



American University

WASHINGTON, DC

RISK MANAGEMENT &

ENVIRONMENTAL HEALTH & SAFETY SERVICES

CHEMICAL HYGIENE PLAN

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www.american.edu/finance/rmehs/

1.0 Purpose

American University is committed to providing a safe environment for all community members and visitors. This Chemical Hygiene Plan (CHP) establishes policies and procedures to ensure the safe use of hazardous chemicals within all University-owned laboratories.

The purpose of this plan is to protect laboratory workers' health and ensure that chemical exposures are minimized. It also defines roles and responsibilities for working with hazardous chemicals, details provisions for lab worker training, outlines emergency procedures, and establishes several safety practices that must be observed when handling hazardous chemicals.

1.1 Program Scope

This plan applies to all laboratory personnel employed by the university who work with, use, store, or handle hazardous chemicals. This document is discussed and made available to students working in all science laboratories during laboratory safety training and is always available on the AU website. It is intended to provide overarching structure and guidance to all science research laboratories.

1.2 Regulations

This CHP complies with Occupational Safety and Health Administration (OSHA) regulations contained in 29 Code of Federal Regulations (CFR) 1910.1450, the "Occupational Exposure to Hazardous Chemicals in the Laboratory" standard and 29 CFR 1910 Subpart Z, "Toxic and Hazardous Substances."

2.0 Roles and Responsibilities

Successful implementation of the CHP is dependent on clearly defined roles and responsibilities. The roles and responsibilities of laboratory personnel are described below.

2.1 EH&S and Chemical Hygiene Officer (CHO)

The CHO is responsible for administering the CHP and minimizing the health hazards of potentially hazardous chemicals used in the laboratories. This position is located within the Environmental Health & Safety (EH&S) office and ensures that regulatory and university requirements for hazardous chemicals are met.

The CHO's principal duties include, but are not limited to:

- Ensure that appropriate policies and procedures are implemented at the department level;
- Understand the regulatory requirements associated with the use of potentially hazardous chemicals;
- Conduct regular chemical hygiene inspections;
- Respond to all health and safety concerns;

- Maintain training and waste records;
- Ensure that all laboratory personnel receive required safety and hazardous waste training; and
- Review and update the CHP as needed, at least annually.

2.2 Department Chair

The Department Chair is responsible for ensuring that the Chemical Hygiene Plan is implemented for their department. At a minimum, responsibilities include, but are not limited to:

- Understand the regulatory requirements associated with the use of potentially hazardous chemicals;
- Monitor the procurement, storage, use, and disposal of laboratory chemicals;
- Establish and enforce appropriate chemical hygiene policies and procedures;
- Ensure the availability of Safety Data Sheets and/or other reference material;
- Ensure that all laboratory personnel receive required safety and hazardous waste training;
- Inform the CHO of all health and safety concerns;
- Review the Standard Operating Procedures (SOPs) created by faculty; and
- Submit CHP updates and improvements to the CHO.

2.3 Principal Investigator/Laboratory Supervisor

Principal investigators and laboratory supervisors have the following responsibilities for chemical hygiene in the laboratory:

- Maintain an up-to-date copy of the AU Chemical Hygiene Plan;
- Establish research/laboratory-specific safety procedures;
- Create special procedures for the storage, use, and disposal of particularly hazardous chemicals;
- Maintain an accurate and up-to-date chemical inventory of their laboratory;
- Ensure the availability of Safety Data Sheets (SDSs) and/or other available reference material;
- Ensure proper labeling and storage of chemicals;
- Implement the recommendations of the CHO, Department Chair, and/or department heads;
- Ensure that required training has been received;
- Ensure that laboratory personnel understand and implement chemical hygiene policies;
- Ensure that appropriate personal protective equipment (PPE) is available and maintained in good condition;
- Select appropriate chemical exposure control measures;
- Monitor the disposal of all hazardous materials; and
- Report all incidents resulting in either personal injury or property damage to the CHO.

2.4 All Personnel Who Handle Hazardous Chemicals

All personnel who handle potentially hazardous chemicals are required to:

- Plan and conduct each laboratory operation in accordance with the requirements of the CHP, good laboratory practices, and as described in the appropriate SOPs;

- Apply all recommended exposure controls (e.g., laboratory hoods or other engineered controls, PPE, or safety equipment provided);
- Participate in all required training programs;
- Respond appropriately to emergencies as directed;
- Report all accidents resulting in personal injury or property damage to the laboratory supervisor; and
- Report all hazardous conditions and safety concerns to their supervisor.

3.0 Hazard Communication

3.1 Inventory

Everyone in control of hazardous chemicals should maintain an accurate chemical inventory in order to minimize waste, track reporting limits, and comply with hazard communication laws. The College of Arts and Sciences uses the external ChemInventory site to manage their chemical inventory. Each chemical container should be barcoded and uploaded to the site prior to storing on American University property and should be removed from the site once empty or discarded. EH&S conducts a yearly inventory reconciliation process to facilitate accuracy of the chemical inventory.

3.2 Chemical Labels

Labeling requirements for all hazardous substances are summarized as follows:

- All containers of hazardous materials must be labeled with the identity of the hazardous substance. The chemical name must be spelled out, no chemical nomenclature or shorthand.
- The label must contain all applicable hazard warning statements.
- The name and address of the chemical manufacturer or other responsible party must be present.
- Manufacturer's product labels must remain on all containers and must not be defaced in any way as long as it still holds the original chemical.
- Labels must be legible and in English.
- Secondary containers (such as spray bottles) must be labeled with the identity of the substance and appropriate hazard warnings.
- Newly synthesized compounds (compounds made within the lab) must be labeled with the appropriate hazard warnings based on the knowledge of the chemical and physical properties of that substance.



3.3 Safety Data Sheets










Safety Data Sheets (SDSs) must be maintained for each hazardous chemical used or stored on university-owned property. These may be maintained in physical or digital format. Refer to the EH&S website for SDS resources. SDSs that comply with the Globally Harmonized System, or GHS, are preferred.

The format for the GHS SDS is as follows:

Section No.	Heading	Components
1	Identification of substance and supplier	GHS product identifier Recommended use of the chemical and restrictions on use Supplier's details (name, address, phone number) Emergency phone number
2	Hazards identification	GHS classification of the substance GHS elements, including precautionary statements
3	Composition/information on ingredients	Chemical identity Common name, synonyms, etc. CAS number, EC number, etc. Impurities and additives that contribute to the classification of the substance
4	First aid measures	Description of necessary measures, subdivided according to different routes of exposure Most important symptoms/effects Indication of immediate medical attention and special treatment needed
5	Firefighting measures	Suitable extinguishing media Specific hazards arising from the chemical Special protective equipment and precautions for firefighters
6	Accidental release measures	Personal precautions, protective equipment, and emergency procedures Environmental precautions Methods and materials for containment and cleaning up
7	Handling and storage	Precautions for safe handling and storage
8	Exposure controls/personal protection	Control parameters Appropriate engineering controls Individual protection measures, such as PPE
9	Physical and chemical properties	Appearance, odor, odor threshold, pH, melting point/freezing point, boiling point and range, flash point, evaporation rate, flammability, vapor pressure, vapor density, relative density, solubilities, partition coefficient, autoignition temperature, decomposition temperature
10	Stability and reactivity	Chemical stability Possibility of hazardous reactions Conditions to avoid Incompatible materials Hazardous decomposition products
11	Toxicological information	The likely routes of exposure Symptoms Delayed and immediate effects Measure of toxicity
12	Ecological toxicity	Ecotoxicity, degradability, bio accumulative potential
13	Disposal considerations	Description of waste residues and information on their safe handling and disposal, including contaminated packaging
14	Transport information	UN Number, UN proper shipping name, transport hazard classes, packing group, special transport precautions
15	Regulatory information	Safety, health, and environmental regulations specific to the product in question
16	Other information	Preparation and revision dates of the SDS

3.4 GHS Pictograms

Pictograms are used on all GHS-compliant Safety Data Sheets and chemical labels to characterize the most prominent hazards associated with that chemical. The nine pictograms and their meanings are summarized below.

	Acute toxicity (fatal or toxic)		Carcinogen Respiratory sensitizer Reproductive toxicity Target organ toxicity Mutagenicity Aspiration toxicity		Flammable Self-reactive Pyrophoric Self-heating Emits flammable gas Organic peroxide
	Corrosive		Oxidizer		Explosive Self-reactive Organic peroxide
	Gas under pressure		Environmental toxicity		Irritant Dermal sensitizer Acute toxicity (harmful) Narcotic effects Respiratory tract irritation

3.5 Signs and Placards











Laboratory entry signs at American University help visitors and first responders quickly identify science laboratory spaces, which typically have restricted entry requirements and may contain unique hazards. They also convey precautions that should be observed upon entering spaces and provide emergency contact information.

Researchers, Public Safety, and Facilities Management are trained to understand the information on the entry signs so that they can make the best use of the information should they need to reference it.

3.5.1 Description

Signs are 8.5" x 11" prints placed either directly on or adjacent to the hallway access point (door) of the laboratory.





- Each sign is composed of six sections, each of which presents important safety information to lab workers, visitors, and first responders.
- The signs do not convey all hazards that may be present in the lab at any given time but are meant to be a good starting point in case of an emergency.
- The entry requirements and hazards sections contain symbols, which are adopted from OSHA, ANSI, and ISO 3864-2 standards. Each symbol and section are described in further detail below.






