Laboratory Chemical Hygiene Plan
(EHS Program 4.1)

1.0 Overview

This Laboratory Chemical Hygiene Plan (Plan) was developed by Environmental Health and Safety (EHS) to establish and maintain a safe and healthy work environment for all laboratory employees at Weill Cornell Medicine (WCM). This Plan and the required training provide procedures to comply with the Occupational Safety and Health Administration (OSHA) "Occupational Exposure to Hazardous Chemicals in Laboratories" Standard, 29 CFR 1910.1450.

This Plan covers all areas of WCM in which laboratory work involving the use of hazardous materials is performed. While the Plan primarily addresses chemical hazards, other materials and processes, such as radiological and biological hazards, are referred to and must be controlled according to specific standards outlined in their respective manuals. This Plan is available on the EHS website, as well as guidelines and policies for other specific hazards and conditions.

2.0 Table of Contents

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3.0 Objectives

The primary goal of the WCM Laboratory Chemical Hygiene Plan is to minimize and reduce exposure to hazardous chemicals that laboratory and clinical personnel handle while performing their daily job functions. To achieve this, this Plan identifies the locations covered and lists standard operating procedures for all labs and the hazards they work with. Particular attention is given to procedures in labs working with chemical hazards that require higher levels of protection.

4.0 Applicability

Weill Cornell Medicine is a medical and graduate school participating heavily in biological, biomedical, and biochemical research. This Plan covers all aspects of laboratory work conducted by WCM students, faculty, and staff involving the use of chemicals, including but not limited to the following locations:

Research Laboratories

- 1300 York Avenue including but not limited to A, B, C, D, LC, E, F, Whitney Buildings
- S Building (515 East 71st Street)
- SI Building (516 East 72nd Street)
- Feil (RR) Building (407 East 61st Street)
- Belfer Research Building (413 East 69th St.)

Clinical Laboratories

- Weill Greenberg Center (1305 York Avenue)
- Helmsley Medical Tower
- Main Hospital (J, K, L, M, N, P, Starr Buildings)
- Oxford Building (422 East 72nd Street)
- DV Building (425 East 61st Street)
- MR Building (416 East 55th Street)
- Other off-site clinical locations

Sites outside of New York City (excluded from NYC-FDNY requirements)

- Burke Medical Research Institute (White Plains, NY)
- WCM Westchester Facility (White Plains, NY)

5.0 Responsibilities

5.1 CHEMICAL HYGIENE OFFICER

The EHS Director is the Chemical Hygiene Officer for WCM. The Chemical Hygiene Officer ensures that department chairs, principal investigators, directors, and managers are complying with the Laboratory Chemical Hygiene Plan.

5.2 ENVIRONMENTAL HEALTH AND SAFETY (EHS)

The Department of Environmental Health and Safety at WCM will:

- Develop, maintain, and disseminate this Plan.
- Serve as a resource for the collection of Safety Data Sheets (SDSs).
- Train laboratory personnel on the principles of this Plan.
- Respond to emergencies in the event of a spill release.
- Maintain records of training, spills, emergencies, and exposures.
- Collect wastes and maintains waste records.
- Inspect labs for compliance with the Plan.

5.3 PRINCIPAL INVESTIGATORS AND OTHER LABORATORY SUPERVISORS

Principal Investigators, Laboratory Safety Coordinators, and other Supervisors must:

- Ensure that all personnel is complying with the Plan.
- Complete the Research Safety Checklist every two years.

- Review and update laboratory roster and training needs of laboratory personnel quarterly.
- Complete an annual inventory of all chemicals in storage rooms and laboratories within their area.
- Ensure that Safety Data Sheets (SDSs) are readily accessible to all lab personnel and emergency responders.
- Provide Personal Protective Equipment (PPE) to lab personnel as needed.
- Develop operating procedures for experiments involving high hazard substances and train lab personnel accordingly.
- Ensure that lab personnel who work with hazardous materials attend Laboratory Safety Training annually.
- For FDNY permitted lab spaces, ensure at least one C-14 Certificate of Fitness for Supervision of Non-Production Laboratories holder is present while the lab is in operation.

5.4 LABORATORY PERSONNEL

Staff in the laboratory must:

- Follow all procedures outlined in this Plan.
- Adhere to recommendations made by the Chemical Hygiene Officer for the lab.
- Receive training annually and follow any updates to this program.

6.0 Research Safety Checklist

As required by the WCM Laboratory Safety Policy, each Principal Investigator in charge of a research laboratory at WCM must complete a Laboratory Safety Registration, which covers chemical, biological and radiological safety.

The Laboratory Safety Registration is divided into 3 components:

- Research Safety Checklist,
- Institutional Biosafety Committee (IBC) Laboratory Registration, and
- Radiation Safety Committee (RSC) Non-Human Use Application.

The EHS Research Safety Checklist acts as a risk assessment tool used to identify and address various hazard issues in research, and it provides principal investigators with a comprehensive checklist for recognizing hazards and compliance issues in the research environment.

The submission and review process of the Research Safety Checklist takes place in the Research Safety Module within the Weill Research Getaway (also known as WRG-RS).

Request access to the Research Safety module (WRG-RS)

- To **initiate a new laboratory registration,** please contact EHS at ehs@med.cornell.edu or (646) 962-7233.
- To **amend a previously approved registration,** the Principal Investigator or designated representative shall contact ehs@med.cornell.edu or the appointed EHS Safety Advisor (SA) to assist with the amendment process.
- **Laboratory registration renewal process** will be initiated by the EHS office. The renewal form will be created within the WRG-RS module and sent to Principal Investigator and designated representative for review, edits, and approval approximately 60 days before the expiration date.

7.0 Chemical Toxicology and Routes of Exposure

Chemicals enter the body via five routes of entry. Chemicals may affect the route-of-entry organ, or they may travel and target specific organs where they will do damage:

1. **Respiration** – primary target lungs (asbestos, osmium tetroxide, phosgene), other target organs (carbon monoxide – blood, methylmercury – brain).
2. **Ingestion** – primary target: gastrointestinal tract (acids); other target organs (lead – bones).
3. **Dermal Absorption** – primary target: skin, including mucous membranes (phenol, solvents); other target organs (solvents, phenol – Central Nervous System).
4. **Ocular** – primary target: eyes, (acids, bases, lachrymators); targets other organs (solvents).
5. **Subcutaneous** – injected into the blood, transferred to the target organ.

7.1 ACUTE EXPOSURE

Short-term, large exposure which results in an acute effect, including:

- allergic reaction
- coughing
- shortness of breath
- skin rash
- burning eyes

7.2 CHRONIC EXPOSURE

Long-term, low exposure that may result in a chronic effect, including:

- asbestosis (asbestos)
- central nervous system disorders (organic mercury, metallic mercury)
- various cancers, lung, kidney, bladder, liver

8.0 Exposure and Medical Monitoring

8.1 EXPOSURE MONITORING

EHS is available to monitor and evaluate exposure to chemicals in the workplace to measure the success of a hazard control program, or to assess levels of exposure prior to designing a program.

8.1.1 Exposure Monitoring Methods

Monitoring can be accomplished through the use of direct-reading instruments such as a portable photoionization detector, which gives an instantaneous but sometimes nonspecific reading.

OSHA-approved methods for monitoring involve placing a sampling badge on an individual or drawing air through tubes or filters over the course of a specified time lapse by using a personal sampling pump, then having the samples analyzed by an independent environmental laboratory.

8.1.2 Exposure Evaluation

The results will be interpreted according to current accepted industrial hygiene practices and compared to the OSHA Permissible Exposure Limits and Action Levels.

If exposure levels require additional exposure prevention and control, EHS will determine the appropriate modifications to the work activity as required by Section 9 of this Plan.

8.2 MEDICAL MONITORING

Medical monitoring is conducted by New York-Presbyterian Hospital Workforce Health and Safety (WHS) for all WCM faculty, staff, and students conducting work in a laboratory where hazardous materials are present.

A baseline examination is conducted for all faculty, staff, and students before beginning work in a laboratory and repeated annually thereafter.

8.2.1 Scenarios Requiring Medical Monitoring

The following scenarios may require additional medical monitoring by WHS:

- **Symptoms Develop** – Lab personnel develops signs or symptoms associated with hazardous chemical exposure.
- **Exposure Monitoring** – Exposure monitoring reveals levels routinely above the action level (or, in the absence of an action level, the permissible exposure limit) for an OSHA-regulated substance for which there are exposure monitoring and medical surveillance requirements. Medical surveillance shall be established for the affected employee as prescribed by the particular OSHA standard.

- **Hazardous Event** – An event occurs in the work area, such as a spill, leak, explosion, or other occurrence resulting in the likelihood of hazardous exposure. The affected individual shall be offered to go for medical consultation and/or examination at WHS.

8.2.2 Accident Reports

The Human Resources department maintains accident reports and sends a copy to EHS, who will investigate the exposure and make recommendations to avoid a re-occurrence.

9.0 Exposure Prevention and Control

Exposure prevention and control methods are generalized into the three categories listed below in order of priority.

9.1 SOURCE CONTROLS

Source controls are measures that reduce and/or prevent exposures to a hazardous substance. Substitution, minimization, and/or alteration of the chemical(s) or procedure are examples of source control. With chemical substitution, exposure to a high hazard chemical is controlled by utilizing a less hazardous chemical (e.g., sodium azide solution instead of the powder form).

9.2 PATHWAY CONTROLS

Pathway controls are administrative or engineering controls (e.g., high hazard operating procedures and chemical hoods) that minimize exposure to a chemical hazard in the work area of the employee. Section 21 of this Plan addresses engineering controls.

9.3 RECEIVER CONTROLS

Receiver controls are personal protective equipment (e.g., gloves) utilized to minimize exposure to a hazard. Personal protective equipment is further discussed in Section 22.

10.0 Safety Data Sheets (SDS)

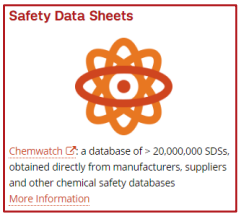
Safety Data Sheets (SDSs) provide basic information about the safety and health hazards posed by a chemical and precautions to take when using it.

The OSHA Laboratory Standard and the Hazard Communication Standard require that:

- SDSs be maintained for every hazardous chemical used and stored in each laboratory area. Contact EHS to request authorization to switch from hard copies of SDS to electronic access.
- SDSs be readily accessible to all personnel working in the laboratory and visible to emergency response personnel.
- All laboratory personnel knows where the SDSs are kept.

All departments should receive an SDS from the chemical manufacturer at the time of purchase. If the SDS is not provided with the chemical shipment, the chemical owner must obtain the SDS within a reasonable amount of time. Chemical owners may obtain a copy of the SDS by downloading it from the manufacturer's website or contacting EHS for assistance.

Chemical users can obtain SDS by:



- Downloading it from the manufacturer's website,
- Retrieving it from the **ChemWatch** SDS database from a WCM IP-connected computer, tablet, or smartphone via the EHS website https://ehs.weill.cornell.edu/sds,
- Retrieving it via email from the Salute inventory, or
- Contacting EHS for assistance.

SDSs have a United Nations Globally Harmonized System of Classification and Labeling of Chemicals (GHS) standardized format consisting of the following 16 sections:

10.1 SECTION 1 – IDENTIFICATION

- Product identifier used on the label.
- Other means of identification.
- Recommended use of the chemical and restrictions on its use.

- Name, address, information, and telephone number of the chemical manufacturer, importer, or other responsible parties.
- Emergency phone number.

10.2 SECTION 2 – HAZARD IDENTIFICATION

- Classification of the chemical consistent with paragraph (d) of §1910.1200 of the US Department of Labor.
- Signal word, hazard statement(s), symbol(s) and precautionary statement(s) conforming to paragraph (f) of §1910.1200.
- Hazards not otherwise classified and identified during the classification process.

10.3 SECTION 3 – COMPOSITION/INFORMATION ON INGREDIENTS

- Chemical name.
- Common name and synonyms.
- CAS number and other unique identifiers.
- Impurities and stabilizing additives that are themselves classified and contribute to the classification of the substance.

10.4 SECTION 4 – FIRST-AID MEASURES

- Description of first aid instructions.
- Most important symptoms/effects, acute and delayed.
- Indication of immediate medical attention and special treatment needed, if necessary.

10.5 SECTION 5 – FIRE FIGHTING MEASURES

- Suitable (and unsuitable) extinguishing media.
- Specific hazards arising from the chemical (e.g., nature of any hazardous combustion products).
- Precautions to be observed when fighting the fire.
- Appropriate protective equipment for firefighters.

10.6 SECTION 6 – ACCIDENTAL RELEASES MEASURES

- Personal precautions, protective equipment, and emergency procedures.
- Methods and materials for containment and clean-up.

10.7 SECTION 7 – HANDLING AND STORAGE

- Precautions for safe handling.
- Conditions for safe storage, including any incompatibilities.

10.8 SECTION 8 – EXPOSURE CONTROLS/PERSONAL PROTECTION

- OSHA permissible exposure limit (PEL).
- American Conference of Governmental Industrial Hygienists (ACGIH), Threshold Limit Value (TLV), and any other exposure limit used or recommended by the chemical manufacturer, importer, or employer preparing the safety data sheet, where available.
- Appropriate engineering controls.
- Individual protection measures such as personal protective equipment.
- Recommended work and personal hygiene practices.

