Containers will be stored in a ventilated, limited access area in labeled, unbreakable, chemically resistant, secondary containment.
- 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 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 shall not be worn outside of the lab and must be decontaminated prior to laundering.

- Hands and arms will be washed immediately after working with these chemicals.
- The PI or supervisor, and EH&S will be notified of spills and other exposure incidents. A physician will be consulted when appropriate.
- 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.
- Women of child-bearing age shall only handle embryotoxins in a fume hood.
- Two people will always be present during work with these chemicals.

**Working with Animals and Chemicals of High Toxicity (Special Precautions)**

- 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 long 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.

## 10.2 Organic Compounds that form Hazardous Peroxides

Some organic compounds can form peroxides during storage, which can then violently explode when exposed to shock, friction, or heat. Purchases of peroxide forming chemicals (PFCs) should be limited to quantities that will be used before peroxides are likely to form. Peroxidizable chemicals are segregated into three classes based on the condition in which peroxides may form. The lists below may not account for all PFCs and the listed chemicals may not pose a hazard in all conditions. Researchers should consider the chemical and physical properties when evaluating the stability of the chemicals stored in the lab.

**Class A:** Chemicals that form explosive levels of peroxides without concentration.

| | | |
|---|---|---|
| Isopropyl ether | Potassium amide | Tetrafluoroethylene[a] (liq.) |
| Butadiene[a] (liquid) | Potassium metal | Divinyl acetylene |
| Chloroprene[a] (liquid) | Sodium amide (sodamide) | Vinylidene chloride |

**Class B:** Chemicals that are a peroxide hazard on concentration (distillation/evaporation). A test for peroxide should be performed if concentration is intended or suspected.

| | | |
|---|---|---|
| 1,1-diethoxyethane | Diethyl ether | Methyl isobutyl ketone |
| Acetaldehyde | Diethylene glycol dimethyl | 4-Methyl-2-pentanol |
| Benzyl alcohol | ether (diglyme) | 2-Pentanol |
| 2-Butanol | Dioxane | 4-Penten-1-ol |
| Cumene | Ethylene glycol dimethyl | 1-Phenylethanol |
| Cyclohexanol | ether (glyme) | 2-Phenylethanol |
| 2-Cyclohexen-1-ol | 4-Heptanol | 2-Propanol |
| Cyclohexene | 2-Hexanol | Tetrahydrofuran |
| Decahydronaphthalene | Methylacetylene | Tetrahydronaphthalene |
| Diacetylene | 3-Methyl-1-butanol | Vinyl ethers |
| Dicyclopentadiene | Methylcyclopentane | Other Secondary Alcohols |

**Class C:** Unsaturated monomers that may autopolymerize as a result of peroxide accumulation if inhibitors have been removed or depleted.

| | | |
|---|---|---|
| Acrylic acid[b] | Methyl methacrylate[b] | Vinyl chloride |
| Acrylonitrile[b] | Styrene | Vinylpyridine |
| Butadiene[c] (gas) | Tetrafluoroethylene[c] (gas) | Vinylidene chloride |
| Chloroprene[c] (gas) | Vinyl acetate | |
| Chlorotrifluorethylene | Vinylacetylene | |

[a]When stored as a liquid monomer
[b]These chemicals form peroxides, but no explosions involving these monomers have been reported
[c]When stored as a gas, these chemicals may autopolymerize as a result of peroxide accumulation.

**Storage & Handling**

Careful consideration must be taken to the storage conditions and shelf life of Peroxide Forming Chemicals (PFC). The rate of peroxide formation can be increased by exposure to oxygen, light, and heat. The presence of contaminants, particularly heavy metals, can accelerate the decomposition of organic peroxides, leading to increased pressure, fire, or explosion. Some commercially available PFCs contain auto-oxidation inhibitors to slow the rate of peroxide formation and extend the shelf life of the product.

Visible cloudiness, discoloration, crystallization, precipitate, or an oily viscous layer are signs of dangerous peroxide levels and should be considered explosion hazards. Rust on metal containers also indicates an increased likelihood of peroxide formation. **Never open containers of peroxide formers of unknown age**, as older containers are more likely to have shock sensitive crystallization formed within the cap. Contact EH&S to safely remove containers from the lab if peroxide formation is suspected.