<h1>CAUTION</h1>			
LABORATORY ENTRY BY AUTHORIZED PERSONNEL ONLY			
Hall of Science		LL17	11/2023
CHEMICAL HAZARDS			OTHER HAZARDS
			 
Explosives	Flammables	Oxidizers	Biosafety level 2 Radioactive materials
SAFETY PRECAUTIONS			
			
Compressed gases	Corrosives	Toxics	Safety glasses
			
Health hazards	Irritants		Gloves
Nearest spill kit: Inside room			
			No food or drink
			
			Safety training
Contact	Name	Phone	Alternate Phone
Primary	Heather McClary	202-885-2007	214-477-2772
Alternate	Fabiola Fernandez	202-885-2541	787-475-6803
EH&S	Heather McClary	202-885-2007	214-477-2772
Public Safety Emergency: 202-885-3636			

Date and Location



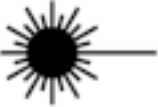

The Date and Location section includes information on the building and room number to which the sign refers. It also includes the date the sign was last updated.

Chemical Hazard Warning Symbols







	Chemicals that may react violently when exposed to heat, friction, or physical shock
	Liquids with a flash point below 199.4°F (93°C) and/or solids that are readily combustible or may cause or contribute to fire through friction
	Oxidizing materials that may cause other materials to ignite and/or explode
	Gas under pressure

	Acidic or basic chemicals present that can severely damage the skin or eyes
	Exposure to chemicals may cause immediate and possibly serious health problems or death
	Limited exposure to these chemicals can cause serious health effects, including cancer, cellular mutations, and/or damage to an embryo or fetus
	Exposure to chemicals may cause inflammation or irritation, especially involving the respiratory system
	Liquids with a boiling point below -240°F (-180°C)

Other Hazard Symbols

	Potentially cancer-causing radioactive materials present
	Biohazardous materials present
	Any level of laser present; may be contained within equipment or unshielded
	High-powered magnet present

Safety Precautions Symbols

	Foot protection is required. Minimally, this means closed-toe shoes.
	Some form of hand protection is required – typically this is for thermal or chemical protection (e.g., nitrile, latex, temperature-resistant mitts).
	Laboratory coats must be worn while in the lab.
	Impact-resistant safety glasses should be worn while working.
	Food and drink are not permitted in the lab.
	Personnel must complete safety training before entering laboratory

Nearest Spill Kit

Kits containing chemical spill clean-up materials are distributed throughout the building. The location of the closest spill kit is indicated here.

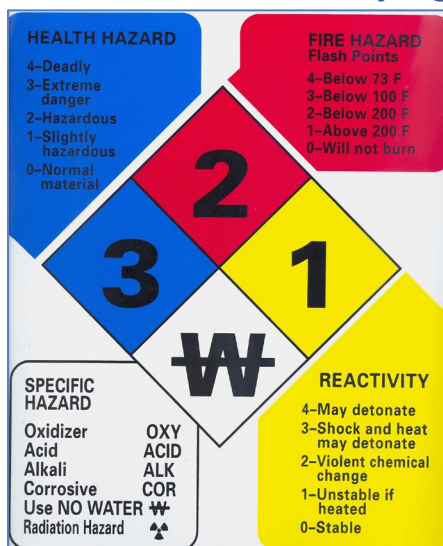
Emergency Contact Information

This section contains phone numbers for the primary contact (typically the Principal Investigator) and an alternate contact (graduate assistant or other knowledgeable person designated by the primary contact).

Sign Request and Information Changes

Lab entry signs are updated annually by the EH&S office. Signs are based on the results of annual Laboratory Safety Surveys and chemical inventory reconciliation. To request an updated sign at other times, contact the Environmental Health & Safety office.

3.5.2 Other laboratory signs and symbols



NFPA Diamonds

An NFPA diamond may be placed on the exterior door of a space containing hazardous chemicals. This information is meant to aid emergency response personnel in the case of a fire or other emergency incident.



The biohazard symbol is used to denote areas or objects that either contain or meet biological agents.



The radiation symbol is used to denote areas or objects that either contain or encounter radioactive materials or radiation-producing equipment. This typically includes items such as radio chemicals and x-ray machines.

4.0 Classes of Hazardous Chemicals

Whenever feasible, less hazardous chemicals should be substituted for all select carcinogens, reproductive toxins, or acutely toxic chemicals.

Individuals working with hazardous chemicals should consult SDSs, warning labels, and/or other sources of chemical information to become knowledgeable about the chemical's hazards prior to working with it.

Chemicals that may easily become airborne (e.g., gases, volatiles, powders) should be dispensed and handled in a chemical fume hood.

4.1 Select Carcinogens

Select carcinogens are those substances recognized by the National Toxicology Program (NTP) and/or the International Agency for Research on Cancer (IARC). OSHA has also identified carcinogens in 29 CFR 1910.1003.

IARC has evaluated over 850 chemicals, mixtures, and exposures (agents). The IARC database is available on the internet at www.iarc.fr.

IARC classifies agents as:

- **Group 1** – The agent is carcinogenic to humans.
- **Group 2A** – The agent is probably carcinogenic to humans.
- **Group 2B** – The agent is possibly carcinogenic to humans.
- **Group 3** – The agent is unclassifiable as to carcinogenicity in humans.
- **Group 4** – The agent is probably not carcinogenic to humans.

Laboratory supervisors should consider the need for and, as appropriate, require use of the following exposure controls for carcinogens on an as-needed basis:

- Work should be conducted in a "designated area" such as a laboratory fume hood, glove box, or designated portion of the laboratory where all personnel with access know the potential hazards.
- Plans must be prepared to include details on personal protection, area equipment, decontamination, and appropriate PPE.
- Plans for using and disposing of these substances should be prepared and approved by the Department Chair prior to initiation of activities. Disposal shall be in accordance with federal EPA and District regulations and should be coordinated with the university CHO.

4.2 Reproductive Toxins

Reproductive toxins may affect both or either gender; therefore, the same recommendations previously listed for work with select carcinogens are to be applied when working with reproductive toxins. Often, this information is identified on the chemical's SDS.

OSHA has specific standards for lead (1910.1025), dibromochloropropane (1910.1044), 1,3-butadiene (1910.1051) and ethylene oxide (1910.1047), and they are specifically identified as reproductive toxins.

Various links for reproductive toxins can be found on OSHA's web page at www.osha.gov. The National Institute for Occupational Safety and Health (NIOSH) also publishes lists of known toxins, which can be found <http://www.cdc.gov/niosh/rtecs/>.

4.3 Peroxide Formers

Organic peroxides (see lists on page 13) are low-power explosives that are extremely sensitive to shock, sparks, or other forms of accidental ignition. They are also sensitive to heat, friction, impact, and light as well as to strong oxidizing and reducing agents. Their slow decomposition may auto-accelerate into an explosion. Therefore, their shelf lives are limited.

All peroxide formers are extremely flammable, and fires involving bulk quantities of peroxide formers should be approached with extreme caution. Peroxide formers should be stored away from heat and light in closed vessels. Refrigeration is recommended. Precautions for handling peroxide formers include:

- Clearly label all containers of peroxides or peroxide-formers with BOTH the date of receipt and the date of opening. EH&S provides appropriate labels.
- Store peroxide formers at the minimum safe temperature to reduce the rates of decomposition.
- Do not refrigerate liquid or solutions of peroxides at or below the temperature at which the peroxide freezes or precipitates. Peroxides in these forms are extremely sensitive to shock and heat.
- Follow the manufacturer's recommendation for shelf life.
- Limit the quantity of peroxide to be handled to the minimum amount required.
- Do not use glass containers with screw-cap lids or glass stoppers.
- Do not return unused solvent to the container.
- Avoid exposure to vapor.
- Clean-up incidental spills immediately.
- Do not use solutions of peroxide-formers in volatile solvents under conditions in which the solvent will be vaporized, thereby increasing the peroxide concentration in the solution.
- Never use a metal spatula with peroxide. Use ceramic or wooden spatulas.
- If crystal formation or precipitation is observable in a peroxide forming material, do not move it. EH&S must be notified immediately, and a deactivation scheduled.

Peroxide-forming chemicals (see lists on page 13) must be monitored and discarded in accordance with the following procedures:

- Adhere to the following guidelines regarding peroxide-forming chemicals:
 - List A: discard or evaluate for peroxides upon expiration, or 3 months after receipt, and then every 3 months thereafter

PEROXIDE-FORMING CHEMICAL		
Date Received:		
Date Opened:		
Date to Discard / Begin Testing:		
Testing Record		
Date:	PPM:	Initials:
Date:	PPM:	Initials:
Date:	PPM:	Initials:

- Lists B and C: discard or evaluate for peroxides upon expiration, or 18 months after receipt, and then every 6 months thereafter
- Procedure for peroxide evaluation:
 - Don appropriate eye protection, lab coat, closed toe shoes, and gloves.
 - Without being moved, visually inspect peroxide forming material in question for crystal formation. If crystals are visible, the container must be discarded as chemical waste.
 - If no crystals are visible, move the container to the nearest fume hood. Adjust the sash to the lowest possible height that allows free manipulation of a pipette.
 - Use a pipette to transfer a drop of sample to a 0-100 ppm peroxide test strip. The results of the test strip shall be interpreted as follows:
 - <25 ppm is considered safe for use
 - 25-50 ppm is not suitable for most laboratory processes, especially those involving heat, distillation, or concentration
 - >50 ppm is considered an immediate hazard and must be discarded as chemical waste
 - Record the results of the testing on the chemical label and share results with EH&S for recordkeeping.