10.9 SECTION 9 – PHYSICAL AND CHEMICAL PROPERTIES

▪ Appearance (physical state, color) ▪ Odor/Odor threshold ▪ pH ▪ Melting point/freezing point ▪ Initial boiling point and boiling range ▪ Flashpoint ▪ Evaporation rate ▪ Flammability (solid, gas)	▪ Upper/lower flammability or explosive limits ▪ Vapor pressure ▪ Vapor density ▪ Solubility(ies) ▪ Partition coefficient: n-octanol/water ▪ Auto-ignition temperature ▪ Decomposition temperature ▪ Viscosity

10.10 SECTION 10 – STABILITY AND REACTIVITY

- Reactivity.
- Chemical stability (under normal conditions).
- The possibility of hazardous reactions.
- Conditions to avoid (e.g., static discharge, shock, or vibration).
- Incompatible materials.
- Hazardous decomposition products.

10.11 SECTION 11 – TOXICOLOGICAL INFORMATION

- Likely routes of exposure.
- Symptoms related to the physical, chemical, and toxicological characteristics.
- Effects from short-term and long-term exposure.
- Numerical measures of toxicity (such as acute toxicity estimates).
- Carcinogenicity data on whether the hazardous chemical is listed in the National Toxicology Program (NTP) Report on Carcinogens (latest edition) or has been found to be a potential carcinogen in the International Agency for Research on Cancer (IARC) Monographs (latest edition) or by OSHA.

10.12 SECTION 12- ECOLOGICAL INFORMATION

- Ecotoxicity (aquatic and terrestrial, where available).
- Persistence and degradability.
- Bioaccumulative potential.
- Mobility in the soil.
- Other adverse effects (e.g., hazardous to the ozone layer).

10.13 SECTION 13 – DISPOSAL CONSIDERATIONS

- Description of waste residues and information on their safe handling and methods of disposal, including the disposal of any contaminated packaging.

10.14 SECTION 14 – TRANSPORT INFORMATION

- UN number.
- UN proper shipping name.
- Transport hazard class(es).
- Packing group, if applicable.
- Special precautions a user needs to be aware of or needs to comply with, in connection with transport or conveyance either within or outside their premises.

10.15 SECTION 15 – REGULATORY INFORMATION

- Safety, health, and environmental regulations specific for the product in question.

10.16 SECTION 16 – OTHER INFORMATION

- The date when the SDS was prepared, or the last edit date.

11.0 Additional Sources of Chemical Hazard Information

EHS maintains a collection of some of the publications listed below, which can be provided upon request. Additionally, the Educational Services Librarians of the WCM Library can assist in selecting some databases and websites for additional information on chemical hazards.

11.1 REFERENCES

There are several toxicology texts available in the WCM Library which are helpful in the evaluation of health hazards of chemicals, including the following:

- Annual Report on Carcinogens: published by The National Toxicology Program (NTP), U.S. Public Health Service.
- IARC Working Group Monographs: A series of monographs published by IARC covering specific agents, groups of agents, or selected industries in which cancer has been caused, or a suspected relationship exists with the chemicals under study.
- The Merck Index: A Compendium of Chemical Information.
- The Chemical Abstracts: detailed bibliographies and abstracts on original research papers on hazards, toxicity, and related topics based on the Chemical Abstracts Services registry number (CAS number).

11.2 MANUFACTURERS AND SUPPLIERS

In addition to providing the SDS, many manufacturers/suppliers have websites and customer service or technical representatives who may be able to provide additional information about the product.

11.3 GOVERNMENTAL RESOURCES

The National Institute of Occupational Safety and Health (NIOSH), the Centers for Disease Control and Prevention (CDC), and OSHA all have published information related to chemical hazards/exposures, which are available or can be requested on their websites.

11.4 PRINT-AND-GO SHEETS

EHS has developed Print-And-Go Sheets with detailed information on what to do in case of exposure to select chemical, biological, or radioactive materials. A list of Print-And-Go Sheets is available on the EHS website and should be reviewed prior to working with that agent. If you or someone in your lab is exposed, seek medical assistance and provide a Print-And-Go Sheet to the healthcare staff providing treatment.

12.0 General Laboratory Safety Requirements

Laboratory personnel must comply with the following laboratory safety requirements:

12.1 CHEMICAL EXPOSURE, SPILLS, AND FIRES

Report all chemical exposures, spills, and fires to the laboratory supervisor and/or Principal Investigator.

12.1.1 Eye Exposure

Remove contact lenses if applicable, and **promptly flush eye(s) using an eyewash for at least 15 minutes. Seek immediate medical attention.**

12.1.2 Skin Exposure

Promptly flush the affected area with water using a safety shower for at least 15 minutes. Remove any contaminated clothing to ensure the chemicals are washed away from the body. Seek immediate medical attention.

12.1.3 Person on Fire

If a person is on fire, walk the individual calmly to the nearest emergency shower, as running may cause the fire to grow or spread more rapidly. Instruct the individual to cover their face and use the shower to extinguish the fire.

If a person cannot be led to the emergency shower safely, douse the person with water or instruct the individual to stop, drop and roll, and then extinguish any small, still-burning flames by patting them out using an available laboratory coat.

Activate the nearest fire alarm pull station and call NYP EMS (212-472-2222) for medical assistance.

Remove any contaminated clothing and place clean, wet clothes on the burn areas. Wrap the individual(s) to avoid shock and exposure. Building-Specific Fire Safety Procedures are detailed in the EHS Fire Safety Manual available on the EHS website.

12.1.4 Fire

Immediately implement the R.A.C.E. fire procedures (Rescue-Alarm-Confine-Evacuate) identified in the Building-Specific Fire Safety Procedures. The Building-Specific Fire Safety Procedures are provided in the Fire Safety Manual available on the EHS website.

12.1.5 Spill Clean-Up

Follow the guidelines in the EHS Program Manual 4.3 Chemical Spill Planning and Response available on the EHS website.

12.2 AVOIDANCE OF ROUTINE EXPOSURE

Develop and encourage safe habits. **Avoid unnecessary exposure to chemicals by any route.** Do not smell or taste chemicals. Do not apply contacts, cosmetics, or lotions in laboratories. Vent any apparatus that may discharge toxic chemicals (e.g., vacuum pumps, distillation columns) into local exhaust devices, such as chemical hoods. Test glove boxes and inspect gloves before use. Do not allow the release of toxic substances in cold rooms and warm rooms since they re-circulate the air with no dilution of vapors or gases.

12.3 FOOD AND DRINK

Eating, drinking, or chewing gum is not permitted in areas where laboratory chemicals are present. Wash hands before conducting any of these activities. Prevent storage, handling, or consumption of food or beverages in laboratory storage areas and laboratory refrigerators, or where glassware or utensils are used for laboratory operations.

12.4 USE OF CHEMICAL HOODS

Work in a chemical hood when there is the potential for the release of toxic chemical gases, vapors, or dust. As a general rule, use a hood or other local ventilation device when working with volatile substances with a Permissible Exposure Limit (PEL) or Threshold Limit Value (TLV) of less than 50 ppm. Consult the SDS for PEL or TLV. Confirm adequate hood performance before use.

- Do not use a hood with flow less than 80 linear feet per minute. Consult the hood's flow monitor or contact EHS to verify chemical hood performance.
- Hood sash height should not exceed 18 inches.
- Keep hood sash closed or at a 2-inch opening at all times except when adjustments within the hood are being made.
- Keep materials stored in hoods to a minimum and do not allow them to block vents or air flow.
- Refer to Section 21 – Engineering Controls for additional chemical hood guidelines.

12.5 LABORATORY DRESS CODE

Clothing that leaves large areas of skin exposed is inappropriate to wear for work in laboratories. **Personal clothing should always cover the body to prevent exposure to spilled materials.** Wear shoes that cover the entire foot. Perforated shoes, open-toe, open-heel shoes, sandals, high heels, or clogs are not permitted. Shoes should have stable soles to provide traction on slippery or wet surfaces in order to reduce the chance of falling. Socks should cover the ankles to protect skin against chemical splashes.

In addition to the personal attire outlined above, always wear personal protective equipment when working in the laboratory. At a minimum, a laboratory coat (fully buttoned) must be worn at all times. Additional or alternate personal protective equipment may be required depending on the nature of the work conducted. Refer to Section 22 – Personal Protective Equipment for additional information.

12.5.1 Operating Machinery and Physical Hazards

Loose clothing, neck-ties, lanyards, dangling jewelry, and long hair must be tied back or removed to prevent them from getting caught in equipment when operating machinery that could present a physical hazard.

12.6 HOUSEKEEPING

Keep your work area clean and uncluttered, with chemicals and equipment properly labeled and stored. Clean up the work area at the end of an operation or each day.

12.7 EXITING LABORATORY

Wash hands and areas of exposed skin and remove laboratory coats and gloves before leaving the laboratory to minimize the potential spread of contamination.

12.8 EQUIPMENT AND GLASSWARE

Handle and store laboratory glassware with care to avoid damage. **Do not use damaged glassware.** Use extra care with Dewar Flasks and other evacuated glass apparatus. Shield or wrap them to contain chemicals and fragments should an implosion occur. Use equipment only for its designed purpose.

12.9 HORSEPLAY

Avoid practical jokes or other behavior which may confuse or distract another worker.

12.10 MOUTH SUCTION AND PIPETTING

Do not use mouth suction for pipetting or starting a siphon. Use a squeeze bulb, house vacuum, or Bernoulli device instead.

12.11 WORK PLANNING

Seek information and advice about hazards, plan appropriate protective procedures, and positioning of equipment before beginning a new operation. Develop a procedure covering use, storage, and disposal of chemicals associated with the work.

12.12 UNATTENDED OPERATION

Below are the basic steps to follow when an operation must be left unattended:

- Design the experiment to prevent the release of hazardous substances in the event of interruptions in utility services such as electricity, cooling water, and inert gas.
- Provide for the containment of toxic substances in the event of failure of utility service.
- Provide fail-safe provisions for equipment such as power stirrers, hot plates, heating mantles, and water condensers.
- Use electrical overload-protection devices when an apparatus is left unattended for long periods of time.
- Leave lights on in the area of unattended laboratory operation.
- Post announcement on the door of the laboratory that briefly describes the nature of the unattended operation, a list of the potentially hazardous materials which might be associated with an unplanned release, and contact number(s) of the person(s) to be contacted in an emergency.

Open flames must never be left unattended.

12.13 VIGILANCE

Be alert to unsafe conditions and see that they are corrected when detected. Watch for overcrowding or over storage of hazardous chemicals. Do not store incompatible chemicals together. Do not store corrosives and poisons above eye level.

Eliminate or minimize distractions to remain aware of your surroundings and able to respond to alarms and emergency notifications. Do not wear noise-canceling headphones unless they are part of the required PPE for an experiment.

12.14 WORKING ALONE

Avoid working alone. **Do not work alone in a laboratory if the procedure is hazardous.** Do not work late nights or weekends with toxic or hazardous chemicals, unless the procedure is standard practice and poses no exceptional risks.

12.15 TRANSPORT OF MATERIALS

Transport of chemicals between floors and buildings requires secondary containment such as tubs, buckets, and trays. Stairways should not be used to transport lab materials. The preferred method of transport is to use the designated elevator and a cart for the material. For small amounts of material that can be hand-carried, a closed, unbreakable, container should be used. If necessary, utilize a one glove method during the transport of materials. **Do not use gloved hands to handle doorknobs or press elevator buttons.**

13.0 Particularly Hazardous Substances and High Hazard Operating Procedures

When the laboratory conducts work with Particularly Hazardous Substances (PHS) and other Highly Hazardous Substances (HHS), Principal Investigators must develop and document supplementary guidelines and precautions for work with each PHS or HHS that go beyond general lab safety requirements.

Principal Investigators must:

- Identify all PHS and HHS present in their laboratories.
- Establish a High Hazard Operating Procedure (HHOP) for the use of these substances.
- Provide training and ensure that all laboratory personnel handling PHS or HHS review and become familiar with the HHOP prior to use.

Laboratory personnel who work with a PHS and HHS must:

- Be familiar with the HHOPs established and the types of hazards associated with those substances.
- Be competent in the safe handling and use procedures identified in the HHOP and/or supporting documentation.
- Receive specific hands-on training from the Principal Investigator or other experienced senior laboratory staff member.

13.1 PARTICULARLY HAZARDOUS SUBSTANCES AND HIGHLY HAZARDOUS SUBSTANCES

PHS are defined in the Occupational Safety and Health Administration's (OSHA) Occupational Exposure to Hazardous Chemicals in Laboratories Standard (29 CFR 1910.1450) as including select carcinogens, reproductive toxins, and chemicals with high acute toxicity. More guidance on identifying PHS is available on the OSHA website, Section 30: Definitions, as well as chemical safety data sheets.

Refer to the EHS Updates on High Hazard Operating Procedures for acute hazards, Working with Carcinogens and Reproductive Toxins, and Handling Low to Moderate Hazards for chronic hazards such as carcinogens and reproductive toxicants.

In addition to chemicals with high acute toxicity, other highly hazardous substances are identified in Section 13.3.

13.2 GENERAL PRECAUTIONS FOR WORKING WITH PARTICULARLY HAZARDOUS SUBSTANCES (PHS)

The OSHA standard states the following considerations must be taken when working with a PHS:

- establishment of a designated area;
- use of containment devices such as fume hoods or glove boxes;
- procedures for the safe removal of contaminated waste; and
- decontamination procedures.

The following are considered standard operating procedures for working with PHSs at WCM.

13.2.1 Designated Area

Laboratories should establish a designated space to restrict the area where PHS are stored and used. Restricting PHS work to a designated location helps protect employees by minimizing the chance of exposure, and limiting the area where contamination might occur.

The designated area may be a portion of the laboratory or a specific room within the laboratory suite. It might be a smaller area such as a particular chemical fume hood, a glove box, or another containment device. **Work with a PHS should not be conducted outside of this designated area.** After work with the PHS is complete, decontaminate the designated work area. Upon leaving the designated area, remove PPE and wash hands with soap and water.