- Peroxidizable chemicals should generally be stored in air-impermeable containers of dark amber glass or compatible opaque material with tight sealing lids, preferably in the original manufacturer container.
- Store PFCs away from heat and light.

- **Label all PFCs with**
    - **"PEROXIDE FORMING CHEMICAL"**
    - **Date of receipt**
    - **Date opened**
    - **Expiration date**
    - **Test date and results, if appropriate**
- Inspect stored peroxide formers regularly, check for expired chemicals and signs of peroxide formation.

**Recommended Shelf Life (if not provided by manufacturer):**

| | **Unopened From Manufacturer** | **After Opening** |
|---|---|---|
| **Class A** | 18 months or manufacturer expiration date | 3 months |
| **Class B** | 18 months or manufacturer expiration date | 12 months |
| **Class C** | 18 months or manufacturer expiration date | 24 hours without inhibitor<br>12 months with inhibitor |

**Detection of Peroxides**

Testing for the presence of peroxides may be appropriate for peroxide forming chemicals stored longer than their recommended shelf-life or prior to distillation or evaporation procedures. Commercial test strips are easy to use and provide colorimetric results in a variety of concentration ranges, but have a limited shelf life. The ferrous thiocyanate and iodide testing methods are sensitive to hydroperoxides, but may not detect the presence of dialkyl peroxides, polyperoxides and cyclic peroxides.

100 ppm is considered a safe threshold of peroxide formation. While it is improbable that most solutions could be explosive just beyond this level, concentration of such solutions could present an explosion hazard. Consideration should be given to the Class of peroxide former regarding the stability of the material for general use, concentration, or continued storage. Furthermore, liquid present in the cap threads after pouring can evaporate, leaving peroxide crystals in the threads, whereby unscrewing the cap could initiate an explosion. Guidelines for safe levels of peroxide formation are shown in the table below.

| | |
|---|---|
| < 25 ppm, mg/L | Safe for use |
| 25 – 100 ppm, mg/L | May not be safe for distillation/concentration |
| > 100 ppm, mg/L | Unsafe for concentration, may not be safe for use or continued storage |

## 10.3 Nanomaterials

Nanomaterials are defined as materials with at least one external dimension in the nanoscale, between 1 and 100 nanometers. A nanofiber has two external dimensions in the nanoscale and a nanoparticle has all three dimensions in the nanoscale. Nanomaterials often exhibit unique properties that differ from their base material, due largely to their high surface to volume ratio and structure.

**Risk Assessment**

The rapid growth of nanotechnology has outpaced the study of the associated safety concerns, thus the potential health effects and safety hazards of nanomaterials are not well understood. To ensure the safety of the UNCG community, **researchers must conduct a risk assessment and document standard operating procedures (Appendix C) prior to use of any nanomaterials**.

Toxicity and Physical Hazards: As particle size decreases into the nanoscale, the biological reactivity can increase significantly, whereby normally inert materials may pose a health risk in the nanoscale. Thus, the chemical, structural, and size-dependent properties must all be considered when assessing the potential for toxicity or physical hazards.

Routes of Exposure: Inhalation is the primary route of concern because nanomaterials can reach and affect all areas of the lungs, penetrate into capillaries, and translocate to other organs. Studies have shown conflicting results with regard to skin penetration by nanomaterials. As such, the risk of absorption through the skin should be assessed for individual nanomaterials.

Use the template in Appendix C to conduct the risk assessment and document standard operating procedures for each nanomaterial to be used in the lab. To complete the risk assessment:

- Review the SDS of the specific nanomaterial (if available).
- Review the SDS of the base material.
- Consider the specific operations and manipulations to be performed.
- Consider reactivity with other chemicals to be used.
- Consider the potential routes of exposure.
- Consider the potential effect of nanoscale size on material properties such as toxicity, reactivity, and physical hazards.
- Assign the highest degree of hazards identified or anticipated from the risk assessment.
- Assign material use and handling precautions to minimize the potential hazards to lab personnel.

## 10.4 Chemicals Requiring Initial Monitoring

Chemicals and substances regulated as air contaminants (Appendix D) pose a high risk to health by inhalation. These substances should be handled in a chemical fume hood or glove box whenever possible. OSHA requires initial monitoring of airborne concentration in the worker's breathing zone if the chemical is handled outside a fume hood or glovebox AND there is reason to believe that exposure levels routinely exceed the action level or permissible exposure limit (PEL). Contact EH&S for help determining whether exposure monitoring is necessary and to arrange monitoring.