4.3.1 List of Peroxide-Forming Chemicals

List A: Peroxide formation from storage	
1,3-butadiene	Chloroprene
Diisopropyl ether	Vinylidene chloride
Tetrafluoroethylene	1,5-Hexadien-3-yne

List B: Peroxide formation from concentration	
Benzyl alcohol	Acetaldehyde
Diethyl acetal	Dicyclopentadiene
Methyl isobutyl ketone (4-methylpentan-2-one)	(±)-2-butanol (sec-butyl alcohol)
4-Methyl-2-pentanol	4-penten-1-ol
Cyclohexanol	2-cyclohexen-1-ol
Tetrahydrofuran	Decalin
1,2-dimethoxyethane	Methylcyclopentane
Cyclohexene	Cumene
Diglyme	1-phenylethanol
Tetralin	Diethyl ether
Isoamyl alcohol (3-methyl-1-butanol)	2-pentanol
1,4-dioxane	(±)-2-Hexanol
1,3-butadiyne	Isopropanol
4-Heptanol	Propyne
2-phenylethanol	

List C: Peroxide formation from polymerization
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Styrene	Vinyl chloride
4-vinylpyridine	Vinylidene chloride
2-vinylpyridine	Acrylic acid
1,3-butadiene	Chlorotrifluoroethylene
Acrylonitrile	Methyl methacrylate
Vinyl acetate	Chloroprene
Tetrafluoroethylene	1-buten-3-yne

4.4 Picric Acid

Dry picric acid is highly explosive. Commercially supplied picric acid contains ten to fifteen percent water. When the moisture content is less than ten percent, picric acid must be handled with extreme care because it is sensitive to shock, heat, and sparks. Avoiding additional drying is critical.

To maintain ten percent or more moisture in a container of picric acid, weigh the container upon receipt from the supplier and record the weight. Before opening, weigh the container again. If there has been a weight loss, assume it contains less than ten percent water and do not open the container. Immediately contact the CHO to arrange for appropriate disposal.

Old bottles of picric acid may contain crystalline deposits under the cap that may be destabilized (explode) by opening the bottle. IF IN DOUBT, DO NOT OPEN. Do not attempt to open any bottles with evidence of crystal formation. Contact the CHO to arrange for deactivation and disposal.

4.5 Perchloric Acid

Perchloric acid is a powerful oxidizing agent that may react explosively with reducing agents and organic compounds. It may only be used in a specially constructed water wash-down fume hood that is inspected frequently. Bottles of perchloric acid should be kept on glass or ceramic trays that have enough volume to hold all the acid in case the bottle breaks.

4.6 Formaldehyde

Formaldehyde is powerful irritant and potential carcinogen. Formaldehyde vapors are irritants and can cause burning of the upper respiratory tract and eyes. The recognition of formaldehyde vapors by odor and eye irritation becomes less sensitive with time as one adapts to formaldehyde. This desensitization can quickly lead to overexposure. Skin contact with formaldehyde should be avoided because it may cause irritation and allergic contact dermatitis. OSHA has established a specific standard for worker exposures to formaldehyde in 29 CFR 1910.1048.

4.7 Flammable and Combustible Liquids

Flammable and combustible liquids shall be stored in compliance with OSHA requirements as outlined in 29 CFR 1910.106 and the DC Fire Code. In general, flammable and combustible liquids will be stored in

appropriate containers inside metal storage cabinets designed and constructed in accordance with 29 CFR 1910.106(d)(3). Flammable materials shall not be stored in refrigerators or freezers that are not designed for this purpose.

Flammable storage cabinets must be clearly marked and remain closed when not in use. Container size limitations for flammable and combustible liquids are summarized in Appendix C.

When a flammable liquid is withdrawn from a drum, or when a drum is filled, both the drum and other equipment should be individually electrically grounded and bonded to each other.

Flammable liquids must never be used in the vicinity of an open flame. When flammable liquids are used in the fume hood with electrical equipment, the equipment must be spark-proof.

4.8 Compressed Gases

Compressed gases are hazardous because of the potential energy of compression and because the gas may be toxic, flammable and/or act as an asphyxiant if released in a confined area. Compressed gas cylinders must be used and stored in accordance with National Fire Protection Association (NFPA) guidelines and in accordance with Compressed Gas Association, Inc. (CGA) Handbook for Handling Compressed Gases.

Written procedures must be developed and implemented for each compressed gas used. The procedures must describe allowable use, engineering and administrative controls, and required PPE, as applicable.

Toxic gases may not be used without prior submission of written procedures to the CHO and Department Chair. Examples of toxic gases include:

- Boron trifluoride,
- Carbon monoxide,
- Chlorine,
- Chlorine trifluoride,
- Dimethylamine,
- Ethylene oxide,
- Fluorine,
- Hydrogen bromide (hydrobromic acid),
- Hydrogen chloride (hydrochloric acid),
- Hydrogen fluoride (hydrofluoric acid),
- Hydrogen sulfide,
- Iodine pentafluoride,
- Methyl bromide (bromomethane),
- Methyl chloride,
- Nitric oxide,
- Nitrogen dioxide,
- Nitrogen chloride,
- Phosgene,
- Silicon tetrafluoride, and
- Sulfur dioxide.

Cylinder size of flammable gases is limited to 200 cubic feet. Valves of flammable gas cylinders must be closed before the laboratory is vacated at the end of the workday.

If a cylinder of toxic or flammable gas is leaking the area should be evacuated and public safety must be contacted to determine the proper course of action.

4.8.1 Pre-Acceptance Requirements

Prior to acceptance of cylinder gases from vendors, the cylinders shall be visually inspected to determine if they meet the following requirements:

- The contents of the cylinder(s) must be identified with decals, stencils, glue, or wired-on tags. Color codes alone or tags hung around the necks of cylinders are not acceptable.
- Cylinders must not be accepted unless the valve safety covers are in place and properly tightened.
- Vendors moving cylinders in university buildings must use hand trucks, carts, or dollies. Cylinders must always remain secure and may not be rolled for distances greater than three feet. Compressed gas cylinders should never be dragged.

4.8.2 Storage Requirements

The following handling and storage requirements will be followed for compressed gases:

- Laboratory personnel must receive training on storage, handling, and hazard precautions prior to use of compressed gases. This training must be documented.
- Compressed gas cylinders shall not be moved unless the protective valve cover is securely in place. The valve safety covers must remain in place until the cylinder is secured to a wall, bench, or other stable structures.
- Compressed gas cylinders shall be moved on cylinder carts, hand trucks, or dollies specifically designed for this purpose. The valve safety covers must be in place and the cylinder secured to the cart during transport.
- Compressed gas cylinders shall not be rolled a distance greater than three feet. Compressed gas cylinders shall never be dragged.
- Compressed gas cylinders shall be secured at all times to prevent them from falling. They may be secured with a chain, canvas strap(s), or a floor stand.
- Piping and manifolds must be constructed of materials compatible with gas in the cylinder.
- The main valve cylinder shall be opened only as far as necessary to produce the required gas flow and closed when the gas is not required.
- Cylinders shall be checked for leaks when received in the laboratory and before and after attachment of the regulator.
- Reserve cylinders shall not be stored in the laboratory.
- Cylinders shall be stored outside or in a separate room designed to meet NFPA standards for storage of compressed gas. Cylinders stored outside must be protected from the weather and tampering by a covered and enclosed area providing safe access and adequate security.
- Laboratories with toxic gases shall be equipped with proper escape respirators. Detection alarms may additionally be appropriate. Employees using these gases must be part of the University's Respiratory Safety Program.
- Empty cylinders shall be labeled as such as promptly removed. A small amount of gas should be left in the cylinder and the valve closed to prevent contamination of the inside of the cylinder.
- Never attempt to refill an empty cylinder.

4.9 Radioactive Materials

Any work involving radioactive materials shall be conducted in accordance with Nuclear Regulatory Commission (NRC) rules and regulations and procedures and practices established in the university's Radiation Safety Manual. Some minimum practices to be observed include:

- All areas where there is a radiation hazard shall be physically isolated and appropriate signs posted to prevent persons from entering the area without being aware of the radiological hazard. Signs having the radiation symbol will be the standard for radiation hazards. The symbol will also be used to distinguish radioactive source containers.
- Individuals approved to procure and use radioisotopes are responsible for ensuring radioactive materials in their laboratories are properly used and secured. All required surveys will be conducted and documented.

5.0 Reducing Exposure to Hazardous Chemicals

Engineering controls (such as local exhaust ventilation), administrative controls, and personal protective equipment are used to control employee exposure to chemicals. It is AU's policy to conduct personal exposure monitoring whenever there is reason to believe that chemical exposure levels for a substance exceed the OSHA action level or Permissible Exposure Level (PEL).

Should occupational exposures exceed OSHA action limits (typically 50 percent of the OSHA PEL), monitoring will be conducted periodically in order to accurately assess personnel exposure. The activity that the employee is conducting that generates the exposure will also be reviewed to find methods that limit the exposure. Periodic monitoring will be discontinued in accordance with OSHA standards when monitoring reveals exposures below OSHA limits.

Employees will be notified by the CHO of monitoring results within 15 working days following receipt of any monitoring results.

5.1 Engineering Controls

Engineering controls employ the use of mechanical devices to alleviate vapors and fumes that personnel might get exposed to. They include:

5.1.1 General Ventilation

The air pressure in laboratories should be negative relative to adjacent areas and corridors. Laboratory exhaust should provide 4 to 12 air changes per hour to maintain good ventilation and make-up air. All exit ports from spectrometer units should be connected to an efficient hood if the possibility of toxic substances being released from the spectrometer exists.

5.1.2 Fume Hoods

The chemical fume hood will help prevent the workers from exposing themselves and other coworkers to toxic chemicals. The fume hood sash shall be always closed unless work is being conducted inside.