The location of the designated area must be clearly communicated and reviewed with staff as part of laboratory-specific training. It must also be included in any of the lab's standard operating procedures and have signage created to alert personnel to the hazards present in that work location. Signage should read something similar to the following:

DANGER – DESIGNATED AREA for (define chemical & hazard)
Authorized Personnel Only

If an entire room is allocated for work with a PHS, laboratories should contact EHS to create or update the Health and Safety Door Sign for the area.

13.2.2 Containment Devices

Containment devices, such as chemical fume hoods, glove boxes, or glove bags, should be used when handling or manipulating a PHS. Containment is critical when performing any operations that may generate hazardous dust or aerosols, and chemical fume hoods are designed to capture chemical vapors and mitigate inhalation hazards.

Chemical fume hoods used for work with PHS must be labeled as designated areas and kept uncluttered to maintain proper airflow. For further guidance on the use of chemical hoods, see Sections 12.4 – Use of Chemical Hoods and Section 21 – Engineering Controls. Consult the EHS Update regarding Toxic Powder Weighing for a description of the tare method that must be used in the event that the lab's balance is located outside of the chemical hood.

13.2.3 Waste Disposal

PHS and mixtures, including contaminated materials (e.g.; pipette tips) and empty reagent bottles, must be appropriately labeled and collected as hazardous chemical waste and disposed of through the EHS Hazardous Waste Program.

Some PHS may also require special disposal procedures to be developed in line with EHS Waste Disposal Procedures. This information must be included as part of laboratory-specific training and outlined in the lab's standard operating procedures or high hazard operating procedures.

If there are any questions on how to dispose of PHS waste or wastes contaminated with a PHS, contact EHS prior to the start of the experiment.

13.2.4 Decontamination Procedures

Consult the safety data sheet (SDS) before starting work with any PHS to determine if special decontamination procedures are required. This decontamination information should be included as part of the lab's standard operating procedures or high hazard operating procedures and staff training. Lab personnel must use the approved decontamination method to clean equipment, non-disposable items (i.e., glassware), and work surfaces immediately after work with the PHS is complete. To protect work surfaces and aid in cleaning, the lab may choose to use plastic-backed absorbent pads, trays, or bench protectors that can be easily decontaminated or discarded. These disposable covers should be changed daily and discarded as hazardous waste if they are contaminated. **Any equipment used with or near a PHS must also be fully decontaminated before it can be removed from the designated area.**

13.3 PARTICULARLY HAZARDOUS & HIGHLY HAZARDOUS SUBSTANCES REQUIRING HHOP

This Plan and the above information serve as the minimum procedural requirements for working with PHS. Any additional precautions and/or any deviations from this require prior approval from the Principal Investigator, and the development of an HHOP. PIs must ensure that staff working with a PHS are trained accordingly, understand the hazards, and have access to the proper personal protective equipment (PPE).

An HHOP is also required for work with highly hazardous substances. This must be developed and staff trained accordingly prior to the start of the experiment. More information is provided in the following sub-sections.

A list of Highly Hazardous Substances, their GHS codes, and examples are included below.

13.3.1 Acutely Toxic Chemicals

Chemicals with a published toxicity level below the levels shown in the table below.

Acute Toxicity (Category 1 and 2) (GHS #H300, H310, H330)
Five GHS categories have been included in the GHS Acute Toxicity scheme from which the appropriate elements relevant to transport, consumer, worker and environment protection can be selected. Substances are assigned to one of the five toxicity categories on the basis of LD50 (oral, dermal) or LC50 (inhalation).

Toxicity	LD_{50} Oral (mg/kg)	LD_{50} Dermal (mg/kg)	LC_{50} Gases (ppm)	LC_{50} Vapors (mg/l)	LC_{50} Dusts & Mists (mg/l)
Category 1	≤ 5	≤ 50	≤ 100	≤ 0.5	≤ 0.05
Category 2	5 - 50	50 - 200	100 - 500	0.5 - 2.0	0.05 - 0.5

Examples of Acute Toxicity Compounds:

- Acrolein
- Arsine
- Chlorine
- Diazomethane
- Diborane (gas)
- Hydrogen Cyanide
- Hydrogen Fluoride
- Methyl Fluorosulfonate
- Nickel Carbonyl
- Nitrogen Dioxide
- Osmium Tetroxide
- Ozone
- Phosgene
- Sodium Azide
- Sodium Cyanide (and other cyanide salts)

13.3.2 Explosive and Reactive (Unstable) Chemicals

Any substance that falls into these categories:

- **Explosives** (GHS #H200, H201, H202, H203, H204, H205)
  An explosive substance or mixture is a solid or liquid which is in itself capable of chemical reaction of producing gas at such a temperature and pressure and at such a speed as to cause damage to the surroundings.
- **Flammable Gases** (GHS #H220, H221)
  Flammable gas means a gas having a flammable range in the air at 20°C and a standard pressure of 101.3 kPa.
- **Self-Reactive Substances** (GHS #H240)
  Self-reactive substances are thermally unstable liquids or solids liable to undergo a strongly exothermic thermal decomposition even without the participation of oxygen (air).
- **Pyrophoric Liquids and Solids** (GHS #H250)
  A pyrophoric is a material that, even in small quantities, is liable to ignite within five minutes after coming into contact with air.
- **Water Reactive Chemicals** (GHS #H260)
  Substances that, in contact with water, emit flammable gases are solids or liquids which, by interaction with water, are liable to become spontaneously flammable or to give off flammable gases in dangerous quantities.

Examples of Explosive and Reactive (Unstable) Chemicals

- Alkali metals
- Alkali metal hydrides
- Alkali metal nitrides
- Anhydrous metal halides ($AlCl_3$, $TiCl_4$)
- Calcium hydride
- Dinitrophenylhydrazine
- Hydrazine
- Inorganic acid halides ($POCl_3$, $SOCl_2$, SO_2Cl_2)
- Lithium aluminum hydride
- Metal and non-metal hydrides (borane, $LiAlH_4$)
- Metal Azides
- Non-metal Halides (BCl_3, BF_3, $BPCl_3$, $SiCl_4$)
- Perchloric and Picric Acid (Dry)
- Sodium Borohydride
- Sodium hydride
- t-Butyllithium
- White Phosphorous
- Zinc and zinc nitrate

13.3.3 Reproductive Toxicants (GHS #H360, H361, H362)

Chemicals such as mutagens, teratogens, or embryotoxins affect reproductive capabilities, including chromosomal damage and/or effects on fetuses.

Examples of Embryotoxins

- Arsenic and certain arsenic compounds
- Cadmium and certain arsenic pds
- Carbon disulfide
- Ethylene glycol monomethyl and ethyl ethers
- Ethylene oxide
- Lead compounds
- Mercury compounds
- Toluene
- Vinyl Chloride
- Xylene

13.3.4 Carcinogens (GHS #H350, H351)

Carcinogens are substances that are:

- Regulated by OSHA as a carcinogen.
- Listed as “known to be carcinogens" in the Annual Report on Carcinogens published by the National Toxicology Program (NTP) latest edition.
- Listed under Group 1 ("carcinogenic to humans") by the International Agency for Research on Cancer Monographs (IARC)(latest editions) listed in either Group 2A or 2B by IARC or under the category, "reasonably anticipated to be carcinogens" by NTP.

Examples of Carcinogenic Substances

- 2- Acetylaminofluorene
- Acrylamide
- Acrylonitrile
- Aflatoxins
- 4-Aminobiphenyl
- Arsenic and arsenic compound
- Asbestos
- Azathioprine
- Barium Chromate
- Benzene
- Benzidine
- Bis (chloromethyl) ether
- 1,4-Butyanedimethylsulfonate
- Chlorambucil
- Chloromethyl methyl ether
- Chromium and chromium cpds
- Cyclophosphamide
- 1,2-Dibromo-3-chloropropane
- 3,3’-Dichlorobenzidine
- Diethylstilbesterol
- 4-Dimethylaminoazobenzene
- Dimethyl sulfate
- Ethylene dibromide
- Ethylene oxide
- Ethylenimine
- Formaldehyde
- Hexamethylphosphoramide
- Hydrazine
- Melphalan
- 4,4’-Methylene-bis{2-chloroaniline}
- Mustard gas(bis(2-chloroethyl)sulfide)
- N,N-Bis(2-chloroethyl)-2-napththylamine
- α-Naphthylamine
- β-Naphthylamine
- Nickel carbonyl
- 4-Nitrobiphenyl
- N-Nitrosodimethylamine
- β-Propiolactone
- Thorium dioxide
- Treosulfan
- Vinyl chloride
- Ethylene dibromide
- Ethylene oxide
- Ethylenimine

13.4 ELEMENTS OF THE HHOP

HHOPs can be stand-alone documents or supplemental information included in research notebooks, experiment documentation, or research proposals. The HHOP establishes and documents all work that involves the use of Highly Hazardous Substances and identifies and consolidates related documents and procedures. HHOPs ensure that a process is in place for hazard assessment and exposure control strategies.

HHOPs must contain the following information:

1. Name of Principal Investigator and location of laboratory.
2. High Hazard Substance Information: name, physical state/concentration, and all hazards of the High Hazardous Substance used in the laboratory. Review the Safety Data Sheet (SDS) and/or container label for information on the hazards.
3. Significant Route(s) of Exposure.
4. Exposure Controls: Identify appropriate measures to control the hazards, including consistent and proper use of Engineering Controls and Personal Protective Equipment.

- Chemical Hood: Should be used for chemicals that may produce vapors, mists, or fumes, or if the procedure may cause generation of aerosols.
- Glove Box/Atmos Bag: Should be used if protection from atmospheric moisture or oxygen is needed, or when a chemical hood may not provide adequate protection from exposure to the substance.
- **Personnel working with High Hazardous Substances must wear Personal Protective Equipment (PPE).**

  Understand the capabilities and limitations of PPE. The required PPE must be identified for each HHOP based on the hazards of the material, work being performed, and the reasonably anticipated types of exposure. Refer to Section 22 – Personal Protective Equipment for additional information relating to PPE selection.

5. Use and Storage:

- Only laboratory personnel who are fully trained on handling and are aware of the hazard(s) associated with the HHS are allowed to use it.
- **Persons handling or conducting procedures with HHSs should never work alone.**
- Provide a brief description of the part of the experiment that involves the substance, with particular attention to how the chemical will be manipulated. Refer to the lab protocol/notes if this information is already covered in this document.
- If a vacuum system is used, describe what will be done to ensure that the substance is not accidentally drawn into the vacuum system (e.g., cold traps, filters). Vacuum systems include central vacuum systems and vacuum pumps within the lab.
- If High Hazardous Substances are administered to animals, a RARC Protection and Control form must be completed. For additional information, please refer to the RARC User's Guide.
- Designate a location where all transfers and work with these substances will be conducted. The "Designated Area" is required for work with select carcinogens, reproductive toxins, or substances with a high degree of acute toxicity. A designated area may be the entire laboratory, a smaller section of a laboratory, or a piece of equipment such as a laboratory hood.
- Review the Safety Data Sheet (SDS) to determine if specific precautions are needed to store this substance.
- All containers used to store High Hazardous Substances must be labeled with the identity of the content and its hazard warning sign.
- All "Designated Areas" must be clearly marked with a hazard warning.
- The Health and Safety Door Sign (HSDS) at the entrance of the lab should have the hazard warning sign of the High Hazardous Substance. If the HSDS does not have the warning sign, contact EHS at 646-962-7233 (1-7233) to add the warning sign.

6. Medical Attention and First-Aid:

- Some High Hazardous Substances may require specific first-aid/emergency procedures (e.g., administration of an antitoxin) in the event of an accident/exposure. The HHOP must include information on the appropriate first-aid procedures, supplies, and emergency contacts, as well as any requirements for follow-up medical consultations or examinations. If you are unsure what emergency/first-aid procedures are required for the material being used, contact EHS for assistance.

7. Decontamination:
   - Good housekeeping is essential to the health and well-being of laboratory personnel. **All equipment and work surfaces used for handling HHS should be decontaminated.** The decontamination method used must effectively remove/deactivate the HHS.
   - When leaving a designated area, remove any PPE to avoid cross-contamination.
   - Ensure a sink for hand washing is available when working with HHS.
8. Emergency Procedures and Spill Response:
   - All individuals working with hazardous substances must have immediate access to an eyewash station, safety shower, and appropriate fire extinguisher. If any equipment is not immediately available, contact EHS at 646-962-7233 (1-7233).
   - Some substances may require specialized spill clean-up or neutralization material. Ensure the laboratory is equipped with the proper emergency supplies for the hazardous materials used.
   - **In the event of a chemical spill, call EHS at 646-962-7233 (1-7233) immediately for assistance in cleaning up the spill. Do not attempt to handle a spill of high hazard chemicals.** Turn off all ignition sources and evacuate the laboratory immediately.
9. Waste Management and Disposal:
   - In addition to the standard waste disposal procedures outlined in the Waste Disposal Procedures, identify supplemental waste management and disposal procedures associated with the HHS. For example, some waste materials may require neutralization or deactivation prior to disposal. Note that supplemental waste management and disposal procedures must be reviewed and pre-approved by EHS.
10. Training:
    - All employees who work with hazardous chemicals or have access to designated areas must complete Annual Laboratory Safety Training provided by EHS. The Principal Investigator or other experienced senior staff familiar with the safe handling of the HHS must provide staff with hands-on HHOP training prior to the start of any work with these chemicals. **Staff must be trained on all components of the HHOP.** New users of HHS must work under the close supervision of an experienced user.

13.5 HIGH HAZARD OPERATING PROCEDURE FORM

The HHOP Form is available on the EHS Website and serves as a tool to coordinate information and resources into a succinct procedure and facilitate review with lab staff.