### 10.5 Department of Homeland Security Chemicals of Interest

The Department of Homeland Security requires any chemical facility, including Universities, to report threshold quantities of Chemicals of Interest (Appendix E). To ensure University compliance with regulatory reporting requirements, Principal Investigators shall submit a current inventory of all chemicals to EH&S at least annually, or within 30 days of acquiring new or additional quantities of DHS Chemicals of Interest.

### 10.6 Controlled Substances

Drugs and other substances that are considered controlled substances under the Controlled Substances Act (CSA) are divided into five schedules. An updated and complete list of the schedules is published annually in Title 21 Code of Federal Regulations 1308.11 through 1308.15. Substances are placed in their respective schedules based on whether they have a currently accepted medical use in treatment in the United States, their relative abuse potential, and likelihood of causing dependence when abused. Researchers acquiring these materials will be required to register with NC DHHS and obtain a DEA license. EHS will aid each Principal Investigator in obtaining his/her licenses for the purchase of controlled drugs if necessary.

For more information, see the Controlled Substance Policy available on the Laboratory Safety webpage https://safety.uncg.edu/resources/lab/.

## 11. Activities Requiring Prior Approval

Some laboratory activities and situations present an elevated risk to health and safety and may require prior approval and planning. These activities include off-hours work, sole occupancy of building, and unattended operations.

**Sole Occupancy and Off-hours Work:**

A prior authorization and emergency contact plan shall be implemented for laboratory work involving hazardous chemicals, procedures, or equipment, when the only person in the building is the lab worker. The Principal Investigator shall determine when an authorization and emergency plan are necessary, considering the hazards associated with the activity and the need for emergency assistance. The **emergency contact plan** for sole occupancy hazardous work shall designate a contact person for periodic check-ins during long operations and to whom the worker shall report the safe completion of the operation.

**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:

- Review of procedure – The PI or lab supervisor shall review the proposed operation procedures to minimize the risk and effects of an accident. Consideration shall be given to a potential interruption of utility service (loss of water pressure, electricity, etc.).

- An individual and backup shall be designated to terminate the process at the planned conclusion of the operation.
- A communication plan shall be implemented to confirm actions taken for processes requiring after-hours mediation or termination which, if not performed, would increase the risk of accident (fire, explosion, chemical release, etc.).
- A sign will be posted at all entrances to the laboratory, indicating an unattended operation is underway and identifying the names and phone numbers of persons familiar with the operation, to be contacted in an emergency.

**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, available in the University Policy Manual.

## 12. Emergency Equipment & Engineering Controls

### 12.1 Emergency Equipment:

**Fire Extinguishers**

Fire extinguishers appropriate for the materials present are supplied in or near all laboratories. Contact EH&S to confirm appropriate fire extinguisher and location, or to request training. Attempt to extinguish a fire only if you they are certain it is safe to do so.

**Emergency Showers and Eyewashes**

All employees who might be exposed to chemical splashes shall be instructed on the location and proper usage of emergency showers and eyewashes. The eyewash should be activated

weekly by laboratory personnel to ensure adequate flow of clean water. Monthly inspections are performed, where feasible, and documented internally by Facilities Operations.

## 12.2 Engineering Controls

Intent - The engineering controls installed in the laboratory are intended to minimize worker exposure to chemical and physical hazards. These controls must be maintained in proper working order for this goal to be realized. Equipment must be inspected regularly to ensure proper function.

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 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.

### Fume Hoods

Fume hoods shall be utilized for all chemical procedures which might result in release of hazardous chemical vapors or dust.

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 at a minimum of 65 and preferably less than 125 feet per minute, or as specified by the manufacturer. 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.

### 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.

### 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 Warms 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 and integrity 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.

## 13. Chemical Spills, Releases, and Incidents

In **EMERGENCY** situations requiring POLICE, FIRE DEPARTMENT, or AMBULANCE services, **CALL UNCG POLICE at 336-334-4444.**

In the event of a chemical spill, release or other accident, UNCG employees will adhere to the procedures outlined in the HazMat response procedures on the UNCG Emergency Management website http://emg.uncg.edu/.