Employees should use chemical fume hoods whenever their work exposes them or their coworkers to hazardous chemicals, and whenever feasible. Hoods shall not be used to dispose of volatile chemicals via evaporation and should not be used for chemical storage, except for small quantities of highly toxic chemicals.

Only essential equipment should be stored inside the hood and should not block vents or restrict airflow inside the hood. All attempts should be made to ensure that the airflow within the hood is not obstructed, as this decreases the efficiency of the hood. All work in the hood should take place at least six inches back from the front sash. Fume hoods shall be spot-checked by the employee for airflow before each use (a spot-check can be made by holding a tissue up to the hood opening to see if it is drawing air). If the fume hood does not draw air, the employee shall not use the hood and should contact the building equipment manager for repair. Adequate airflow is typically defined as a face velocity of 60 to 100 linear feet per minute (lfpm) with the sash open to a workable height. The sash height must be maintained below the breathing height of the laboratory worker.

Procedures involving the use of acutely hazardous chemicals, potentially volatile liquids, finely divided solid chemicals, or where there is the potential for explosion shall be conducted in a laboratory hood or other suitable containment. Volatile radioactive material must be used in appropriately filtered fume hoods.

Laboratory fume hoods should be equipped with a continuous monitoring device to allow convenient confirmation of adequate hood performance before use, such as a pressure gauge (e.g., magnehelic gauge) or electronic air flow meter. If the monitoring device is not functioning properly, please submit a 2Fix ticket.

Laboratory personnel should understand and follow these guidelines:

- A fume hood is a safety device that collects vapors and fumes. It is not to be used to dispose of chemicals by evaporation.
- Any apparatus inside the hood shall be placed six inches back away from the sash bottom edge.
- The fume hood sash shall be always closed unless work is being conducted inside.
- The hood fan shall always be on.
- In the event of a power failure, all work activity in the hood shall cease and the sash should be closed.
- Inspect hood vents and fans frequently for cleanliness and to see that they are clear of obstructions. If any problems are found, contact the CHO.

5.1.3 Fume Hood Annual Testing and Certification

The CHO is responsible for making sure that annual quantitative evaluations of all laboratory fume hoods are performed. Average acceptable face velocities range between 80 and 120 linear feet per

minute (lfpm). The sash is lowered to a point where optimal average face velocity readings are obtained (e.g., 100 lfpm).

Laboratory personnel must ensure that the fume hood is uncluttered for the annual test. Results of this quantitative inspection are posted on a sticker on the fume hood, dated and initialed by the inspector. Hood test data is kept on file by the CHO.

The presence of adequate make-up air in the laboratory fume hood room is evaluated on an as-needed basis. Make-up air needs to be provided to compensate for the air exhausted out of the fume hood. To prevent excessive cross-drafts and ensure the validity of the fume hood face velocity readings, the background air velocity (measured with the fume hood fan off) from the make-up/supply air should not exceed 25 lfpm in front of the fume hood.

5.2 Biosafety Cabinets

Biosafety cabinets protect the user and surrounding environment from pathogens by moving air from the front of the fume hood and filtering the air through a HEPA filter prior to exhausting the air back into the room. A HEPA filter does not protect against most chemical vapors and therefore should only be used when working with biological agents.

5.2.1 Annual testing and certification

The CHO is responsible for the annual evaluation of all laboratory biosafety cabinets. The inflow (100-120 lfpm) and downflow (50-60 lfpm) velocities are measured and fan speeds are adjusted accordingly. Lab personnel must ensure that the cabinet is decontaminated and uncluttered for the annual test. Results of this quantitative inspection are posted on a sticker on the face of the cabinet. Test certifications are kept on file by the CHO.

5.3 Laminar Flow/Clean Benches

Clean benches filter air from the room and move it down and out the front, toward the user. The clean bench is used when the researchers wish to protect the sample from contamination but offers no protection to the user.

5.3.1 Annual testing and certification

The CHO is responsible for the annual evaluation of all clean benches. The downflow velocity (80-120 lfpm) is measured and fan speeds are adjusted accordingly. Lab personnel must ensure that the bench is decontaminated and uncluttered for the annual test. Results of this quantitative inspection are posted on a sticker on the face of the bench. Test certifications are kept on file by the CHO.

5.4 Local Exhaust Ventilation

Local exhaust ventilation is used when ventilation for a small-scale process is needed. They can be either ducted or filtered and are often found in animal research facilities where anesthesia and other gases may be administered on a benchtop.

If you are using a filtered local exhaust ventilation system, make sure you understand the limitations of the filter(s) installed in the device.

5.4.1 Annual testing and certification

Snorkels are monitored annually by EH&S. There is no set airflow standard for local exhaust ventilation; airflow is compared across years to ensure continued performance. Test results are kept on file by the CHO.

5.5 Administrative Controls

Policies, or administrative controls, have been set in place to ensure personnel protection when engineering controls alone are not adequate. These measures are described below.

5.5.1 General Procedures

The following minimum general safety rules will be followed in all university laboratories:

- No running, jumping, or horseplay will be tolerated.
- No employee shall work alone in a laboratory or chemical storage area when performing a task that is considered unusually hazardous by the Department Chair.
- No laboratory worker shall work alone outside of normal business hours without proper notification and/or the use of personal panic alarms.
- Spills shall be immediately addressed in accordance with the Emergency Response guidelines in this document. Small spills on bench tops shall be cleaned immediately to prevent contact with skin or clothing.
- Lifting of heavy items should be performed in the proper fashion (using legs to lift and not the back).
- Minors may not enter laboratories unless they are part of a university-recognized program (see *Children on Campus and Working with Minors Policy* www.american.edu/policies/)
- Animals (except for research animals) are not allowed in laboratories.
- No sandals or open-toed shoes shall be allowed in laboratories.

5.5.2 Personal Hygiene

Workers should promptly wash the skin after contact with chemicals. If special cleaning agents are required, they should be on-hand prior to working with the chemical.

Clothing worn in the laboratory shall offer protection from splashes and spills, shall be easily removable in case of an accident, and shall be fire resistant. Nonflammable, nonporous aprons typically offer the most satisfactory and least expensive protection. Lab jackets or coats should have fasteners (either snaps or buttons) that can be readily removed. These coats shall be fastened closed when working in the laboratory and removed prior to exiting the laboratory.

If lab coats are not used in the laboratory, then long sleeves and long pants must be worn when students, staff or faculty are using hazardous materials.

Disposable gloves and safety eyewear must be worn when manipulating hazardous materials.

Laboratory clothing should be kept clean and replaced when necessary. Clothing should be replaced or laundered using appropriate decontamination procedures whenever contamination is suspected.

Lab coats and gloves are not to be worn outside the laboratory, especially in rest room or break facilities. Any lab coats, respirators, or other protective gear must be left in the lab areas. Employees are responsible for washing their personal protective equipment. Typically, this should be performed with soap and water. Solvents should not be used.

Inhalation is one of the four modes of entry for chemical exposure. "Sniff testing" should not be performed.

Remove jewelry, bracelets, and watch if they may interfere with the experiments, become a hazard, or be contaminated by the experiments. Long hair should be tied back, preventing it from falling into the eyes or face. Do not eat, drink, smoke, or apply cosmetics or lotions in the laboratory or chemical storage areas.

5.5.3 Housekeeping

The laboratory must be kept as clean as the work allows. Each laboratory employee shall be responsible for maintaining the cleanliness of the laboratory.

- Reagents and equipment shall be returned to their proper place after use. Contaminated or dirty glassware shall be placed in specific cleaning areas and not allowed to accumulate. Chemicals (especially liquids) shall never be stored on the floor, except in closed-door cabinets suitable for the materials being stored. Large bottles (2.5 liters or larger) shall not be stored above the bench top.
- Reagents, solutions, glassware, or other apparatus shall not be stored in hoods. Besides reducing the available workspace, they may interfere with the proper airflow patterns and reduce the effectiveness of the hood as a safety device.
- Counter tops shall be kept neat and clean. Bench tops shall not be used for chemical storage. All work done in fume hoods should be performed in the "Safety Zone" (6 inch minimum from the sash).
- Stored items and equipment should not project beyond the front shelf or counter limits.
- Shelves used to store chemicals outside of cabinets must have lips or guards.

- Stored items shall never block access to fire extinguishers, safety showers/eyewashes, safety equipment, or other emergency equipment.
- Stairways, hallways, passageways/aisles and access to emergency equipment and/or exits must be maintained in a dry condition and not be obstructed in any fashion, including storage, equipment, and wiring.
- All working surfaces and floors should be cleaned regularly.
- All containers must be labeled with the identity of their contents and the hazards associated with those chemicals, including chemicals in non-original containers. All chemicals in waste containers must be identified and the relative quantities of each identified.
- All chemical containers, including hazardous waste bottles, must be capped when not in use. Parafilm and foil covers are not appropriate for long-term storage.
- All hazardous waste containers must be labeled using the University's Hazardous Waste label and stored within secondary containment.

5.5.4 Standard Operating Procedures

Supervisors shall prepare Standard Operating Procedures (SOPs) for operations within their laboratories that involve hazardous chemicals. These SOPs shall address all safety considerations, such as but not limited to, the area in which the work will be performed (e.g., fume hood, glove box), safety equipment to be used, precautions to be observed, and the PPE necessary.

SOPs shall be available to all employees and shall be used in conducting the task described.

Personnel must be trained in the SOPs and this training must be documented. A format template for SOPs is attached as Appendix B.