EHS is available to assist in the development and implementation of the HHOP and associated exposure control strategies for HHSs and PHSs. Completed HHOP forms must be available to lab staff for review and uploaded to the laboratory's Salute chemical inventory.

14.0 Receiving Chemicals

All chemicals received by the laboratory must be inspected prior to unpacking. If there appears to be leakage on the outside of the box or the packing material or if the contents appear to be damaged, contact EHS and the company from whom the chemical was ordered. **All damaged chemical containers must be considered as spilled material and disposed of as chemical waste.** Additionally, the laboratory must ensure that:

- The chemical inventory is updated.
- The SDS is available in the binder or online.
- The chemical label is legible and secure on the container. If the container label has been defaced, it should be relabeled.

15.0 Chemical Inventory- Salute

All laboratories must maintain a complete inventory of all hazardous chemicals and report annually the types, quantities and locations where these chemicals are being stored and used at the College. EHS will compile all the chemical inventories for the College and submit the annual WCM chemical inventory reports to the appropriate Federal and local government agencies as part of the Community Right-to-Know Program.

Information reported to external agencies is generalized by building and does not contain any personal identifying information. More detailed information is kept in the EHS Office and made available during an incident requiring an emergency response in an area storing hazardous materials.

To assist in this process, the College provides access to Salute. Salute is a web-based EHS information database that allows authorized users access to their chemical inventory via the internet. Contact EHS for additional information on Salute and the steps required to create a chemical inventory.

15.1 OBTAINING ACCESS TO CHEMICAL INVENTORY - SALUTE

Principal investigators and staff they have delegated as Safety Coordinators will have access to maintain and edit the laboratory's chemical inventory within the Salute Chemical Safety Menu. Principal investigators can add or remove Safety Coordinator status using the People profile in Salute. Any member listed on the laboratory's roster will have Read-Only access to the chemical inventory record. Contact EHS for additional assistance 646-962-7233.

15.2 ADDING A CHEMICAL TO THE INVENTORY

When adding a chemical to the inventory maintained in Salute, include the following fields at a minimum. Most are selected from drop-down menus.

- **Full Chemical Name**: Enter the full chemical name of each hazardous chemical. The user can type the chemical name then select from the suggested items in the Chemical Name field. The user can also search for the chemical by entering the CAS number in this field. Abbreviations and chemical nomenclature are not acceptable.
- **Quantity:** Total volume or weight of the chemical container (numerical value only).
- **Unit:** Enter the correlating unit of measure (e.g., pounds, gallons, etc.).
- **Container Count**: The number of containers of the specified quantity possessed by the laboratory.
- **Location:** The building name, floor, and room number where the chemicals are physically located. The room number should be indicated on a placard adjacent to the entrance to the area.
- **Location Comment**: Enter specific information about the chemical location within the room (e.g., stored under chemical fume hood).

Optional fields are available for manufacturer, manufacturer ID, and expiration date.

15.3 UPDATING THE CHEMICAL INVENTORY

At a minimum, the inventory is a yearly average of what is in the lab at any one time. **If the quantity of a chemical is continuously fluctuating due to use, the amount should be overestimated rather than underestimated.** Chemical inventories should be reviewed and edited on at least a yearly basis. Personnel should be looking at the physical condition of primary and secondary containers. **Chemicals should be inspected for signs of decomposition, such as discoloration, turbidity, caking, moisture in dry chemicals, particulates in liquids, and pressure buildup.**

16.0 Chemical Labeling Requirements

All chemical containers must be properly labeled.

16.1 MANUFACTURER LABELING REQUIREMENTS

Original containers from chemical manufacturers are required under the Federal OSHA Hazard Communication Standard to provide the following information:

- Common name of the chemical.
- Chemical manufacturer's name, address, and emergency telephone number.
- Health and safety hazard warnings (e.g., flammable, corrosive).

16.2 LABORATORY LABELING REQUIREMENTS

Laboratory personnel is responsible for ensuring that all chemical containers produced in the laboratory are properly labeled as follows:

- Labels on all chemical containers should be legible and easy to read.
- The chemical name should be spelled out in English, no chemical structures.
- Hazards should also be listed if possible.
- If abbreviations are used, an abbreviations cross-reference sheet (e.g., EtBr = Ethidium Bromide) must be posted near the entrances to the laboratory.

16.3 DATE LABELING REQUIREMENTS FOR REACTIVE CHEMICALS

For the following chemical groups, write the date of receipt and date of opening on each container. The dates on the container should be noted prior to each use.

The following chemicals should not be held past the recommended expiration date, or in the specified amount of time from the date of receipt:

- Picrics,
- Perchlorates,
- Peroxides,
- Peroxidizable materials (aldehydes, ethers, and compounds containing benzylic hydrogen atoms),
- Chemicals with polymerization hazards, and other unstable or reactive chemicals.

16.4 DISPOSAL OF UNLABELED/UNKNOWN CHEMICALS

Unlabeled/unknown chemicals must be disposed of via EHS as required by WCM Waste Disposal Procedures.

17.0 Chemical Storage Limits and Requirements

Chemical storage areas in the laboratory setting include storerooms, laboratory work areas (shelves and bench cabinets), storage cabinets, and refrigerators/freezers.

17.1 FDNY PERMITTED LABORATORIES AND CHEMICAL STORAGE ROOMS

Hazardous chemicals may only be used and/or stored in laboratories or chemical storage rooms that have been permitted by the Fire Department of the City of New York (FDNY). **A permitted laboratory must have a "Laboratory – Potentially Hazardous Substance" sign on the laboratory's exterior door. Chemical storage is only permitted in areas that have this signage.**

17.2 CHEMICAL STORAGE LIMITS

WCM laboratories are categorized as a Type I, II, III, IV, or Class B or D permitted space based on the age of the construction (old versus new fire code), the fire rating of the space construction, and the type of sprinkler system. Refer to the Health and Safety Door Sign or contact EHS to get the type or class of a specific space.

The storage limits for each type are as follows:

17.2.1 Flammable Liquids and Other Hazardous Materials Limits for Type I to IV Labs

Lab Type	Fire Rating	Fire Protection	Flammable Liquids	Flammable Solids	Oxidizing Materials	Unstable Reactives
I	2 hours	Sprinklers	30 gal	15 lbs.	50 lbs.	12 lbs.
II	1 hour	Sprinklers	25 gal	10 lbs.	40 lbs.	6 lbs.
III	2 hours	No Sprinklers	20 gal	6 lbs.	30 lbs.	3 lbs.
IV	1 hour	No Sprinklers	15 gal	3 lbs.	20 lbs.	2 lbs.

17.2.2 Flammable Liquids Limits for Class B and D Labs

Class	Excluding quantities in storage cabinets or safety cans		Including quantities in storage cabinets or safety cans	
	Max. quantity Class I liquids alone per lab unit (gal)	Max. quantity Class I, II, IIIA Liquids per Lab Unit (gal)	Max. quantity Class I Liquids alone per Lab Unit (gal)	Max. quantity Class I, II, IIIA Liquids per Lab Unit (gal)
B	5 gals/100 ft^2 Max. 25	10 gals/100 ft^2 Max. 25	10 gals/100 ft^2 Max. 25	20 gals/100 ft^2 Max. 25

Class	Excluding quantities in storage cabinets or safety cans		Including quantities in storage cabinets or safety cans	
D	1 gals/100 ft^2 Max. 75	1 gals/100 ft^2 Max. 75	2 gals/100 ft^2 Max. 150	2 gals/100 ft^2 Max. 150

17.2.3 Other Hazardous Materials Limits for Class B and D Labs

Chemicals	Max. quantity in 1-hr fire rated lab	Max. quantity in 2-hr fire rated lab
Water-Reactive Material	2.5 lbs.	5 lbs.
Pyrophoric Material	0.5 lbs.	1 lbs.
Highly Toxic Material	5 lbs.	5 lbs.
Toxic Material	250 lbs.	250 lbs.
Corrosive Material	250 Gallons	250 Gallons
Flammable Solids	10 lbs.	15 lbs.
Oxidizers/Org Peroxides	40 lbs. [a]	50 lbs. [a]
Unstable reactive	6 lbs. [b]	12 lbs. [b]
[a] Max. 2 lbs. of Class 3 oxidizers & 1 lb. of Class I organic peroxides. [b] Max. 1 lb. of Class 3 unstable reactive material.		

17.2.4 Flammable Gas Storage Limits Type I to IV Labs

Area of Laboratory in square feet	Up to 500 ft^2	Per additional 100 ft^2	Maximum per Laboratory Unit
Maximum Capacity (water capacity)	9.24	1.54	15.4

17.2.5 Flammable Gas Storage Limits Class B and D Labs

Gas Types	Storage capacity in ft^3 up to 500 ft^2 of lab area	Per additional 100 ft^2	Max. Capacity
Flammable	12	2.4	NA
Oxidizing	12	2.4	NA
Liquid flammable	2.4	0.36	NA
Health hazard 3 or 4	0.3	0.06	NA

Flammable gases are prohibited from use or storage below grade.

17.3 GENERAL STORAGE REQUIREMENTS

17.3.1 Storage Locations

- Room perimeter: Materials may be openly stored up to the sprinklered ceiling along the perimeter of the room as long as the front edge of the material is at least 18 inches in all directions from the sprinkler head. (A minimum 24-inch clearance from the ceiling is required for non-sprinklered spaces)
- Room center: Open storage of materials within 18 inches of a sprinklered ceiling in the center of the room (i.e., non-perimeter) is not permitted. (A minimum 24-inch clearance from the ceiling is required for non-sprinklered spaces)
- Sinks: No storage of chemicals, excluding standard detergents, is permitted under sinks.
- Shelves should be secured firmly to walls.
- Provide anti-roll lip on all shelves.
- Store acids and corrosives in dedicated cabinets and separate acids and bases. Nitric acid can be stored (with secondary containment) with other acids.
- Store flammables in a vented flammables cabinet when possible.
- Store chemicals requiring special storage requirements separately. Special attention must be paid to the following:
  - Nitrates, nitrites, and azides
  - Perchlorates
  - Perchloric acid
  - Peroxides
  - Those chemicals that form peroxides (ether, THF, dioxane)
  - Phosphorus
  - Flammable solids (sodium, lithium, potassium)
  - Strong oxidizers
- Every chemical should have an identifiable storage place and should be returned to that location after each use.
- Labs must develop a storage scheme in each chemical storage area to ensure the segregation of incompatibles, and efforts must be made to isolate particularly flammable, reactive, and toxic materials. Chemical storage on benchtops should be minimized to reduce the amounts of chemicals unprotected from potential fire and to prevent them from being easily knocked over.
- Store all chemical containers in an upright position.
- Hazardous chemicals should not be stored above eye level.
- Large containers should be stored on lower levels.
- Chemicals must not be stored on the floor.
- Stored chemicals must not be exposed to direct sunlight or heat.
- Secondary containment should be used when storing close to a water source, segregating those chemicals that need secondary containment, or when storing acids on bare metal.
- All chemical containers must be returned to their proper storage place at the end of the workday.

17.3.2 Laboratory Refrigerators

- **Laboratory refrigerators cannot be used to store food.**
- **The use of standard refrigerators to store flammable liquids is prohibited.** Standard laboratory refrigerators must be labeled with a notice to indicate that the unit is not suitable for storing flammable liquids with a flash point below 100°F. Use explosion-proof or flammable-proof refrigerators to store flammable liquids that require refrigeration.

17.3.3 Water-Reactive Chemicals

- Water-reactive chemicals must be stored in a manner to prevent direct contact with water and fire sprinkler systems.
- The storage area for water-reactive chemicals must be labeled “Water-Reactive Chemicals.”

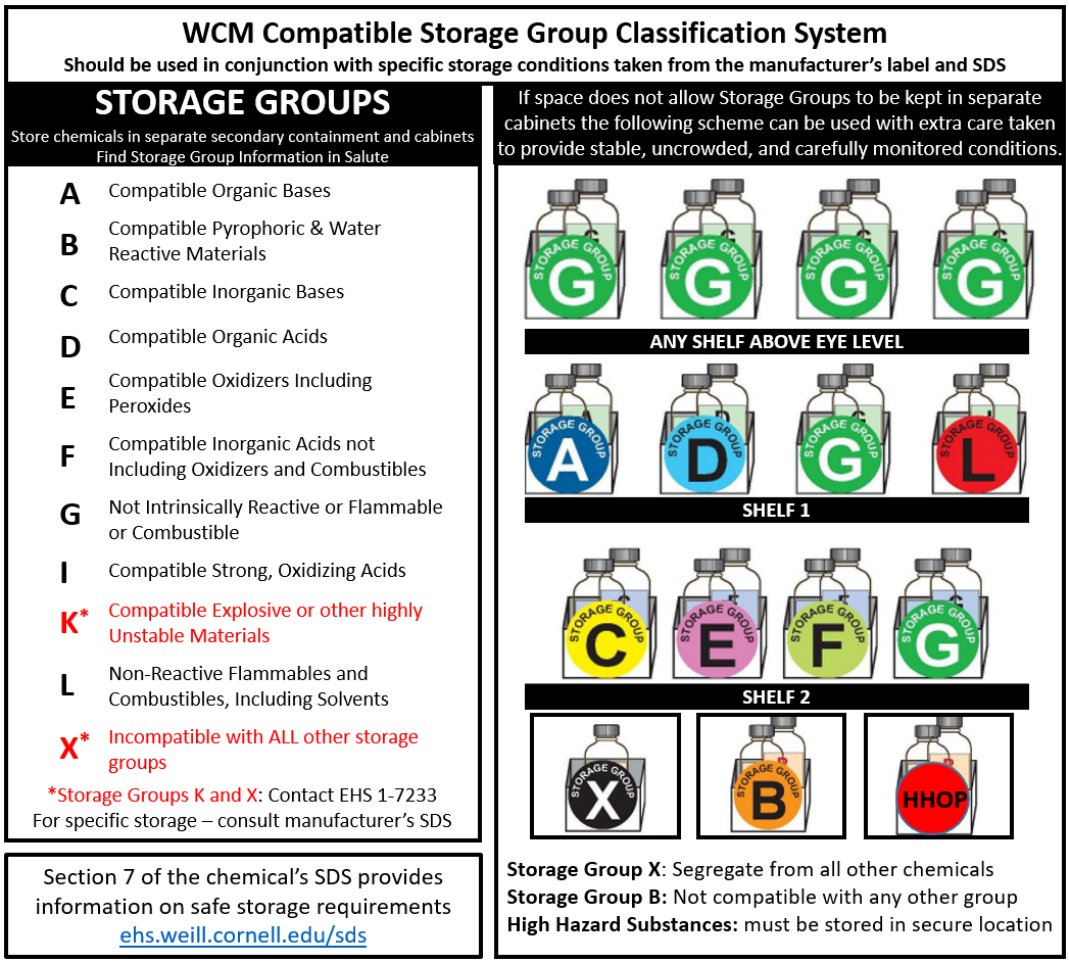
17.3.4 Compressed Gases

- The name of the gas must be marked on the cylinder.