Small spills (< 1 L) shall be cleaned immediately by laboratory personnel and/or the lab supervisor. EH&S HAZMAT Response personnel are available at any hour for consultation or assistance with spill clean-up. EH&S HAZMAT 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 HAZMAT 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.

### Reporting

Incident reports for large spills, releases, and incidents resulting in injury or exposure to personnel must be sent to the EH&S Department as soon as feasible. Personnel are also encouraged to report near misses and other concerns, which can be made anonymously. Reports can be submitted by:

- Calling EH&S at 336-334-4357
- E-mailing the Laboratory Safety Manager (staff directory at https://safety.uncg.edu/)
- Submitting a Spartan Safety Concern (link at https://safety.uncg.edu/)

## 14. Medical Consultations

### 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 a hazardous exposure, the employee will be provided an opportunity for medical consultation for the purpose of determining the need for medical examination.

### Seeking Medical Attention

For emergency medical services, call 336-334-4444.

For non-emergency medical attention, students and employees shall report to 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 336-334-4444.

**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.

## 15. 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 and 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.

### 15.1 Responsibilities

**Researcher**

- 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.
- 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.

## 15.2 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.

**Biological Materials**

- Treat and dispose of all biological waste according to UNCG Biological Safety Policy.
- Ensure that all biological material is adequately sealed and labeled prior to transport.
- Refrigerators, freezers, and other equipment used with biohazardous materials should be emptied and cleaned prior to transport.
- Disinfect all unwanted equipment potentially contaminated with biohazards, prior to transfer to surplus or another lab.
- Disinfect all lab surfaces potentially contaminated with biohazards, prior to departure.

**Radioactive Materials**

- Notify the Radiation Safety Officer of your intention to relocate or terminate authorization.
- Perform a thorough radiation contamination survey of equipment and laboratory surfaces. Decontaminate and repeat survey until all surfaces are free or removable contamination.

## 16. Recordkeeping

- Incident 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.
- 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.
- Upon the completion of training, records shall be forwarded to the EH&S Department for review and retention.

# Appendix A:  Glove Compatibility Table

THE UNIVERSITY of NORTH CAROLINA GREENSBORO

# Resistance To Chemicals of Common Glove Materials



| 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 |

| Chemical | Natural | Neoprene | Nitrile | Vinyl |
|---|---|---|---|---|
| Hydrochloric acid (conc) | G | G | G | E |
| Hydrofluoric Acid (30%) | G | G | G | E |
| Hydrogen peroxide | G | G | G | E |
| Iodine | G | G | -- | G |
| Methylamine | G | G | E | E |
| Methyl Cellosolve | F | E | -- | P |
| 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 glove materials. 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: Lab-Specific Training Form

# Lab-Specific Training

All lab members must be trained annually on the specific hazards present in their laboratory and the associated safety precautions. General laboratory safety training can be completed through universal department or university presentations. Lab-specific training topics must be presented by the principal investigator or a senior laboratory supervisor.

Training presented by the Principal Investigator (PI) or Lab Supervisor:

**General Laboratory Safety** (may be fulfilled by universal safety training):

- ☐ Location of UNCG Chemical Hygiene Plan (https://safety.uncg.edu/LaboratorySafety.html)
- ☐ Hazard Communication Program Information (signs, labels, symbols)
- ☐ Storage, use, and disposal procedures for general chemical classifications
- ☐ Physical hazards and signs/symptoms of exposure to general chemical classifications
- ☐ Precautions to mitigate hazard exposure
- ☐ Response to spills, incidents, and emergencies
- ☐ Security considerations

**Lab-Specific Topics** (presented by PI or Lab Supervisor):

- ☐ Location and contents of the Lab Safety Plan
- ☐ Location of Chemical Inventory & Safety Data Sheets (SDS)
- ☐ Identify high hazard and restricted materials, equipment, or areas of the lab
- ☐ Use of particularly hazardous substances. Specify personnel and materials (Select Carcinogens, Reproductive Toxins, High Acute Toxicity, Nanomaterials, etc.):

_____

_____

_____

_____

- ☐ Other lab hazards/procedures, specify: _____

_____

_____

_____

_____

*See next page for signatures of trainer and trainees*

## Lab-Specific Training

By signing below, I confirm that I have received training and understand the hazards and procedures checked on page 1.

| Name (Please print) | Signature | Date |
|---|---|---|
| | | |
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Trainer:

| | | |
|---|---|---|
| | | |

*PI / Lab Supervisor*

*File this form in your Laboratory Safety Plan binder to document training.*

# Appendix C:  SOP Template for Hazardous Materials or Procedures

**Standard Operating Procedure**

| | | |
|---|---|---|
| For work with: enter chemical name, category, or process | | |
| PI / Lab Director: | | Date: |
| Building & Room(s): | | |
| Chemical Name(s) | CAS # | Qty |
| | | |

Process Description (Describe the operations, quantities, concentrations, etc.)