Before performing laboratory work, the laboratory user must:

- Review research protocols and/or SOPs carefully.
- Be familiar with the location and use of safety facilities such as first aid, fire extinguishers, showers, eyewash fountains, and exits.
- Ensure that safety equipment is readily available and in good condition.
- Be familiar with safety precautions specified in the SDSs of the chemicals to be handled, and
- Plan for emergency situations.

5.6 Personal Protective Equipment (PPE)

PPE is used after all administrative and engineering controls have been applied and will be provided by the departments.

Personnel must adhere to the following guidelines regarding PPE use in the laboratories:

- Selection of appropriate PPE depends on the work to be performed;
- Chemical, biological, physical, and environmental factors;
- Expected duration of exposure;
- Temperature; and
- Other factors.

5.6.1 Laboratory Coats

All laboratory workers at AU are required to have laboratory coats. These coats are to be worn in the laboratory and removed when the employee does not need the protection they provide, that is, when the employee leaves the laboratory.

- Lab coats shall have fasteners (either snaps or buttons) so that they can be readily removed and shall be fastened closed when working in the laboratory.
- Employees must understand that laboratory coats are used to prevent contamination of their personal clothing and, in performing their function, may become contaminated. Wearing potentially contaminated laboratory coats outside of the laboratory could expose others unnecessarily to hazardous chemicals.
- Lab coats may only be cleaned by an appropriate laundry provider. Lab coats may not be taken home or to public laundry facilities. If lab coats are grossly contaminated with hazardous materials, they must be disposed of as hazardous waste.

5.6.2 Gloves

Proper protective gloves shall be worn whenever there is a potential for contact with toxic, corrosive, or infectious materials and materials of unknown toxicity. Where available, the manufacturer's guidance on the SDS should be consulted to aid in determining the need and type of protective gloves.

No single material is resistant to all chemicals and the appropriate glove material must be based upon the chemical(s) to be handled and the chemical resistance (or permeability) of the glove.

- Permeation rates will vary, and the allowable time that a glove may be used should be based on the permeation characteristics of the glove material and the relative toxicity (or hazard) of the chemical(s) being used. This information may be obtained from the manufacturer of the glove.

Before each use, gloves should be inspected for discoloration, punctures, and tears. For especially toxic materials, only new gloves should be used and the gloves should be pressure tested prior to use. Double layering of gloves with an inner and outer layer provides additional protection. Both layers should be resistant to the chemical(s) being used.

Disposal frequency of reusable gloves should be determined in advance of use based upon contamination encountered, time of exposure, and length of use. Disposable gloves should not be washed and reused.

Gloves must be worn whenever it is necessary to handle sharp-edged objects or exposure to very hot or very cold materials. Leather gloves or heavy cotton gloves must be used for handling broken glassware, for inserting glass tubes into rubber stoppers and for similar operations where protection from chemicals is not needed. Insulated gloves should be worn when working at temperature extremes. Various synthetic materials such as Nomex® or Kevlar® can be used briefly up to 1,000° F and may be used in combination with other materials such as leather.

5.6.3 Eye Protection

Protective eye and face protection are required whenever there is a reasonable probability of injury to the eye or face that could be prevented by such equipment. Therefore, eye protection is required whenever there are potential hazards including flying objects, liquids, injurious radiation, or combination of these hazards. Safety glasses must be ANSI-approved (ANSI Z87.1) and have protective side shields.

As a general rule, safety glasses are required to be worn by any person in a laboratory where active operations are occurring.

- Safety goggles should be worn in situations where a splash of liquid or the presence of airborne particulates may cause potential injury to the eye.
- Face shields are required whenever there is a potential of exposure to materials that may cause injury to the face (such as corrosives, toxic liquids, or exploding glass).
- The use of a face shield does not alleviate the requirement to wear appropriate safety glasses or goggles beneath the face shield.

5.6.4 Respirators

Respirators have not been issued at AU because there is no reason to suspect that exposure levels exceed the OSHA action levels or PELs. However, any laboratory worker that desires additional protection for certain unusual operations should contact the CHO to enroll in the Respiratory Protection Program.

The employee must be trained in respiratory protection, undergo medical evaluation, and be fit-tested before being issued a respirator. Due to the quantities and properties of chemicals used, and the availability of engineered exposure controls, the likelihood of inhalation exposure is judged to be small. Therefore, no respirators have been issued for personal protection.

General PPE Selection Guide

	PPE to be Considered	Use Considerations
ACID/BASE EXPOSURE HAZARDS	Face Shields Butyl Rubber Gloves Neoprene Gloves Tyvek Coveralls Safety Glasses Goggles Laboratory Coat Splash Apron	Face shields offer optimum facial protection (including eyes) from accidental acid splashes. Safety goggles or glasses will not adequately protect facial skin. Gloves should be used to protect hands and arms when manually handling acids. Butyl rubber and neoprene are appropriate for many acids, but the product material must be determined based on the specific chemical. Workers should be trained in emergency procedures (e.g., spill response, clean-up, use of emergency eye wash station).
CHEMICAL EXPOSURE HAZARDS	Latex Gloves Nitrile Gloves Half-face Respirator Full-face Respirator Cloth Coveralls Disposable Tyvek Coveralls	Face shields offer optimum facial protection (including eyes) from accidental splashes. Safety goggles or glasses will not adequately protect facial skin. Latex gloves can protect against most biological dermal exposures but may result in subsequent latex sensitivity to certain susceptible

	Splash Apron Eye Protection	workers. Nitrile gloves will protect against many chemical hazards, but material compatibility and permeation rates must be reviewed to ensure the appropriate glove material is selected. Although respirator use is not anticipated, half-face respirators, equipped with proper chemical cartridges, may be used only if splash hazards are minimal. Full-face respirators protect against facial skin and eye exposure and increase the level of respiratory protection. Aprons, and laboratory coats will help minimize dermal exposures and contamination migration.
EYE/FACE HAZARDS	Safety Glasses Safety Goggles Face Shield	Depending on construction, goggles with impact-resistant lenses can protect against large particles and projectiles as well as vaporized chemicals and splashes. Safety glasses also afford protection against large particles and projectiles, although somewhat more limited. Note that face shields, although often suitable for splashes, are typically not adequate for projectiles. Areas where eye hazards from chemicals exist typically require the installation of emergency eye wash stations.

6.0 Chemical Exposure Assessment

6.1 Medical Consultations and Examinations

Medical examinations and consultations shall be made available to employees, arranged by the university's Risk Management and Environmental Health and Safety department, and will be provided to employees under the following conditions:

- Whenever an employee develops signs or symptoms of overexposure associated with a hazardous chemical to which the worker may have contacted in the laboratory.
- Where exposure monitoring reveals an exposure level routinely above the action level (or in the absence of an action level, the PEL) for an OSHA-regulated substance for which there are exposure monitoring and medical surveillance requirements.
- Whenever an event takes place in the work area such as a spill, leak, explosion or other occurrence resulting in the likelihood of a hazardous exposure.

The CHO will provide the following information to the physician:

- The identity of the hazardous chemical(s) to which the worker may have been exposed.
- A description of the conditions under which the exposure occurred, including quantitative exposure data, if available.
- A description of the signs and symptoms of exposure that the employee is experiencing.

After the medical consultation and/or examination, the doctor will issue a written opinion to the employee, which includes:

- Any recommendation for further medical follow-up;
- The results of the medical examination and any associated tests;
- The presence of a medical condition which could place the employee at increased risk as a result of exposure to a hazardous chemical found in the laboratory; and

- A statement that the doctor has informed the employee of the results of the consultation or medical examination and any medical condition that may require further examination or treatment.

After the medical consultation and/or examination, the medical officer will issue a written opinion to AU that includes:

- The result of the medical examination (pass/fail); and
- The presence of any medical condition that would place the employee at an increased risk.

All findings unrelated to occupational exposure shall remain confidential between the physician and the employee and shall not be included in the written opinion. The written opinion will be available to the CHO upon request. This information will be considered confidential and will be discussed only for the purposes of avoiding similar exposures in the future and for improving hazard controls in the workplace.

6.1.1 Records and Recordkeeping

Accurate records shall be maintained for any measurement taken to monitor employee exposures and any medical consultation and examinations including tests or written opinions required by the laboratory standard.

- Exposure records shall be maintained by the Risk Management and Environmental Health and Safety department. AU's contracted medical doctor will maintain the medical records.
- These records shall be kept during the worker's employment at AU and for a period of at least 30 years thereafter.
- All records concerning laboratory hoods and biosafety cabinets shall be kept by the CHO. These records include performance testing and maintenance.

7.0 Chemical Storage and Transport

7.1 Chemical Labeling

Each chemical in the laboratory must be properly labeled. Most chemicals are shipped with a manufacturer's label, which contains all necessary information. These labels should not be removed or damaged as long as they accurately reflect the contents of the container.

Each chemical bottle, including diluted chemical solutions, must be labeled with its contents and its associated hazards. It is also recommended that each bottle be dated when received and when opened to assist in determining which chemicals are expired.

When new chemicals and compounds are generated by laboratory operations, they must be labeled with the name, date, and hazard information. The owner of the chemical should also be listed in case questions arise about the container's contents.

Peroxide forming chemicals (e.g., ethers) can degrade to form shock sensitive, highly reactive compounds and must be labeled with the date of receipt and on first opening the bottle. These

chemicals are only allowed for a one-year shelf life before they must be either be tested for peroxides or disposed of. The most recent test date must be listed on the label.