- Storage of more than one cylinder of flammable gas in a lab is not permitted unless they are in use.
- Flammable gas cylinders should be stored in a separate area from other types of compressed gasses.
- Cylinders of incompatible gases must be segregated by distance. Group cylinders by the type of gas (e.g., toxic, corrosive).
- Empty cylinders should be separated from full cylinders and labeled “Empty or MT.”
- All compressed gases must be stored away from direct or localized heat, such as radiators, steam pipes, or boilers, in well-ventilated and dry areas, and away from areas where heavy items may strike them (e.g., near elevators or service corridors).
- All compressed gases, including empty cylinders, must be secured in an upright position with chains, straps, or special stands, and must be capped when stored or moved.
- A hand truck must be available for transporting gas cylinders to and from storage areas.
- Gas cylinders must be hydrostatically tested by the vendor every ten years. The last testing date is embossed in the metal near the head of the cylinder.

17.4 SEGREGATION OF INCOMPATIBLE CHEMICALS

- Chemicals must be segregated to prevent the mixing of incompatible chemicals in the event that containers break or leak.
- Utilize the compatible storage group classification system associated with the laboratory’s Salute chemical inventory to identify and segregate incompatible chemicals properly.
- For additional information on segregation guidelines shown in the graphic below, refer to the EHS Chemical Storage Update.



18.0 Security of Hazardous Materials in Labs

Laboratories need to take specific actions in order to provide security against theft of highly-hazardous materials, and to ensure compliance with federal regulations. Each department should review and develop procedures to ensure the security of all hazardous materials in their area of responsibility.

Many laboratories already implement various means of security, including securing controlled substances, syringes and needles, and radioactive materials. One easy way to increase security is to ensure laboratory doors are locked whenever the laboratory is left unattended, even for a few minutes.

Follow these guidelines to minimize opportunities for intentional removal of any hazardous materials from your laboratory:

18.1 DEVELOP A SECURITY POLICY

Develop a site-specific security policy.

- Assess your laboratory area for hazardous materials and particular security issues.
- Develop and implement laboratory security procedures for the lab group.
- Train laboratory group members on security procedures and assign responsibilities.

18.2 CONTROL ACCESS

Control access to areas where hazardous materials are used and stored.

- Limit laboratory access to only those individuals who need to be present.
- Restrict off-hours access to individuals authorized by the Principal Investigator.
- Lock freezers, refrigerators, storage cabinets, and other containers where stocks of biological agents, hazardous chemicals, or radioactive materials are not directly controlled by workers (for example, when located in unattended storage areas).
- Do not leave hazardous materials unattended or unsecured at any time.
- Close and lock laboratory doors when no one is present.

18.3 KNOW WHO IS IN THE LABORATORY AREA

- Consider using a logbook for staff to sign in and out each day or using carded access devices.
- Ensure that all personnel wears their WCM/ NYP identification badge.
- Approach anyone you do not recognize and ask if you can help direct them.

18.4 SECURE HIGHLY HAZARDOUS MATERIALS

- Use a log to sign highly hazardous materials in and out of secure storage.
- Take a periodic inventory of all highly hazardous chemicals, biological agents/toxins, radioactive materials, and controlled substances.
- Track the use and disposal of hazardous materials. Report any missing material to EHS.
- Know what materials are being ordered and brought into the laboratory area.
- Visually screen packages before bringing them to the laboratory. Packages containing potentially infectious materials should be opened in a biological safety cabinet or another appropriate containment device.
- Communicate the removal of materials to the laboratory staff.

18.5 EMERGENCY PLAN

Restricted access to laboratory areas can make emergency response more challenging. Consider the following when developing an emergency plan:

- Have a protocol for reporting incidents. Laboratory directors, in cooperation with facility safety and security officials, should have policies and procedures in place for the reporting and investigating incidents or possible incidents, such as undocumented visitors, missing chemicals, or unusual or threatening phone calls.
- Review and update the laboratory's emergency contact information on or near your laboratory door.

18.6 AGENTS OF CONCERN

Laboratory researchers should be aware of the highly hazardous materials in their area.

- For lists of select agent toxins, review the CDC website.
- For a list of highly-hazardous chemical waste, review the EHS list of Acutely Toxic Chemicals.
- Refer to Section 13 for the requirements for Particularly Hazardous and Highly Hazardous Substances.

19.0 Safety Precautions for Special Hazards

19.1 ALLERGENS

Allergic reactions result from sensitization to a particular chemical or classes of chemicals. An allergic reaction can be immediate, occur within minutes after exposure, or have a delayed effect.

- Wear suitable gloves to prevent hand contact with allergens or substances of unknown allergenic activity.
- Contact EHS for a respirator needs assessment.

19.2 BUNSEN BURNER

Bunsen burners produce an open flame, burn at a high temperature, and as a result, present the potential for an accident to occur. In case of a fire, activate the nearest fire alarm pull station, notify all lab personnel, and evacuate the premises.

When working with Bunsen burners, follow these safety guidelines:

- Place the Bunsen burner away from any overhead shelving, equipment, or light fixtures.
- Remove all papers, notebooks, combustible materials, and excess chemicals from the area.
- Tie back any long hair, dangling jewelry, or loose clothing.
- Inspect hose for cracks, holes, pinched points, or any other defect, and ensure that the hose fits securely on the gas valve and the Bunsen burner.
- Replace all hoses found to have a defect before using.
- Notify others in the laboratory that the burner will be in use.
- Utilize a sparker/lighter with an extended nozzle to ignite the Bunsen burner. Never use a match to ignite the burner.
- Have the sparker/lighter available before turning the gas on.
- Adjust the flame by turning the collar to regulate air flow and produce an appropriate flame for the experiment (typically a medium blue flame).
- **Do not leave open flames unattended, and never leave the laboratory while the Bunsen burner is on.**
- Shut off the gas when its use is complete.
- Allow the burner to cool before handling.
- Ensure that the main gas valve is off before leaving the laboratory.

19.3 HYDROGEN FLUORIDE (HYDROFLUORIC ACID)

Hydrogen fluoride/ hydrofluoric acid (HF) is an extremely corrosive acid and a systemic poison due to the fluoride ion it readily releases. This fluoride ion causes tissue necrosis, hypocalcemia, and hypomagnesemia. Visible damage to affected areas can remain symptom-free for up to 24 hours, especially with dilute solutions of < 20%. Concentrated solutions of > 40 % generally show symptoms more quickly. Burns are extremely painful and should receive immediate attention as exposure to HF may be fatal. It is a respiratory, dermal, and ingestion hazard.

If your laboratory utilizes HF, the Principal Investigator must develop a High Hazard Operating Procedure for its use abiding by Section 13 – High Hazard Operating Procedures. All personnel working in the laboratory must be familiar with the HHOP and the EHS Print-And-Go Sheet: Hydrofluoric Acid Post-Exposure Guidance.

In addition to basic laboratory procedures, the procedure below must be followed:

- HF must only be stored in approved polyethylene containers. HF etches glass and corrodes metal.
- Work with the smallest quantities possible.
- Review the Safety Data Sheet (SDS) prior to working with HF. Know the hazards.
- Restrict access to the work area and post that HF is being used.
- PPE is essential. Goggles, gloves adequate for strong acids, clothing cover (laboratory coat), and, if there is a splash hazard, a full-face shield, and sleeve covers.
- All PPE remains in the lab. Contaminated PPE must be neutralized or disposed of as hazardous waste.

- Full-length pants and closed shoes must be worn.
- Work should be done in a hood to minimize inhalation and to minimize hazards in the event of an accidental release.
- A hydrofluoric acid (HF) spill control or universal spill kit that is good for HF is required in all areas using or storing hydrofluoric acid.
- Maintain a supply of 2.5% Calcium Gluconate ointment in the work area in the event of skin contact.
- Know first aid procedures before you begin working and know where the nearest eyewash and safety shower are located.

20.0 Peroxide-Forming Chemicals

Peroxide-forming chemicals are a class of compounds that have the ability to form shock-sensitive explosive peroxide crystals. A peroxide is a chemical that contains a peroxo (O-O) unit, with the chemical formula of $[O_2]^{2-}$.

Many of the organic solvents commonly used in WCM laboratories have the potential to form explosive peroxide crystals through an auto-oxidation process. Diethyl ether and tetrahydrofuran are two of the more common peroxide-forming chemicals used at WCM. The risk associated with peroxide formation increases if the peroxide crystallizes or becomes concentrated by evaporation or distillation. Factors that affect the rate of peroxide formation include exposure to air, light and heat, moisture, and contamination from metals. Therefore, it is extremely important that this procedure is followed regarding the identification, handling, storage, and disposal of peroxide-forming chemicals.

20.1 CLASSES OF PEROXIDE FORMING CHEMICALS

There are four classes of peroxide-forming chemicals:

1. **Class A** – Severe peroxide hazard: May form explosive concentrations of peroxides without concentration by evaporation or distillation even if never opened.
2. **Class B** – Concentration hazard: Form explosive peroxides but usually become hazardous when distilled, evaporated or otherwise concentrated. Note that some of these chemicals are quite volatile and repeated use may allow enough evaporation to occur to concentrate peroxides to explosive levels.
3. **Class C** – Shock and heat sensitive: May exothermically polymerize as a result of decomposition of peroxides.
4. **Class D** – Peroxidizable chemicals not clearly categorized and thus not included in Class A, B, or C.

Examples of chemicals in each class are included below in Section 20.7

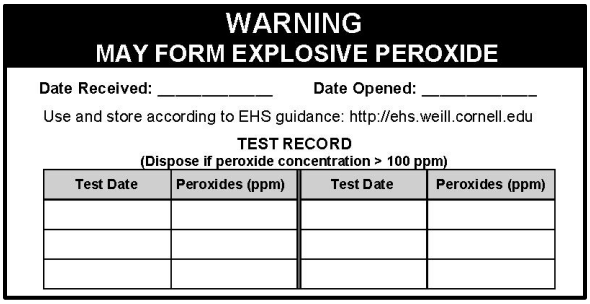
20.2 PURCHASING CONSIDERATIONS

When possible, purchase only peroxide-forming chemicals which contain a peroxide formation inhibitor (e.g., tetrahydrofuran or diethyl ether inhibited with butylated hydroxytoluene, BHT).

Only purchase quantities of peroxide-forming chemicals that you expect to use before the expiration and disposal timeframes.

20.3 LABELING REQUIREMENTS

Every container of Class A, B, and C peroxide-forming chemicals must be labeled with the **date received** and **date opened**. EHS will provide labels similar to the one shown below, upon request.



For Class D chemicals, follow the manufacturer's labeling recommendations.

20.4 STORAGE AND USE REQUIREMENTS

- Do not touch or attempt to open a container of a peroxide-forming chemical if there are whitish crystals around the cap and/or in the bottle. The friction of screwing the cap may detonate the bottle. **If crystals or precipitate are visible, contact EHS immediately at 646-962-7233.**
- Do not handle a peroxide-forming chemical container if it is not marked with date received and date opened if it has been opened.
- Do not store peroxide-forming chemicals in direct sunlight because sunlight accelerates peroxide formation.
- If a peroxide-forming chemical is flammable and requires refrigeration, store it in a flammable-proof refrigerator.
- Do not distill, evaporate or concentrate a peroxide-forming chemical to dryness.
- Do not distill, evaporate or concentrate a peroxide-forming chemical unless a High Hazard Operating Procedure has been evaluated by EHS conforming to Section 13 on High Hazard Substances.

20.5 TESTING AND DISPOSAL REQUIREMENTS

Peroxide-forming chemicals must be disposed of or tested according to the table below, or the manufacturer's expiration date-whichever comes first. Note that High Hazard Substances such as pyrophoric, severely acutely toxic, unstable chemicals, and commonly used secondary alcohols not distilled or concentrated (e.g., 2-propanol) will not be tested for peroxide formation. Refer to Section 13 on High Hazard Substances for details.

Time to disposal or testing for peroxides

	Class A	Class B	Class C	Class D
Unopened: from date received	1 year	1 year	1 year	Contact EHS if peroxide crystals are present.
From date opened	3 months	6 months	6 months	Contact EHS if peroxide crystals are present.
High Hazard Substances (e.g., pyrophoric, severely acutely toxic, unstable, water reactive)	Not tested, discard 1 year from receiving or at manufacturer's expiration date.			Contact EHS if peroxide crystals are present.

Submit a chemical collection request for the disposal of a peroxide-forming chemical via Salute.