Risk Assessment (list physical and health hazards and symptoms):

Designated Use Area(s):

Hazard Control:

Personal Protective Equipment (PPE):

Engineering Controls:

Administrative and Work Practice Controls:

**Special Handling / Storage Requirements:** Ex.: Always wash hands and arms immediately after working with these materials. Assure that at least 2 people are present at all times if a compound in use is highly toxic or of unknown toxicity. Store breakable containers of these substances in chemically resistant trays; also work and mount apparatus above such trays or cover work and storage surfaces with removable, absorbent, plastic backed paper.

Waste (describe waste collection and disposal procedures):

**Emergency Procedures:** personnel decontamination, when to seek medical attention, reporting to supervisor or EH&S, cleanup/decon for small or large spills, etc…

Step By Step Operating Procedure (if applicable):

All personnel working with these materials shall read and adhere to this SOP

# Appendix D: SOP Template for Select Carcinogens

**UNCG Laboratory Operating Procedures / Select Carcinogens**

**PI / Teaching Lab Coordinator:**
**Lab / Room #:**

**Process Description:** Storage and use of Select Carcinogens in the laboratory.

*(List substances here or reference location of high hazard inventory)*

**Risk Assessment: "**Carcinogen" commonly describes any agent that can induce cancer or increase its incidence. "**Select Carcinogens**" are regulated carcinogens known to pose a higher risk of cancer, per specific cancer inducing criteria set by OSHA, the National Toxicology Program, and the International Agency for Research on Cancer Monographs.

**Safety Equipment:**
**Engineering / Ventilation Controls:** Manipulation of carcinogens should be carried out in a fume hood. Manipulation of carcinogens outside of a fume hood may require special ventilation controls in order to minimize exposure to the material. Fume hoods provide the best protection against exposure to carcinogens in the laboratory and are the preferred ventilation control device. When possible, handle carcinogens in a fume hood. If the use of a fume hood proves impractical, attempt to work in a glove box or on an isolated area on the bench top.

**PPE:** LAB COAT, GLOVES, and SAFETY GLASSES must be worn at all times when handling select carcinogens. When the potential for splash hazard exists, safety goggles and/or face protection must also be worn. Check glove compatibility for best protection.

**Special Handling / Storage Requirements:** Select Carcinogens must be used in a DESIGNATED AREA, which should be a fume hood or specially ventilated area:

**DESIGNATED USE AREA**:_____

**Emergency Procedures:** Prepare for spills by having the appropriate clean up equipment on hand. The appropriate clean up supplies can be determined by consulting the material safety data sheet. This should occur prior to the use of any carcinogen. In the event of a spill, alert personnel in the area that a spill has occurred. Remove contaminated clothing and thoroughly rinse contaminated skin/eyes.

For large spills outside the fume hood, vacate the laboratory immediately, assess the inhalation risk to determine whether it is safe to enter the room or if respiratory protection or time for dissipation is needed. Call EHS (336)334-4357 for assistance. Call the UNCG Police 4-4444 if after-hours or for emergency services. Remain in area in safe location to restrict access to the area and assist with cleanup.

# Appendix E: SOP Template for Substances with High Acute Toxicity

**UNCG Laboratory Operating Procedures / <u>High Acute Toxicity</u>**

**PI / Teaching Lab Coordinator:**
**Lab / Room #:**

**Process Description:** Storage and use of substances with High Acute Toxicity in the laboratory.

*(List substances here or reference location of high hazard inventory)*

**Risk Assessment:** 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 $LD_{50}$ for albino rats of <50 mg/kg; or
- Topical $LD_{50}$ for albino rabbits of <200 mg/kg; or
- Inhalation $LC_{50}$ in albino rats of <200 ppm or 2 mg/L for one hour.