7.2 Chemical Storage and Segregation

Class of Chemical	Recommended Storage Method	Examples	Incompatibilities (See SDS)
Compressed gas, flammable	Store in a cool, dry area away from oxidizing gases. Strap or chain cylinders to a wall or benchtop.	Methane, acetylene, propane	Oxidizing and toxic compressed gases, oxidizing solids
Compressed gas, oxidizer	Store in a cool, dry area, away from flammable gases and liquids. Strap or chain cylinders to a wall or benchtop.	Oxygen, chlorine, bromine	Flammable gases
Compressed gas, poison	Store in a cool, dry area away from flammable gases and liquids. Strap or chain cylinders to a wall or benchtop.	Carbon monoxide, hydrogen sulfide	Flammable and/or oxidizing gases
Corrosive, acid	Store in separate storage cabinet	Mineral acids – hydrochloric acid, sulfuric acid, nitric acid, perchloric acid, chromic acid, chromerge	Flammable liquids, flammable solids, bases, oxidizers
Corrosive, base	Store in separate storage cabinet	Ammonium hydroxide, sodium hydroxide	Flammable liquids, oxidizers, poisons, acids
Shock sensitive material	Store in secure location away from all other chemicals	Ammonium nitrate, nitro urea, picric acid, trinitroaniline, trinitroanisole, urea nitrate, zirconium picramate	Flammable liquids, oxidizers, poisons, acids, bases
Flammable liquid	In grounded flammable storage cabinet	Acetone, benzene, diethyl ether, methanol, ethanol, toluene, glacial acetic acid	Acids, bases, oxidizers, poisons
Flammable solid	Store in a separate dry, cool area away from oxidizers, corrosives, and flammable liquids	Phosphorous	Acids, bases, oxidizers, poisons
General chemical, non-reactive	Store in designated chemical stock area, preferably behind glass doors or below eye-level	Agar, sodium chloride, sodium bicarbonate, most non-reactive salts	See SDS
Oxidizer	Store in secondary containment inside a non-combustible cabinet, separate from flammable and combustible materials	Peroxides, perchlorates, chlorates, nitrates, bromates, superoxides	Reducing agents, flammables, combustibles
Poison	Store separately in vented, cool, dry area, in unbreakable chemically resistant secondary containment	Cyanides, heavy metals	Flammable liquids, acids, bases, oxidizers

Water-reactive	Store in a dry, cool place, protect from water fire sprinkler and other potential sources of water intrusion	Sodium, potassium, and lithium metals, lithium aluminum hydride	Separate from all aqueous solutions and oxidizers
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7.3 Chemical Security

The proper security of chemicals is necessary to maintain research integrity and educational capacity of university laboratories and storerooms and to promote the health and safety of the campus community at-large.

Although the University's laboratories typically hold chemicals in small quantities, chemical hazards are not always proportional to the volume of the chemical. Therefore, access to chemicals, chemical processes, and associated equipment is strictly limited to individuals trained in their safe use, storage, and disposal.

- Access control measures are in place to provide physical locks and electronic monitoring of entrance and exit-ways.
- Doors to laboratory spaces must be secured when individuals responsible for the lab are not immediately present.
- Laboratory supervisors are expected to make reasonable efforts to secure hazardous chemicals from loss, theft, and use by unintended or untrained individuals.
- All laboratory personnel are expected to abide by all laboratory security requirements set by their supervisors and the University.

7.4 On-Campus Distribution of Hazardous Chemicals

Precautions must be taken when transporting hazardous substances between laboratories.

- Chemicals must be transported between stockrooms and laboratories in break-resistant, secondary containers such as bottle carriers made of rubber, metal, or plastic, that include carrying handle(s) and which are large enough to hold the contents of the chemical container in the event of breakage.
- Compressed gas cylinders must be strapped down with a rope or chain during transfer.
- Only individuals trained to handle hazardous materials and knowledgeable about the hazards associated with the materials they are handling may transfer hazardous chemicals between buildings.
- At no time are chemicals permitted to be transferred in personally owned vehicles.

7.5 Off-Campus Distribution of Hazardous Chemicals

The transportation of hazardous chemicals and compressed gases over public roads, or by air, is strictly governed by international, federal, and state regulatory agencies, including the U.S. Department of Transportation (DOT) and the International Air Transport Association (IATA).

Any person who prepares and/or ships hazardous materials must comply with pertinent regulations regarding training, quantity, packaging, and labeling. Without proper training, it is illegal to ship

hazardous materials. Those who violate the hazardous materials shipment regulations are subject to criminal investigation and penalties.

University personnel who sign hazardous materials manifests, shipping papers, or those who package hazardous material for shipment, must be trained and certified by EH&S. Individuals who wish to ship or transport hazardous materials off-campus must contact EH&S for assistance prior to transporting the materials.

At no time are chemicals permitted to be transferred in personally owned vehicles.

8.0 Training

All chemical users including employees will be provided with information and training by the CHO (or designee). Training shall be provided at the time of an employee's initial assignment to a work area where hazardous chemicals are present and prior to assignments involving new exposure situations. The frequency of refresher information and training shall be determined by the employer. Topics shall include:

- The contents and availability of this document;
- The names and phone numbers of the of the CHO and Department Chair;
- The location of Hazardous Substance Inventories and SDSs for their area;
- Utility of SDSs;
- Awareness regarding the release or presence of a hazardous chemical;
- General laboratory safety procedures;
- Proper use of fume hoods;
- Available equipment for protection from the hazards of chemicals;
- Policies and procedures regarding the disposal of hazardous wastes;
- Emergency procedures; and
- These training requirements.

Laboratory-specific training must be provided to all new personnel by the PI/Laboratory Supervisor.

9.0 Regulated Waste Management

9.1 What is regulated waste?

Regulated waste is any waste stream other than municipal solid waste that is regulated by at least one of the following agencies: EPA, OSHA, DOT, NRC, DEA. Examples of regulated waste include blood/other potentially infectious materials, radioactive materials, hazardous chemicals, biological agents, and controlled substances.

Because these waste streams have varying legal restrictions on storage, transportation, and disposal, it is important to understand the specific requirements of the waste materials you generate. If you have questions or are unsure about the proper methods of disposal for your waste, contact the Environmental Health & Safety office for guidance.

9.2 Chemical Waste

Characteristic hazardous waste chemicals (flammable, reactive, corrosive, toxic), such as solvents, acids, bases, water/air sensitive materials, and heavy metals.

Chemical waste must be managed in accordance with U. S. EPA Hazardous Waste Regulations (40 CFR, Parts 260 through 272) and District of Columbia Hazardous Waste Regulations.

All researchers are responsible for proper management of chemical waste accumulation in their labs. In these areas, the waste must be managed as follows:

- Chemical waste containers must have an AU hazardous waste label affixed to them and include an “accumulation start date” denoting the date that wastes were first put into the container.
- The contents of the container must be written on the label. The chemical constituents must be spelled out (no chemical nomenclature or shorthand) in the “Chemical Composition” column.
- All hazardous waste containers must be kept closed except when adding or removing waste (this also applies to containers holding instrument effluents). This requirement minimizes waste evaporation.
- Containers used for waste must be in good condition and made of material compatible with the waste it contains.
- Hazardous waste containers must be placed in chemically compatible secondary containment (e.g., a tub) of suitable capacity to contain the chemical should the primary container leak.
- Wastes should be segregated by compatibility for safety purposes and to allow for economic waste disposal. Some examples of incompatible chemicals are provided in Appendix D.

HAZARDOUS WASTE		Accumulation Start Date:
American University EHS (202) 885-2007		
Chemical Composition	%	
ASSOCIATED HAZARD(S)		
<input type="checkbox"/> Corrosive	<input type="checkbox"/> Reactive	<input type="checkbox"/> Flammable
<input type="checkbox"/> Toxic	<input type="checkbox"/> Oxidizer	<input type="checkbox"/> Non-Haz
<input type="checkbox"/> Other:		
Generator:	Labeled By:	
Department:	Bldg & Room:	

Note: Absolutely no hazardous chemicals shall be poured down the drain or placed in ordinary, non-hazardous trash containers. Broken and contaminated glassware must be placed in puncture-resistant receptacles.

Any questions concerning waste management should be directed to the Risk Management and Environmental Health and Safety department or the CHO.

9.2.1 Screening for Contamination or Formation of Hazardous Byproducts

Chemicals likely to contain contaminants (e.g., PCBs) or form hazardous byproducts over time (e.g., peroxide-formers) require precautionary testing prior to disposal. Waste chemicals suspected of contamination or hazardous byproducts must be designated as such by checking the "Other" option and providing relevant details in the blank space provided.

9.2.2 Transfer of Chemical Waste to a Satellite Accumulation Area

When a waste container is at capacity or the waste generation process has come to an end, the container should be securely capped or closed and transferred to the satellite accumulation area in Hall of Science T04. Prior to transfer, verify that the label is filled out.

Note: Uncapped waste containers or containers that have been closed using Parafilm or foil will not be accepted into the waste stream. Departments are responsible for providing secure waste storage containers to store and transfer their waste to the satellite accumulation area.

9.3 Sharps

Materials: Broken glass, sharp plastic, plate glass, Pyrex.

- If not contaminated with an infectious agent, dispose of material in a glass waste box. When full, close it securely and bring it to the designated waste accumulation area for pick-up.

Materials: Glass pipettes, needles, syringes, scalpel blades, razor blades, glass microscope slides and coverslips.

- These items must be disposed of in a sharps container.
- When a container is 3/4 full, close it and place it in a medical waste box provided by EH&S. Prior to the scheduled medical waste pick-up, tape the medical waste box closed and label it "sharps."
- Sharps waste and other pathological waste must be in separate boxes and may not be mixed.
- No box may exceed 40 pounds.

9.4 Animal Bedding

Soiled animal bedding generated from IACUC-approved research activities.