NOTE: If the peroxide-forming chemical has a visible peroxide formation or is greater than one-year-old, bypass the online form and contact EHS immediately. ***Do not move or handle these containers.***

EHS will arrange to test and, if necessary, stabilize peroxide-forming chemicals prior to removal.

20.6 TESTING FOR PEROXIDES

High Hazard Substances (HHS) such as pyrophoric, unstable, water-reactive, acutely toxic chemicals will **not** be tested for peroxide formation. Store, use, and discard peroxide-forming HHS according to their High Hazard Operating Procedures (HHOP). For details on HHOP, please review the EHS Update on HHOP.

Secondary alcohols used for distillation or evaporation must be managed and stored as peroxide formers. Secondary alcohols are compounds in which the hydroxyl group, -OH, is attached to a saturated carbon atom which has two carbon atoms attached to it, such as 2-pentanol and 2-butanol.

When testing for peroxide, use the guidelines below to interpret results and determine the action to take:

Peroxide concentration	Action
<25 ppm	Considered safe for general use
25-100 ppm	Not recommended for distilling or concentrating
>100 ppm	Avoid handling and contact EHS for safe disposal immediately

20.7 PEROXIDE-FORMING CHEMICAL LISTS

The lists presented below are not comprehensive. Refer to the manufacturer's information if a chemical is not listed.

20.7.1 Class A – Severe Peroxide Hazard

Butadiene (liquid monomer)	Isopropyl ether	Sodium amide (sodamide)
Chloroprene (liquid monomer)	Potassium amide	Tetrafluoroethylene (liquid monomer)
Divinyl acetylene	Potassium metal	Vinylidene chloride

20.7.2 Class B – Concentration Hazard

Acetal	Diethylene glycol dimethyl ether	4-Methyl-2-pentanol
Acetaldehyde	Diethyl ether	2-Pentanol
Benzyl alcohol	Dioxanes	4-Penten-1-ol
2-Butanol	Ethylene glycol dimethyl ether	1-Phenylethanol
Cumene	Furan	2-Phenylethanol
Cyclohexanol	4-Heptanol	2-propanol*
Cyclohexene	2-Hexanol	Tetrahydrofuran
2-Cyclohexen-1-ol	Methylacetylene	Tetrahydronaphthalene
Decahydronaphthalene	3-Methyl-1-butanol	Vinyl ethers
Diacetylene	Methylcyclopentane	Other secondary alcohols
Dicyclopentadiene	Methyl isobutyl ketone	

*Tested prior to concentration or distillation only.

20.7.3 Class C – Shock and Heat Sensitive

Acrylic acid	Chlorotrifluoroethylene	Vinyl acetate
Acrylonitrile	Methyl methacrylate	Vinylacetylene (gas)
Butadiene (gas)	Styrene Vinylpyridine	Vinyladiene chloride
Chloroprene	Tetrafluoroethylene (gas)	Vinyl chloride (gas)

20.7.4 Class D –Peroxidizable chemicals not classified as Class A, B or C.

Acrolein	p-Chlorophenetole	4,5-Hexadien-2-yn-1-ol
Allyl ether	Cyclooctene	n-Hexyl ether
Allyl ethyl ether	Cyclopropyl methyl ether	o.p-Iodophenetole
Allyl phenyl ether	Diallyl ether	Isoamyl benzyl ether
p-(n-Amyloxy)benzoyl chloride	p-Di-n-butoxybenzene	Isoamyl ether
n-Amyl ether	1,2-Dibenzyloxyethane	Isobutyl vinyl ether
Benzyl n-butyl ether	p-Dibenzyloxybenzene	Isophorone
Benzyl ether	1,2-Dichloroethyl ethyl ether	b-Isopropoxypropionitrile
Benzyl ethyl ether	2,4-Dichlorophenetole	Isopropyl-2,4,5-trichlorophenoxy acetate

Benzyl methyl ether	Diethoxymethane	n-Methylphenetole
Benzyl-1-napthyl ether	2,2-Diethoxypropane	2-Methyltetrahydrofuran
1,2-Bis(2-chloroethoxyl)ethane	Diethyl ethoxymethylenemalonate	3-Methoxy-1-butyl acetate
Bis(2-ethoxyethyl)ether	Diethyl fumarate	2-Methoxyethanol
Bis(2-(methoxyethoxy) ethyl) ether	Diethyl acetal	3-Methoxyethyl acetate
Bis(2-chloroethyl) ether	Diethylketene	2-Methoxyethyl vinyl ether
Bis(2-ethoxyethyl) adipate	Diethoxybenzene (m-,o-,p-)	Methoxy-1,3,5,7-cyclooctatetraene
Bis(2-methoxyethyl) carbonate	1,2-Diethoxyethane	b-Methoxypropionitrile
Bis(2-methoxyethyl) ether	Dimethoxymethane	m-Nitrophenetole
Bis(2-methoxyethyl) phthalate	1,1-Dimethoxyethane	1-Octene
Bis(2-methoxymethyl) adipate	Di(1-propynl) ether	Oxybis(2-ethyl acetate)
Bis(2-n-butoxyethyl) phthalate	Di(2-propynl) ether	Oxybis(2-ethyl benzoate)
Bis(2-phenoxyethyl) ether	Di-n-propoxymethane	b,b-Oxydipropionitrile
Bis(4-chlorobutyl) ether	1,2-Epoxy-3-isopropoxypropane	1-Pentene
Bis(chloromethyl) ether	1,2-Epoxy-3-phenoxypropane	Phenoxyacetyl chloride
2-Bromomethyl ethyl ether	p-Ethoxyacetophenone	a-Phenoxypropionyl chloride
beta-Bromophenetole	1-(2-Ethoxyethoxy)ethyl acetate	Phenyl-o-propyl ether
o-Bromophenetole	2-Ethoxyethyl acetate	p-Phenylphenetone
p-Bromophenetole	(2-Ethoxyethyl)-a-benzoyl benzoate	n-Propyl ether
3-Bromopropyl phenyl ether	1-Ethoxynaphthalene	n-Propyl isopropyl ether
tert-Butyl methyl ether	o,p-Ethoxyphenyl isocyanate	Sodium 8-11-14-eicosatetraenoate
n-Butyl phenyl ether	1-Ethoxy-2-propyne	Sodium ethoxyacetylide
n-Butyl vinyl ether	3-Ethoxypropionitrile	Tetrahydropyran
Chloroacetaldehyde diethylacetal	2-Ethylacrylaldehyde oxime	Triethylene glycol diacetate
2-Chlorobutadiene	2-Ethylbutanol	Triethylene glycol dipropionate
1-(2-Chloroethoxy)-2-phenoxyethane	Ethyl-b-ethoxypropionate	1,3,3-Trimethoxypropene
Chloroethylene	Ethylene glycol monomethyl ether	1,1,2,3-Tetrachloro-1,3-butadiene
Chloromethyl methyl ether	2-Ethylhexanal	4-Vinyl cyclohexene
beta-Chloroethoxyphenol	Ethyl vinyl ether	Vinylene carbonate
o-Chorophenetole	2,5-Hexadiyn-1-ol	

21.0 Engineering Controls

21.1 GENERAL VENTILATION AND EXHAUST

The general ventilation system in laboratories must be well maintained with the laboratories operating under negative pressure. This negative pressure should be maintained in laboratories to ensure airflow into the laboratory from uncontaminated areas.

General ventilation will not be relied upon to protect employees from toxic exposures. Chemical hoods and other local exhaust system devices must be used for these purposes.

21.1.1 Air Changes

General ventilation should provide four to twelve (4 - 12) room changes per hour in laboratories where fume hoods are used as the primary method of control. Storage areas used for flammables must have at least six air changes per hour. Air should be 100% outside air (i.e., no re-circulation) in all active laboratories and chemical storage areas. Air removed from the laboratories through vents and ducts by general ventilation should be vented to the outside, not into the general facility circulation. Intake vents for the system should be far enough removed from the system's exit port to prevent cross-contamination. Ventilation from these areas is 100% exhaust.

21.2 CHEMICAL HOODS (DUCTED)

An important safety device in a laboratory is a properly functioning chemical hood. The chemical hood protects users from inhaling chemicals by constantly pulling air into the hood and exhausting it out of the building. Chemical hoods also provide protection in the event of an explosion or fire.

A chemical hood should be used when:

- Handling chemicals with significant inhalation hazards such as toxic gases, toxic chemical vapors, volatile radioactive material, and respirable toxic powders.
- Carrying out experimental procedures with strong exothermic reactions.
- Handling chemicals with a significant vapor pressure.
- Chemical vapors generated could cause a fire hazard.
- Working with compounds that have an offensive odor.
- Working with volatile chemicals with a PEL < 50 ppm.

21.2.1 Chemical Hood Operating Procedures

- Chemical hoods must operate with the average face velocity of 80-150 feet per minute (fpm) at a sash height of 18 inches with an optimum range of 80-120 fpm.
- **Confirm that the chemical hood is operational.** Check the air flow gauge if present. Check a telltale (a piece of paper attached to the bottom of the sash). The telltale should be noticeably pulled toward the back of the hood.
- Position the hood sash to a maximum of 18 inches high to ensure proper airflow velocities at the work opening. **Adjust the sash to shield it from splashes or flying objects.** In addition to aiding in proper airflow, the sash acts as a physical barrier in the event of an unplanned incident in the hood.
- **Keep hood storage to an absolute minimum**. Excess materials in the hood disrupt airflow and can act as a barrier or cause airflow to bounce back across the face of the hood. Do not take up hood space and block ventilation by storing unused equipment or chemicals in hoods. If large items must be kept in the hood, contact EHS for evaluation, certification, and a smoke test.
- **Keep all work at least six inches inside the hood.** The capture ability of a hood may not be 100% at the front of the hood.
- **Avoid cross drafts**. Someone walking rapidly past the work opening can create a cross draft that may disturb the direction of airflow and cause turbulence.
- **Keep the hood clean.** Remove old experimental glassware and clutter. Wipe up spilled chemicals or residues. Ensure the glass sash remains clear for visibility.
- **Do not heat perchloric acid in standard chemical hoods.** Perchloric vapors may create explosive perchlorates in the ductwork. Contact EHS prior to perchloric acid digestions.
- **Separate and elevate large equipment.** Use blocks or racks to elevate equipment one to two inches off the hood deck surface so that air can easily flow around all apparatus with no disruption.

- **Avoid opening and closing the hood sash rapidly and fast arm movements in front or inside the hood.** These actions may cause turbulence and reduce the effectiveness of hood containment.
- **Use extreme caution with ignition sources inside a hood.** Ignition sources such as electrical connections and equipment, hot plates, controllers, and open flame can ignite flammable vapors or explosive particles from materials being used in the hood.
- **Never put your head inside a hood while operations are in progress.** The plane of the sash is the imaginary boundary that should not be crossed except to set up or dismantle equipment.
- **Report airflow and physical structure problems to EHS and Facilities Management & Campus Operations as soon as possible. If a hood fails while working with highly hazardous materials, close the sash immediately.** Leave the immediate area and contact EHS for further assistance.
- **Lower the sash to a 2-inch opening when the hood is not being used.**

21.2.2 Chemical Hood Certification

Chemical hoods are tested and certified by EHS on an annual basis. EHS will contact Facilities Management & Campus Operations to repair chemical hoods which do not pass. Chemical hoods are tested with the sash at 18 inches.

- **PASS** – Chemical hoods with an average face velocity between 80-150 feet per minute (fpm) are passing and certified. The optimum range for average face velocity is 80 - 120 fpm.
- **RESTRICTED USE ONLY** – Chemical hoods with an average face velocity between 151 and 180 fpm are acceptable for restricted use only. Laboratories should not use acutely toxic, highly hazardous, or carcinogenic chemicals in hoods deemed for restricted use only.
- **FAIL** – Chemical hoods that fall below 80 fpm or exceed 180 fpm fail and must not be used until they have been repaired and pass a new EHS functional test.

21.2.3 Shutdown Notification

Notifications will be posted when chemical hood fans are shut down. For minor shutdowns affecting only a few hoods, notifications will be placed directly on each hood affected. For large shutdowns affecting large areas (e.g., an entire building), notifications will be posted in elevators and other public areas, as is done for other utility shutdowns.

21.3 CHEMICAL HOODS (DUCTLESS)

21.3.1 Performance Requirements

Ductless chemical hoods are used when the requirements of the lab are such that a ducted hood is not needed. The ductless chemical hoods make use of a filter bed that can filter such hazards as particulates, vapors, acids, and bases. The FDNY allows the use of these hoods for low-level use of some chemicals. The same performance standards apply for the use of these hoods as with ducted hoods, with the one addition that the filter system MUST be changed as per manufacturer's recommendations. Before a ductless hood is purchased or used, contact EHS for an evaluation to determine if the hood and filter(s) are acceptable for the hazard(s).

21.3.2 Use of Ductless Chemical Hoods

- Filters must be appropriate for the chemical(s) used.
- **These hoods are to be used with low levels of chemicals only.**
- Highly toxic, explosive, or reactive chemicals or procedures are not authorized.
- Filter usage must be tracked, and filters changed according to the vendor's recommendations.

21.3.3 Required Work Practices with Ductless Hoods

- **Hood fans should be turned on when in use.**
- Ensure that EHS has monitored hood face velocity within the last year before using the hood.
- Filters should be in good working condition.
- Set sash to the lowest position possible for maximum face velocity.
- Do not store chemicals and equipment in the hood.
- Wash hood work surface as often as necessary.

21.4 SPLASH SHIELD

Splash shields provide low cost and effective personal protection against splashes when:

- Pipetting or pouring materials.
- Using hand-held equipment to mix or homogenize materials.
- Working with materials under pressure.