**Safety Equipment:**
**Engineering / Ventilation Controls:** Substances with a high acute toxicity should be handled in a fume hood. Manipulations outside of a fume hood may require special ventilation controls in order to minimize exposure to the material. Fume hoods provide the best protection against exposure to toxic substances in the laboratory and are the preferred ventilation control device. When possible, handle highly toxic substances in a fume hood. If the use of a fume hood proves impractical, attempt to work in a glove box or on an isolated area on the bench top.

**PPE:** LAB COAT, GLOVES, and SAFETY GLASSES must be worn at all times when handling highly toxic substances. When the potential for splash hazard exists, safety goggles and/or face protection must also be worn. Check glove compatibility for best protection.

**Special Handling / Storage Requirements:** Highly Toxic Substances must be used in a DESIGNATED AREA, which should be a fume hood or specially ventilated area:

**DESIGNATED USE AREA**:_____

**Emergency Procedures:** Prepare for spills by having the appropriate clean up equipment on hand. The appropriate clean up supplies can be determined by consulting the material safety data sheet. This should occur prior to the use of any substances with high acute toxicity. In the event of a spill, alert personnel in the area that a spill has occurred. Remove contaminated clothing and thoroughly rinse contaminated skin/eyes.

For large spills outside the fume hood, vacate the laboratory immediately, assess the inhalation risk to determine whether it is safe to enter the room or if respiratory protection or time for dissipation is needed. Call EHS (336)334-4357 for assistance. Call the UNCG Police 4-4444 if after-hours or for emergency services. Remain in area in safe location to restrict access to the area and assist with cleanup.

# Appendix F:  Chemicals Requiring Initial Monitoring

| Chemicals & Substances Requiring Initial Monitoring | |
|---|---|
| **Name** | **CAS#** |
| 4-Nitrobiphenyl | 92-93-3 |
| methyl chloromethyl ether | 107-30-2 |
| 3'-Dichlorobenzidine (and its salts) | 91-94-1 |
| bis-Chloromethyl ether | 542-88-1 |
| Alpha-Naphthylamine | 134-32-7 |
| beta-Naphthylamine | 91-59-8 |
| Benzidine | 92-87-5 |
| 4-Aminodiphenyl | 92-67-1 |
| Ethyleneimine | 151-56-4 |
| beta-Propiolactone | 57-57-8 |
| 2-Acetylaminofluorene | 53-96-3 |
| 4-Dimethylaminoazo-benzene | 60-11-7 |
| N-Nitrosodimethylamine | 62-75-9 |
| 1,2-dibromo-3-chloropropane | 96-12-8 |
| 1,3-Butadiene | 106-99-0 |
| Acrylonitrile | 107-13-1 |
| Benzene | 71-43-2 |
| Beryllium | 7440-41-7 |
| Cadmium | 7440-43-9 |
| Chromium (VI) | 18540-29-9 |
| Coke oven emissions | |
| Cotton dust | |
| Ethylene oxide | 75-21-8 |
| Formaldehyde | 50-00-0 |
| Inorganic arsenic | 7440-38-2 |
| Lead | 7439-92-1 |
| Methylene Chloride | 75-09-2 |
| Methylenedianiline | 101-77-9 |
| Respirable crystalline silica | |
| Vinyl chloride | 75-01-4 |
| Asbestos | |

# Appendix G: Department of Homeland Security Chemicals of Interest

| Department of Homeland Security Chemicals of Interest | | |
|---|---|---|
| **Chemical** | **Synonym** | **CAS#** |
| 1- Pentene | | 109-67-1 |
| 1,1-Dimethylhydrazine | [Hydrazine, 1, 1-dimethyl-] | 57-14-7 |
| 1,3-Bis(2-chloroethylthio)-n-propane | | 63905-10-2 |
| 1,3-Butadiene | | 106-99-0 |
| 1,3-Pentadiene | | 504-60-9 |
| 1,4-Bis(2-chloroethylthio)-n-butane | | 142868-93-7 |
| 1,5-Bis(2-chloroethylthio)-n-pentane | | 142868-94-8 |
| 1-Butene | | 106-98-9 |
| 1-Chloropropylene | [1-Propene, 1-chloro-] | 590-21-6 |
| 1H-Tetrazole | | 288-94-8 |
| 2,2-Dimethylpropane | [Propane, 2,2-dimethyl-] | 463-82-1 |
| 2-Butene | | 107-01-7 |
| 2-Butene-cis | | 590-18-1 |
| 2-Butene-trans | [2-Butene, (E)] | 624-64-6 |
| 2-Chloroethylchloro-methylsulfide | | 2625-76-5 |
| 2-Chloropropylene | [1-Propene, 2-chloro-] | 557-98-2 |
| 2-Methyl-1-butene | | 563-46-2 |
| 2-Methylpropene | [1-Propene, 2-methyl-] | 115-11-7 |
| 2-Pentene, (E)- | | 646-04-8 |
| 2-Pentene, (Z)- | | 627-20-3 |
| 3-Methyl-1-butene | | 563-45-1 |
| 5-Nitrobenzotriazol | | 2338-12-7 |
| 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 |