- Soiled animal bedding that is non-infectious (Biosafety Level 1) should be double bagged, knotted or taped closed, and placed in the designated waste bin to be disposed of via the regular trash. No bag should exceed 40 pounds.
- Biosafety Level 2+ labs must dispose of all animal bedding waste as medical waste, with red bags and biohazard boxes. Biohazard boxes are picked up by EH&S at pre-arranged times and upon request.

9.5 Biological Waste

Experimentally cultured stocks, plates, ethidium bromide gels, (non-sharps) materials contaminated with blood or other potentially infectious materials, materials contaminated with human mutagens, teratogens, carcinogens, or federal listed Select Agents.

- Place medical waste in red bags only. When full, close bags and place in cardboard medical waste box provided by EH&S. Contact EH&S to schedule pick-up. Prior to a scheduled medical waste pick-up, tape boxes shut.
- Boxes must be under 40 pounds apiece. Boxes exceeding 40 pounds will not be picked up.
- If material can be autoclaved or otherwise sterilized so that it no longer presents a biological or sharps hazard, it may be disposed of as regular waste.

9.6 Pathological Waste

Animal carcasses, tissues, and organs generated from IACUC-approved research activities.

- Bag and store all animal carcasses in the designated freezer only.
- Within 6 hours of a scheduled medical waste pick-up, pack bags in the biohazard boxes provided by EH&S and tape shut.
- Boxes must be under 40 pounds each. Boxes exceeding 40 pounds will not be accepted.

9.7 Research Equipment

Any apparatus used in the laboratory for research purposes, such as liquid scintillation counters, gas chromatography instruments, refrigerators, incubators, and chemicals storage cabinets. This includes filters from biosafety cabinets, ductless fume hoods, air purifications units, etc.

- Research equipment contaminated with any hazardous material must be decontaminated by a qualified individual prior to recycling or disposal. If the equipment cannot be decontaminated, it must be disposed of as the hazardous waste in contains.

9.8 Radioactive Materials

All waste containing materials that emit ionizing radiation.

- No amount of radioactive material may be discharged into the sewage system (including all drains and toilets) or otherwise released into the environment.
- Store in the restricted laboratory's waste accumulation area and segregate by the isotope's half-life.
- For isotopes with half-lives less than 125 days, the Radiation Safety Officer will transfer waste to the decay-in-storage area at quarterly intervals and upon request.
- Isotopes with half-lives greater than 125 days cannot decay in storage. The Radiation Safety Officer will transfer waste to the waste storage area on a quarterly basis and upon request.
- Do not mix solid/dry waste products with liquid waste regardless of the isotopes involved.
- Waste containers will be provided by the University's Environmental Health and Safety office or must meet the specifications set by the Radiation Safety Officer.

9.9 Controlled Substances

Substances and chemicals controlled by the U.S. Drug Enforcement Administration.

- Controlled substances not dispensed and rendered irretrievable during the course of research may be disposed of through Environmental Health and Safety. Contact the Chemical Hygiene Officer to schedule a time to bring the waste to the hazardous waste storage area.
- Per DEA regulations, two employees of the license holder (registrant) must be present to observe the handling of the controlled substance until it is rendered non-retrievable.
 - If the substance is transported from the laboratory to the waste storage location prior to destruction, both registrant employees must always be with the substance during the transport.
 - The substance will be rendered non-retrievable in collaboration with an external waste vendor.
- A DEA Form 41 (Appendix F) must be generated to document destruction. The original copy will be provided to the license holder and a duplicate will be kept on file with EH&S. The license holder is not required to send the completed Form 41 to the DEA but must keep the paperwork on file for at least two years.

More information on DEA disposal regulations can be found on the [ECFR website](#).

10.0 Emergency Response

10.1 Emergency Equipment

10.1.1 Safety Showers

Drench-type safety showers are present in each chemical laboratory and readily available to all employees and students who work with injurious corrosive materials or other chemicals that may require an immediate response to a chemical emergency resulting in a significant exposure to the body. The valve handle of safety showers should be rigidly fixed and plainly labeled. Chain pulls are difficult to grasp in an emergency, unless provided with a large ring. The valve should open readily in either direction and remain open until intentionally closed. Water flow must be sufficient to drench the employee rapidly. All employees shall ensure that access to the showers is not impeded by storage of equipment or materials.

Each shower will be flushed and inspected annually by the EH&S department. If the shower does not operate properly upon inspection, the department shall immediately submit a 2Fix request. All employees who work in the area shall be informed that this equipment is temporarily not operational (a prominent sign will suffice). A log will be kept of these monthly inspections and include the initials of the inspector and the date of inspection.

10.1.2 Eye Wash Fountains

Eye wash fountains are present in each chemical laboratory and shall be readily available to all employees who work with injurious corrosive materials or other chemicals that may require an immediate response to a chemical emergency resulting in a significant exposure to the body. Eye wash fountains shall provide a gentle flow of aerated water for an extended period of at least 15 minutes. Use of hands shall not be required to maintain the water flow. All employees shall ensure that access to the eye wash fountain is not impeded by storage of equipment or materials.

Each eye wash fountain will be flushed and inspected annually by the EH&S department. If the eyewash does not function properly upon inspection, the employee shall submit a 2Fix request immediately. All employees who work in this area shall be informed that this equipment is temporarily not operational (a prominent sign will suffice). A log of the monthly inspections will be kept and a summary tag shall be attached to the eye wash fountain that includes the inspection date and initials of the inspector.

10.1.3 Fire Extinguishers

Fire extinguishers are in each chemical laboratory and readily accessible to trained employees who attempt to put out a small incipient fire. Fire extinguishers are required by the District of Columbia fire code and employees and students are not required to use the fire extinguisher to put out a fire.

Employees must be trained on the use and limitation of portable fire extinguishers before they use a fire extinguisher and should be familiar with the proper type of extinguisher for each type of fire. The four basic types of fires are summarized below.

Class A - Ordinary combustible fires such as paper and wood fires. Typical extinguishing agents include water and multipurpose dry chemicals.

Class B - Flammable liquid and gas fires. Extinguishing agents are dry chemicals, carbon dioxide, and foam.

Class C - Electrical fires. Extinguishing agents include dry chemicals and carbon dioxide.

Class D - Metal fires. The extinguishing agents are special powders.

10.1.4 Fire Alarms and Smoke Detectors

Fire alarms and smoke detectors are present in each laboratory. In the event of a fire, the fire alarm should be activated for immediate response by emergency campus responders. Nothing should be stored near the alarms or detectors.

10.1.5 Miscellaneous

Other emergency equipment may be present in laboratories including fire blankets, first aid kits, and emergency stretchers.

10.2 Emergency Response

A list of emergency phone numbers shall be posted near each entry door in the laboratory(s). This list will include the phone number of the university health clinic, the Public Safety dispatcher, the "2FIX" system and outside emergency services. Each laboratory shall have the name and phone number of a primary emergency contact and an alternate emergency contact for the room posted on an outside door. These individuals should be knowledgeable of the contents, layout, and operations of that room. Home phone numbers of these emergency contacts shall be maintained in a secure internal SharePoint site (AU login required) for consultation during emergency situations.

In situations of personal health emergencies, employees shall use their best discretion to summon the appropriate aid. In other emergencies, such as fires, employees must be aware beforehand of the locations of the nearest exits, fire alarms, and fire extinguishers.

Employees shall be familiar with the use and inspection of emergency equipment. All inspections must be recorded and these logs kept with the equipment. The following emergency equipment is available and inspected at the stated frequency.

- Portable fire extinguishers - inspected monthly;
- Safety showers - inspected and flushed annually; and
- Eyewash fountains - inspected and flushed annually.

A brief summary of emergency procedures is provided below.

10.2.1 Fire

In the event of a fire, employees should pull the nearest fire alarm, notify other employees, evacuate the building according to the evacuation plan, and call AU's Public Safety office (extension 3636) once safely outside.

10.2.2 Chemical Spill

Only small spills shall be handled by employees knowledgeable about the contents of the spilled material. Appropriate spill kits available in the laboratories must be used. The Environmental Safety Coordinator, CHO, and Public Safety should be contacted for other spills to determine the appropriate response. If the spill cannot be cleaned by the university staff, a contractor and/or the fire department may need to be called. See Appendix E for detailed spill response instructions.

10.2.3 Chemical Splash

Eye wash fountains and showers should be used as necessary. Emergency aid should be summoned as needed by calling Public Safety. All workers who use the fountains and/or showers must be seen by medical personnel. Employees shall be familiar with operations of the eye wash and emergency showers.

10.2.4 First Aid and Accident Reporting

AU staff that are trained and designated as responsible for rendering first aid or medical assistance as part of their job duties are covered under the BBP standard. However, OSHA will consider it a "de minimis" violation (a technical violation carrying no penalties) if university staff who administer first aid as a collateral duty to their routine work assignments, are not offered the pre-exposure hepatitis B vaccination.

All such incidents must be immediately, or as soon as feasible, reported to the employee's supervisor. Under no circumstances should incidents be reported later than the employee's work shift. The Risk Management and Environmental Health and Safety department must then be notified to file an internal report of the accident and to determine if an exposure has occurred and if post exposure evaluation and follow-up is required.

Appendix A: Glossary

The following definitions are adapted from the OSHA laboratory standard (29 CFR 1910.1450).

Action Level - A concentration in air designated in 29 CFR Part 1910.1000, subpart Z, for a specific substance, calculated as an eight-hour time-weighted average (TWA), which, if exposure levels exceed this value, initiates certain required activities such as exposure monitoring and medical surveillance.

Carcinogen – See “select carcinogen.”