22.0 Personal Protective Equipment (PPE)

Choose personal protective equipment and clothing based on the types of chemicals handled, the degree of protection required, and the areas of the body which may become contaminated. **All personal protective clothing and equipment must, at a minimum, meet standards set by the American National Standards Institute (ANSI).** Every effort must be made to evaluate the effectiveness of equipment and make improvements where possible. Special consideration must be given to purchasing appropriate PPE and other safety equipment when extremely hazardous substances are involved.

22.1 LABORATORY COATS AND OTHER PROTECTIVE CLOTHING

Laboratory coats must be worn when working in the laboratory. Appropriate laboratory coats should be worn fastened and with the sleeves rolled down. Lab coats must also be properly fitted for each laboratory member in order to provide the utmost protection. A fire-resistant laboratory coat is required when handling pyrophoric materials and other high fire hazard operations. Additional information on lab coats is available on the EHS website.

Lab coats should be removed before exiting the building, entering the cafeteria, restrooms, or any public area.

Depending on the nature of the work being conducted, additional or alternate protective clothing may be used by laboratory personnel including, lab aprons, shoe covers, coveralls, or sleeve covers.

Proper selection of laboratory coats and other protective clothing must consider the following characteristics:

- Ability to resist fire, heat, and chemicals used.
- Chemical impermeability.
- Comfort.
- Ease of cleaning (unless disposable).
- Ability to be removed during an emergency or chemical splash (e.g., fasteners instead of loop-buttons).

22.2 LAUNDRY SERVICES

Once a laboratory coat or other protective clothing has been used, it is considered contaminated and must then be laundered. Industrial laundry services must be utilized to clean laboratory coats and other protective clothing. Do not use local laundromats, dry cleaners, and/or personal washers and dryers to clean laboratory coats and other protective clothing that has been used in laboratories.

22.3 GLOVES

Gloves must be worn whenever there is a chance for hand contact with chemical, biological, radiological, and other laboratory materials. At a minimum, disposable latex or nitrile gloves should be worn. Disposable gloves are only intended to provide protection from incidental contact with chemicals. The addition of heavier weight gloves may be required if the chemicals involved are easily absorbed through the skin or are acute or chronic toxins.

There is a variety of gloves, both disposable and non-disposable, to resist degradation and permeation depending on the material they are made of and their thickness.

22.3.1 Glove Use Requirements

- Gloves must be selected based on the hazards of the experiment. See Section 22.3.2 for more information.
- **Lab personnel must inspect gloves prior to use.** No glove completely resists degradation or permeation and must be replaced periodically, depending on the frequency and duration of use as well as the working concentration of the reagents utilized.
- Disposable latex or nitrile gloves are not intended to provide protection from prolonged or repeated contact with chemicals. Disposable gloves must be removed if there is any sign of damage or contamination.

- Gloves with long cuffs or sleeve covers must be worn if the particular procedure causes the laboratory coat sleeve to provide insufficient protection to the entire arm area.
- **Wash hands thoroughly after removing gloves.**
- Re-usable gloves must be washed before removal except those permeable to water.
- **Two pairs of gloves should be worn if there is potential for hand contamination during removal.**
- **Remove at least one glove to open doors or press elevator buttons.**

22.3.2 Glove Selection and Glove Chart

- Lab personnel with latex allergies must be provided with latex-free gloves.
- Lab personnel should consult the glove manufacturer's permeation and resistance charts to ensure the glove provides adequate protection for the required duration of use and chemical hazards.

Gloves Recommended Use Guidelines

GLOVE TYPE	RECOMMENDED USE	GOOD FOR SPECIFIC CHEMICALS
Natural Rubber (Latex)	Good for dilute acids and bases Biologicals, buffers, water-based dyes Not good for chlorinated hydrocarbons, aromatic hydrocarbons, diethyl ether, ethidium bromide	Solutions of acetic, hydrochloric, sulfuric acids, ammonium hydroxide, sodium hydroxide, ethanol, isopropanol, methanol, formaldehyde, acetone
Nitrile Rubber	Good for a wide variety of solvents and petroleum products Not good for aromatic hydrocarbons, chlorinated hydrocarbons, acetone	Oils, greases, aliphatic hydrocarbons, DMSO, alcohols, acid solutions, formalin, ethidium bromide
Butyl Rubber	Good for ketones, esters and acids Not good for aliphatic, aromatic, chlorinated hydrocarbons, gasoline and petroleum products	Glycol ethers, acetone, ethanol,
Neoprene	Good for acids and bases, peroxides, petroleum products, hydrocarbons, alcohols, phenols Not good for halogenated and aromatic hydrocarbons	Ethanol, isopropanol, acetic acid, acetone, acetonitrile, DMSO, formalin, hydrochloric acid, ethidium bromide
Polyvinyl Chloride (PVC)	Good for acids and bases; limited for organics, amines, and peroxides; Not good for most organics	Solutions of acids and bases, alcohols
Polyvinyl Alcohol (PVA)	Good for aromatics, ketones, and chlorinated solvents; Not good for water-based solutions- PVA coating is water soluble	Benzene, toluene, chlorobenzene, chloroform, methylene chloride, carbon tetrachloride, hexane, carbon disulfide
Viton™	Exceptional for chlorinated and aromatic hydrocarbons	Benzene, toluene, chloroform, PCB's
Silver shield™/4H™	Laminated gloves with exceptional resistance for a large variety of chemicals, poor dexterity.	Aromatics, esters, chlorines, and ketones

22.4 EYE AND FACE PROTECTION

Laboratory personnel may need to wear eye protection when working in the laboratory with chemical, biological, radiological, and physical hazards.

22.4.1 Eye and Face Protection Standards

Eye protection must meet ANSI's "Practice for Occupational and Educational Eye and Face Protection," Z87.1 – 2020. Prior to use, personnel will verify that the equipment has been approved for the particular procedure (e.g., ANSI certified for chemical splashes but not for impact).

For labs, ANSI standards require a minimum lens thickness of 3 mm impact resistance, the passage of flammability test, and lens retaining frames.

22.4.2 Eye and Face Protection Selection

The following table should be consulted in choosing protective eyewear:

Condition Requiring Eye/Face Protection	Type of Eye/Face Protection Required
Handling of aqueous solutions, biologicals, mild corrosives	Standard safety glasses with side shields and brow guard
Handling strong corrosives, solvents, a large volume of chemicals	Chemical resistant goggles, indirect vents
Working with glassware under reduced or elevated pressure. Glassware in high-temperature operations	Impact protection glasses/goggles
Potential for flying objects, particles or chemical splash	Face shields for impact and splash
Vacuum system, reactions with potential for explosions	Both goggles and face shield
Lasers, ultraviolet, infrared or other light sources, glass blowing, welding, torch use	Specialized eye protection

22.4.3 Contact Lens Use

Contact lenses may be worn in a laboratory setting, as detailed in the Centers for Disease Control (CDC) and NIOSH publication *Contact Lens Use in a Chemical Environment.* **In the event of a chemical exposure, begin eye irrigation immediately and remove contact lenses as soon as practical.** Do not delay irrigation while waiting for contact lens removal. Contact lenses should be removed only in a clean environment after the workers have thoroughly washed their hands. Direct handling, application, or removal of contact lenses while in a chemical laboratory is prohibited. Standard eye protection requirements still apply.

22.5 RESPIRATORS

Under no circumstance is respiratory protective equipment to be used by any person at WCM unless approved by EHS pursuant to the EHS Program Manual 7.1 – Respiratory Protection Program available on the EHS website.

The Respiratory Protection Program requires training, fit testing, and medical exam consistent with the OSHA Respiratory Standard (Title 29, Code of Federal Regulations, Part 1910.134). **All respiratory protection must be chosen in conjunction with EHS, since there are strict legal requirements as to the use and distribution of these devices.**

Respirators must be worn in the lab when performing non-routine operations such as chemical waste disposal, spill response, or those procedures that pose a respiratory hazard, such as working with extremely toxic materials, or doing a procedure where the fume hood is not sufficient. These procedures will require the use of a negative pressure half face, full face, or self-contained breathing apparatus. Each lab must determine if any operations require the use of a respirator.

Respirators are available to those individuals who:

- Routinely clean up chemical spills.
- Work with toxic chemicals or gases that recommend respiratory protection.

- Work with chemicals in locations where chemical hoods are not available.
- Work with biologicals that require the use of a respirator, according to CDC guidelines and WCM Biosafety guidelines.

23.0 Emergency Equipment

23.1 EMERGENCY SAFETY SHOWERS

Emergency safety showers are required in laboratories where hazardous and corrosive materials are used. Promptly flush the exposed skin with water using a safety shower for at least 15 minutes. Remove any contaminated clothing to ensure the chemicals are washed away from the body. Seek immediate medical attention.

23.1.1 Safety Shower Locations and Flow Requirements

Showers must be located within 25 feet of every laboratory, storage area, or chemical preparation room entrance, and no point within the laboratory may be more than 10 seconds or 100 feet away.

23.1.2 Safety Shower Testing and Maintenance

Safety showers are tested annually and maintained by Facilities Management & Campus Operations.

23.2 EYEWASH STATIONS

Remove contact lenses if applicable, and promptly flush eye(s) using an eyewash for at least 15 minutes and seek immediate medical attention.

23.2.1 Eyewash Locations

The eyewash can be located next to the shower but is usually by a sink. **The eyewash station should be in a lab along a normal path of egress and should take no longer than 15 seconds to reach from any point in the laboratory.**

23.2.2 Eyewash Testing and Maintenance

Laboratory personnel should flush eyewashes weekly. Facilities Management & Campus Operations maintains and tests them.

23.3 FIRE EXTINGUISHERS

Portable fire extinguishers must be present in all laboratories, chemical storage, and preparation areas. Fire extinguishers should be located near doors of labs, storage, or work areas, or just inside or outside of the door so that when the occupant attempts to retrieve the extinguisher, they should be moving toward the exit.

Contact EHS at 646-962-7233 if:

- A fire extinguisher is missing.
- The needle of the pressure gauge is in the “recharge” zone (red).
- An extinguisher was discharged.

24.0 Laboratory Signage

The following signage is required for laboratories and is available from EHS.

24.1 HEALTH AND SAFETY DOOR SIGN

The Health and Safety Door Sign Program has been developed to help WCM personnel and potential emergency responders identify the hazards present in an area before entering the room.

At a minimum, an EHS door sign must be prepared and posted outside each doorway leading from a public hallway, and the hazard assessment must be inclusive of all the interior rooms. Additional EHS door signs can be prepared for the interior rooms, which more specifically identify the hazards in those specific areas.

24.2 SIGNAGE REQUIRED IN NEW YORK CITY

All laboratories or storage areas with hazardous materials in a facility located in New York City must have the following posted:

- LABORATORY - POTENTIALLY HAZARDOUS SUBSTANCES (must be in red lettering on a white background)
- NO SMOKING

24.3 SPECIAL HAZARD SIGNAGE

The following hazard signage is required when these materials are present in the laboratory:

- FLAMMABLE GAS
- WATER REACTIVE MATERIALS
- WARNING BIOHAZARDOUS MATERIALS
- RADIOACTIVE MATERIALS
- CHEMICAL WASTE SATELLITE ACCUMULATION AREA
- CHEMICAL STORAGE
- BIOWASTE STORAGE
- RADIOACTIVE WASTE STORAGE
- LASERS
- STORE NO FLAMMABLES FLASHING BELOW 100ºF (on standard refrigerators, cold rooms and freezers)

24.4 EMERGENCY EQUIPMENT AND EXIT IDENTIFICATION

Signs must also be posted indicating safety showers, eyewash stations, fire extinguishers, and Exits (illuminated) and should be legible and conspicuous.

25.0 Laboratory Outreach/Inspections

EHS will perform laboratory outreach/inspections on a routine basis to ensure compliance with the Standard Operating Procedure of this Plan, FDNY directives, and EPA regulations.

The inspections will look at issues such as:

- Signage
- Housekeeping
- Personal protective equipment use
- Chemical safety and hoods
- Chemical waste
- Fire safety and emergency equipment
- Biological safety, biosafety cabinets, and wastes
- Training and required records/documents

26.0 Waste Management

Refer to Manual 5.2 – WCM Waste Disposal Procedures Manual for waste management issues.

27.0 Laboratory Close-Out Procedures

Laboratories within WCM must be left in a state suitable for new occupants or renovation activities. The vacating Principal Investigator and Department are responsible for ensuring the disinfection of equipment and counters, electronics and fluorescent bulb recycling, and proper disposal of chemical, biological, and radioactive waste materials.

Laboratory space cannot be re-occupied, nor renovation work started until space has been inspected and cleared by EHS and the Health Physics Office. Once clearance is completed, the Laboratory Clearance Form (Appendix B) will be posted conspicuously in the laboratory.

The vacating Principal Investigator and Department must complete the following procedures before the laboratory space is cleared by EHS.

27.1 RADIOACTIVE MATERIALS (RAM)

All radioactive waste, lead pigs, lead bricks, sheeting, and radioactive sources from equipment must be properly transferred or disposed of. The licensee is responsible for the costs of disposal. A final contamination survey must be performed. Environmental Health and Safety/Health Physics (646-962-7233) is available for assistance with clearance.

27.2 BIOLOGICAL WASTE MATERIALS

- Place Sharps (e.g., syringes, Pasteur pipettes, serological pipettes, razor blades) in a Sharps container and complete the Sharps Collection Request online.
- Dispose of all solid media and supplies as red bag waste.
- Dispose of all other potentially biohazardous waste in red bags as red bag waste.
- Decontaminate all liquid media by autoclaving or by treating for 30 minutes with a bleach solution (final concentration to be 10%) before drain disposal.
- Decontaminate all work surfaces using a freshly prepared 10% bleach solution or 70% alcohol.