| Department of Homeland Security Chemicals of Interest | | |
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| **Chemical** | **Synonym** | **CAS#** |
| Arsine | | 7784-42-1 |
| Barium azide | | 18810-58-7 |
| Bis(2-chloroethylthio)methane | | 63869-13-6 |
| Bis(2-chloroethylthiomethyl)ether | | 63918-90-1 |
| 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 |
| Butane | | 106-97-8 |
| Butene | | 25167-67-3 |
| 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 |
| Chloroform | [Methane, trichloro-] | 67-66-3 |
| Chloromethyl ether | [Methane, oxybis(chloro-)] | 542-88-1 |
| Chloromethyl methyl ether | [Methane, chloromethoxy-] | 107-30-2 |
| 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 |
| Diethyl methylphosphonite | | 15715-41-0 |

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| **Chemical** | **Synonym** | **CAS#** |
| Diethyldichlorosilane | | 1719-53-5 |
| Diethyleneglycol dinitrate | | 693-21-0 |
| Difluoroethane | [Ethane, 1,1-difluoro-] | 75-37-6 |
| Dimethylamine | [Methanamine, N-methyl-] | 124-40-3 |
| Dimethyldichlorosilane | [Silane, dichlorodimethyl-] | 75-78-5 |
| 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 |
| 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 |

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| **Chemical** | **Synonym** | **CAS#** |
| 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 |
| 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 |

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| **Chemical** | **Synonym** | **CAS#** |
| Methylphosphonothioic dichloride | | 676-98-2 |
| Methyltrichlorosilane | [Silane, trichloromethyl-] | 75-79-6 |
| N,N-(2-diethylamino)ethanethiol | | 100-38-9 |
| N,N-(2-diisopropylamino)ethanethiol | N,N-diisopropyl-(beta)-aminoethane thiol | 5842-07-9 |
| N,N-(2-dimethylamino)ethanethiol | | 108-02-1 |
| N,N-(2-dipropylamino)ethanethiol | | 5842-06-8 |
| N,N-Diethyl phosphoramidic dichloride | | 1498-54-0 |
| N,N-Diisopropyl phosphoramidic dichloride | | 23306-80-1 |
| N,N-Dimethyl phosphoramidic dichloride | [Dimethylphosphoramido-dichloridate] | 677-43-0 |
| N,N-Dipropyl phosphoramidic dichloride | | 40881-98-9 |
| Nickel Carbonyl | | 13463-39-3 |
| Nitric acid | | 7697-37-2 |
| Nitric oxide | [Nitrogen oxide (NO)] | 10102-43-9 |
| Nitrobenzene | | 98-95-3 |
| 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 |
| o,o-Diethyl S-[2-(diethylamino)ethyl] phosphorothiolate | | 78-53-5 |
| 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 |
| O-Mustard (T) | [Bis(2-chloroethylthioethyl)ether] | 63918-89-8 |
| Oxygen difluoride | | 7783-41-7 |
| Pentane | | 109-66-0 |
| 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 |

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| **Chemical** | **Synonym** | **CAS#** |
| 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 mustard (Mustard gas (H)) | [Bis(2-chloroethyl)sulfide] | 505-60-2 |
| 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 |

| Department of Homeland Security Chemicals of Interest | | |
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| **Chemical** | **Synonym** | **CAS#** |
| 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 |
| 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 |
| Trimethyl phosphite | | 121-45-9 |
| Trimethylamine | [Methanamine, N,N-dimethyl-] | 75-50-3 |
| Trimethylchlorosilane | [Silane, chlorotrimethyl-] | 75-77-4 |
| 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 |