27.3 BIOLOGICAL SAFETY CABINETS (BSC)

- Remove the contents from the cabinets.
- Disconnect tissue culture media vacuum flask.
- Decontaminate all accessible surfaces with an appropriate disinfectant.
- A certified contractor must decontaminate the BSC if it is being relocated to a different room or a location outside of the building.
- Re-certify the BSC using a certified contractor when a BSC is relocated.
- If the BSC is not being moved and repair work will not open the contaminated inner space, then decontaminate surface with an appropriate disinfectant.

27.4 INTERNAL RELOCATION OF CHEMICALS

Lab personnel is allowed to transport chemicals from their current laboratory to the new laboratory in the same building (i.e., no transporting on sidewalks or across streets). Lab personnel must contact EHS to discuss transportation procedures, including cart usage, secondary containment, and chemical segregation. Upon relocation, the chemical inventory for the laboratory must be updated.

If the lab does not wish to move the chemicals, the lab can utilize the procedure for “External Relocation of Chemicals.” The lab is responsible for the costs of the outside contractor.

27.5 EXTERNAL RELOCATION OF CHEMICALS

Chemical moves to external locations must be transported by a hazardous material hauler approved by the U.S. Department of Transportation. EHS has agreements with vendors to provide this service. However, all related chemical move costs are the responsibility of the laboratory.

In order to utilize these services, lab personnel is required to:

- Remove all laboratory chemicals from shelves and cabinets and place them in a central location. Label the area “Chemicals to be moved.”
- The vendor will prepare all paperwork necessary for the chemical move.
- Upon relocation, update the chemical inventory.

27.6 CHEMICAL WASTE DISPOSAL

All chemical waste must be managed according to the WCM Waste Disposal Procedures. At a minimum, the following procedures must be followed:

- Complete and keep hazardous waste labels on all chemical waste containers. Hazardous waste labels are available free of charge by contacting EHS or downloading from the EHS website.
- Keep all chemical waste in an appropriate container (screw type lid) and closed at all times.
- Keep an area of the laboratory or other points of waste generation designated for chemical waste only and label it with the Chemical Waste Satellite Accumulation Area poster available from EHS.
- Use Salute to submit chemical waste collection requests.

- For disposal of various aqueous buffers and empty containers, refer to the WCM Waste Disposal Procedures – Drain and Trash Disposal of Chemicals.

27.7 DISPOSAL OF COMPRESSED GAS CYLINDERS

Remove regulators and replace the valve stem cap. Return gas cylinders to the supplying vendor. Contact EHS for non-returnable cylinders.

27.8 RELOCATING COMPRESSED GAS CYLINDERS

When laboratory relocations require crossing a public road (e.g., from 1300 York Avenue to the S building at 515 East 71 Street), compressed gas cylinders (including Liquid Nitrogen Cylinders) must be transferred by the supplying vendor. Contact the appropriate vendor to arrange the move.

27.9 LIQUID NITROGEN-LINED FREEZERS

The vendors supplying liquid nitrogen recommend that liquid nitrogen-lined freezers be drained to a minimum level (to sustain freezing of cells) before relocating. Liquid nitrogen freezers must be moved by the moving company, and the vendor should be scheduled to refill the freezers as soon as possible at the new location.

27.10 LABORATORY EQUIPMENT RELOCATION OR DISPOSAL

Equipment that has been used with hazardous materials must be decontaminated before it can be discarded, moved, repaired, or recycled. Complete the Equipment Decontamination Form online and email it to ehs@med.cornell.edu.

Follow the procedure before laboratory equipment is cleared:

- Remove all contents from laboratory equipment (e.g., chemicals, media, and glassware).
- Remove all bench coats and disposable liners/covers from equipment and dispose of in red bag waste.
- Decontaminate all surfaces of contamination-prone equipment, e.g., refrigerators, freezers, incubators, water baths, biological safety cabinets, and centrifuges with an appropriate disinfectant. Contact EHS for assistance.
- Equipment used with radioactive materials will need additional clearance by Environmental Health/Health Physics personnel.
- Freezers which have been used for the storage of biological materials must be unplugged and defrosted.
- Incubators and water baths must be drained of all standing water, including water inside the jacket.

27.11 ELECTRONICS RECYCLING

All electronics (central processing units, monitors, keyboards, printers, televisions, and scanners) must be separated from general trash and placed in a designated area for collection by Facilities. The designated area must be under the direct control of the generator (no hallway storage). All electronics must be clearly labeled with a dated, removable sign “to be recycled.” EHS will pay for the recycling cost. Departments must pay the Facilities Management & Campus Operations charge to move the equipment to the storage facility.

Facilities Management & Campus Operations can be reached at 212-746-2288 or https://facilities.weill.cornell.edu/

27.12 GENERAL LABORATORY CLEANUP

All laboratory areas must be thoroughly cleaned to ensure the removal of all hazardous residues. **All surfaces where hazardous chemicals have been used or stored must be washed with detergent and water, including bench tops, cabinets, drawers, and floors.**

Decontaminate accessible surfaces of furniture and other items that are to be removed from the laboratory to prevent harm to movers.

- Remove all bench coats and disposable liners/covers from work surfaces and dispose of in red bag waste.
- Empty and properly dispose of material from all drawers, cabinets, and fume hoods.
- Properly clean laboratory bench tops, cabinets, drawers, floors and fume hood surfaces (preferably with soap and water).

28.0 Training

Departments are responsible for ensuring that the training of their personnel is up to date. Laboratory personnel must receive annual Lab Safety Training. Training sessions are provided by EHS upon request or available on demand through the Learning Management System. For information on how to retrieve training records, visit the Training Records and Certificates section on the EHS website.

The following is an outline for all initial and annual refresher training:

1. Introduction
2. Standards and Regulations
3. Chemical Hygiene Plan
   - Standard Operating Procedures
   - Procedures for Toxics and Other Hazards
4. Information on Chemicals
   - (Material) Safety Data Sheets
   - Other information sources
   - Labels
5. Toxicology
   - Routes of Exposure
   - Target Organs
   - Acute and Chronic Exposures
6. Medical Monitoring
7. Chemical Classification
8. Receiving and Storage
9. Preventing Exposure
   - Substitution and Minimization
   - Engineering Controls
   - Personal Protective Equipment
10. SOPs and Laboratory Practices
11. Fire Department Regulations
    - Codes
    - Fire Extinguishers
12. Waste Disposal
    - Satellite Accumulation Area
    - Collecting Chemical Waste
    - Other Waste Streams
13. Spills
    - Small Spills
    - Large Spills

29.0 Record Retention and Availability

EHS maintains records on file for the following:

- Exposure monitoring
- Spill incidents
- Inspections
- Accidents
- Waste Manifests

Training records of all Chemical Safety and Waste Management training for the past year are available on the Weill Business Gateway. The EHS website has instructions for the retrieval of training records. For previous years, call the EHS office.

Certificates of training are available in each employee's Weill Business Gateway My Learning account or by request to EHS. To request a certificate from EHS, please email ehs@med.cornell.edu with the date of training and the training title.

30.0 Definitions

- **Carcinogens** are chemicals or substances capable of causing cancer. They are chronically toxic in that they cause damage through repeated or continuous exposures. The effects of exposure may only become apparent after a long latency period.
- **Certificate of Fitness** is a written statement issued by the FDNY certifying that the person to whom it was issued has passed an examination as to their qualifications to perform such work mentioned therein, and that they have authority to perform such work during the term specified.
- **Combustible Liquid** means a liquid mixture, substance, or compound having a flashpoint at or above 100ºF when tested in a Tagliabue closed cup tester.
- **Explosive Material** shall mean any quantity of Class A, Class B, or Class C explosives as classified by the Department of Transportation and any other chemical compounds or mixtures thereof used as the propelling or exploding material in any cartridge or other explosive device.
- The **Lower Explosive Limit** (LEL) and **Upper Explosive Limit** (UEL) values are the minimum and maximum concentrations of flammable gas or vapor between which ignition can occur. Concentrations below the LEL are too lean to burn, while concentrations above the UEL are too rich. All concentrations between LEL and UEL are in the flammable range, and special precautions are needed to prevent ignition or explosion.
- **Flammable Gas** means a gas that will form an explosive mixture upon concentration with air or which will ignite in air. Utility gas piped into a laboratory shall not be considered as flammable gas for the purpose of classification under these regulations.
- **Flammable Liquid** means any liquid mixture, substance, or compound which will emit a flammable vapor at a temperature below 100ºF when tested in a Tagliabue closed cup tester.
- **Flammable Solid** means a solid substance other than one classified as an explosive, which is liable to cause fire through friction, through absorption of moisture, through spontaneous chemical changes, or as a result of retained heat from manufacturing or processing. Examples are white phosphorous, nitrocellulose, metallic sodium and potassium, and zirconium powder.
- **Flash Point** is the lowest temperature at which a flammable liquid gives off sufficient vapor to form an ignitable mixture with air near its surface or within a vessel.
- **Hazardous chemical** means any chemical which has a physical hazard or a health hazard.
- **Health hazard** means any chemicals which are carcinogens, toxic or highly toxic agents, reproductive toxins, irritants, corrosives, sensitizers, hepatotoxins, nephrotoxins, neurotoxins, agents which act on the hematopoietic system, and agents which damage the lungs, skin, eyes, or mucous membranes.
- **Laboratory** is a generic term denoting a building, space, equipment, or operation wherein testing, research, or experimental work is conducted and shall include laboratories used for instructional purposes.
- **Laboratory Unit** means an enclosed, fire-rated space used for testing, research, experimental or educational purposes. Laboratory units may or may not include offices, lavatories, and other contiguous rooms maintained for, or used by, laboratory personnel, and corridors within the units. It may contain one or more separate laboratory work areas.
- **Laboratory Work Area** means a room or space within a laboratory unit for testing, analysis, research, instruction, or similar activities which involve the use of chemicals or gases. A work area may or may not be enclosed.
- **Lethal Concentration 50 (LC_{50})**: The concentration of a material in the air that, based on laboratory tests, is expected to kill 50 percent of a group of test animals when administered as a single exposure (usually 1 to 4 hours).
- **Lethal Dose 50 (LD_{50})**: A single dose of a material expected to kill 50 percent of a group of test animals. The dose is expressed as the amount per unit of body weight, the most common expression being milligrams of material per kilogram of body weight (mg/kg of body weight). Usually refers to oral or skin exposure.
- **Oxidizing Material** means a substance that yields oxygen readily to support combustion. Examples are chlorates, permanganates, peroxides, and nitrates.
- **Physical Hazard** means a chemical for which there is scientifically valid evidence that it is a combustible liquid, a compressed gas, explosive, flammable, an organic peroxide, an oxidizer, pyrophoric, unstable (reactive), or water-reactive.
- **Reactive (Unstable) Chemical**. - Reactive (unstable) chemical means a substance, other than one classified as an explosive or blasting agent, which will vigorously and energetically react, is potentially explosive, will polymerize or decompose instantaneously, undergo uncontrollable auto-reaction, or can be exploded by heat, shock, pressure or combinations thereof. Examples are pyrophoric, water-reactive, and organic peroxides.
- **Reproductive Toxins** are defined by the OSHA Laboratory Standard as substances that cause chromosomal damage (mutagens) and substances with lethal or teratogenic effects on the developing fetus.

- **Select Carcinogens** are defined by the following criteria:
  - Are regulated by OSHA as a carcinogen; or
  - Are listed under the category, "known to be carcinogens," in the Annual Report on Carcinogens published by the National Toxicology Program (NTP) (latest edition); or
  - Are listed under Group 1 ("carcinogenic to humans") by the International Agency for Research on Cancer Monographs (IARC) (latest editions); or
  - Are listed in either Group 2A or 2B by IARC or under the category, "reasonably anticipated to be carcinogens" by NTP, and causes statistically significant tumor incidence in experimental animals in accordance with any of the following criteria:
    - After inhalation exposure of 67 hours per day, 5 days per week, for a significant portion of a lifetime to dosages of less than 10 mg/m3;
    - After repeated skin application of less than 300 (mg/kg of body weight) per week; or
    - After oral dosages of less than 50 mg/kg of body weight per day.
- **Storage Cabinet** means a cabinet for the storage of flammable liquid which is designed and constructed as required by “OSHA General Industry Standards - Flammable and Combustible Liquids.”
- **Storage Room** means a room where chemicals or gases are stored and not otherwise used or reacted.
- **Threshold Limit Values** (TLVs) are guidelines prepared by the American Conference of Governmental Industrial Hygienists, Inc. (ACGIH) to assist industrial hygienists in making decisions regarding safe levels of exposure to various hazards found in the workplace.
- **TLV-TWA**: The allowable Time Weighted Average concentration for a normal 8-hour workday (40-hour work week).
- **TLV-STEL**: The short-term exposure limit or maximum concentration for a continuous 15-minute exposure period (maximum of four such periods per day, with at least 60 minutes between exposure periods) and provided the TLV-TWA is not exceeded.
- **TLV-C**: The ceiling exposure limit is the concentration that should never be exceeded, even instantaneously.

31.0 References

- WCM EHS Program Manuals
- OSHA Code of Federal Regulations Title 29, Part 1910.1450 – Occupational Exposure to Hazardous Chemicals in Laboratories
- OSHA Code of Federal Regulations Title 29, Part 1910.1200 – Toxic and Hazardous Substances
- FDNY Fire Department Rules
- FDNY C14 Study Material
- CDC-NIOSH Current Intelligence Bulletin 59 – Contact Lens Use in a Chemical Environment, June 2005
- OSHA Code of Federal Regulations Title 29, Part 1910.1000 – Table Z-1 Limits for Air Contaminants