Chemical Hygiene Officer (CHO) - An employee who is designated by the employer and is qualified by training or experience to provide technical guidance in the development and implementation of the provisions of the Chemical Hygiene Plan. This definition is not intended to place limitations on the position description or job classification that the designated individual shall hold within the employer's organizational structure.

Chemical Hygiene Plan (CHP) - A written program, required by 29 CFR Part 1910.1450, which sets forth procedures, equipment, personal protective equipment (PPE), and work practices that are capable of protecting employees from the health hazards presented by hazardous chemicals used in a particular workplace. References to the CHP in this document are inclusive of the appendices.

Combustible Liquid - Any liquid having a flashpoint at or above 100 degrees Fahrenheit (°F) [37.8 degrees Celsius (°C)] but below 200°F (93.3°C), except any mixture having components with flashpoints of 200°F (93.3°C) or higher, the total volume of which make up 99 percent or more of the total volume of the mixture.

Compressed Gas - A gas or mixture of gases having, in a container, an absolute pressure exceeding 40 pounds per square inch (psi) at 70°F (21.1°C); or a gas or mixture of gases having, in a container, an absolute pressure exceeding 104 psi at 130°F (54.4°C) regardless of the pressure at 70°F (21.1°C); or a liquid having a vapor pressure exceeding 40 psi at 100°F (37.8°C) as determined by the American Society for Testing and Materials (ASTM) publication ASTM D-323-72.

Designated Area - An area, which may be used for work with "select carcinogens," reproductive toxins, or substances, which have a high degree of acute toxicity. A designated area may be the entire laboratory, an area of a laboratory, or a device such as a laboratory hood.

Emergency - Any occurrence such as, but not limited to, equipment failure, rupture of containers, or failure of control equipment, which results in an uncontrolled release of a hazardous chemical into the workplace.

Employee - An individual employed in a laboratory workplace who may be exposed to hazardous chemicals in the course of his or her assignments.

Explosive - A chemical that causes a sudden, almost instantaneous release of pressure, gas, and heat when subjected to sudden shock, pressure, or high temperature.

Flammable - A chemical that falls into one of the following categories:

Flammable aerosol - An aerosol that, when tested by the method described in 16 CFR 1500.45, yields a flame projection exceeding 18 inches at full valve opening, or a flashback (a flame extending back to the valve) at any degree of valve opening.

Flammable gas - A gas that, at ambient temperature and pressure, forms a flammable mixture with air at a concentration of 13 percent by volume or less; or a gas that, at ambient temperature and pressure, forms a range of flammable mixtures with air wider than 12 percent by volume, regardless of the lower limit.

Flammable liquid - Any liquid having a flashpoint below 100°F (37.8°C), except any mixture having components with flashpoints of 100°F (37.8°C) or higher, the total of which make up 99 percent or more of the total volume of the mixture.

Flammable solid - A solid, other than a blasting agent or explosive as defined in 29 CFR 1910.109(a), that is liable to cause fire through friction, absorption of moisture, spontaneous chemical change, or retained heat from manufacturing or processing, or which can be ignited readily and when ignited burns so vigorously and persistently as to create a serious hazard. A chemical shall be considered to be a flammable solid if, when tested by the method described in 16 CFR 1500.44, it ignites and burns with a self-sustained flame at a rate greater than one-tenth of an inch per second along its major axis.

Flashpoint - The minimum temperature at which a liquid gives off a vapor in sufficient concentration to ignite when tested as referenced in 1910.1450(b). Organic peroxides, which undergo auto-accelerating thermal decomposition, are excluded from any of the flashpoint determination methods specified above (also see definition of organic peroxide).

Hazardous Chemical – A chemical for which there is statistically significant evidence based on at least one study conducted in accordance with established scientific principles that acute or chronic health effects may occur in exposed employees. The term "health hazard" includes chemicals which are carcinogens, toxic or highly toxic agents, reproductive toxins, irritants, corrosives, sensitizers, hepatotoxins, nephrotoxins, neurotoxins, agents which act on the hematopoietic systems, and agents which damage the lungs, skin, eyes, or mucous membranes.

Laboratory - A facility where the "laboratory use of hazardous chemicals" occurs. It is a workplace where relatively small quantities of hazardous chemicals are used on a non-production basis.

Laboratory Scale - Work with substances in which the containers used for reactions, transfers, and other handling of substances are designed to be easily and safely manipulated by one person. "Laboratory scale" excludes those workplaces whose function is to produce commercial quantities of materials.

Laboratory-Type Hood - A device, located in a laboratory, enclosed on five sides with a moveable sash or fixed partial enclosure on the remaining side, constructed and maintained to draw air from the laboratory and to prevent or minimize the escape of air contaminants into the laboratory, which allows chemical manipulations to be conducted in the enclosure without insertion of any portion of the employee's body other than hands and arms. Walk-in hoods with adjustable sashes meet the above definition provided that the sashes are adjusted during use so that the airflow and the exhaust of air contaminants are not compromised and employees do not work inside the enclosure during the release of airborne hazardous chemicals.

Laboratory Use of Hazardous Chemicals - Handling or use of such chemicals in which all of the following conditions are met:

- Chemical manipulations are carried out on a "laboratory scale."
- Multiple chemical procedures or chemicals are used.
- The procedures involved are not part of a production process, nor in any way simulate a production process.
- "Protective laboratory practices and equipment" are available and in common use to minimize the potential for employee exposure to hazardous chemicals.
- Safety Data Sheets (SDSs) - Information on chemical products supplied by product manufacturers or distributors which includes information on the physical hazards, health hazards, safe handling procedures, and emergency and first aid procedures.
- Medical Consultation - A consultation which takes place between an employee and a licensed physician for the purpose of determining what medical examinations or procedures, if any, are

appropriate in cases where a significant exposure to a hazardous chemical may have taken place.

Organic Peroxide - Any organic compound that contains the bivalent -O-O- structure and which may be considered to be a structural derivative of hydrogen peroxide where one or both of the hydrogen atoms has been replaced by an organic radical.

Oxidizer - A chemical other than a blasting agent or explosive as defined in 29 CFR 1910.109(a), that initiates or promotes combustion in other materials, thereby causing fire either of itself or through the release of oxygen or other gases.

Permissible Exposure Limit (PEL) - The maximum allowable exposure concentration set forth in 29 CFR Part 1910, subpart Z, for a specific substance. The PEL is calculated as an eight-hour TWA or expressed as a ceiling concentration.

Physical Hazard - 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.

Protective Laboratory Practices and Equipment - Those laboratory procedures, practices, and equipment accepted by laboratory health and safety experts as effective, or that the employer can show to be effective in minimizing the potential for employee exposure to hazardous chemicals.

Reproductive Toxins - Chemicals which affect the reproductive capabilities including chromosomal damage (mutations) and effects on fetuses (teratogens).

Select Carcinogen - Any substance, which meets one of the following criteria:

- Is regulated by OSHA as a carcinogen;
- Is listed under the category "known to be carcinogenic" in the Annual Report on Carcinogens published by the National Toxicology Program (NTP) (latest edition);
- Is listed under Group I "carcinogenic to humans" by the International Agency for Research on Cancer (IARC) Monographs (latest editions);
- Is listed in either Group 2A or 2B by IARC or under the category "reasonably anticipated to be carcinogenic" by NTP and causes statistically significant tumor incidence in experimental animals in accordance with any of the following criteria:
 - After inhalation exposure of six to seven hours per day, five days per week, for a significant portion of a lifetime to dosages of less than 10 mg/m, or
 - 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.

Unstable (reactive) – A chemical, which, in the pure state or as produced or transported, will vigorously polymerize, decompose, condense, or become self-reactive under conditions of shocks, pressure, or temperature.

Water-Reactive - A chemical that reacts with water to release a gas that is either flammable or presents a health hazard.

Appendix B: Standard Operating Procedure Template

American University
STANDARD OPERATING PROCEDURE:

TITLE

Full chemical name:	
Principal Investigator (PI):	
Date SOP created:	

A. Human health and hazard information
B. Preparation
C. Transportation
D. Use
E. Disposal
F. Spill response and emergency procedures
G. Hazard communication
H. Unique Instructions
I. Additional information or references

Appendix C: Container Size Limitations for Flammable and Combustible Liquids

Container Size Limitations for Flammable Liquids

Class ¹	Type of Container			
	Glass (gallons)	Metal (gallons)	Safety Cans (gallons)	Drums (gallons)
IA	0.125	1	2	60
IB	0.25	5	5	60
IC	1	5	5	60

¹Class IA -- liquid with a flash point below 73°F (22.8°C) and boiling point below 100°F (37.8°C).
 Class IB -- liquid with a flash point below 73°F and boiling point at or above 100°F.
 Class IC -- liquid with a flash point above 73°F and boiling point below 100°F.

Container Size Limitations for Combustible Liquids

Class	Type of Container			
	Glass (gallons)	Metal (gallons)	Safety Cans (gallons)	Drums (gallons)
II ¹	1	5	5	60
IIIA	1	5	5	60

¹Class II -- liquid with a flash point at or above 100°F (37.8°C) and below 140°F (60°C).
 Class IIIA -- liquid with a flash point at or above 140°F (60°C) and below 200°F (93.4°C).

Appendix D: Examples of Common Incompatible Chemicals

Chemical	Incompatible chemical(s)
Acetic acid	Aldehyde, bases, carbonates, hydroxides, metals, oxidizers, peroxides, phosphates, xylene
Acetylene	Halogens, mercury, potassium, oxidizers, silver
Acetone	Acids, amines, oxidizers, plastics
Alkali and alkaline metals	Acids, chromium, ethylene, halogens, hydrogen, mercury, earth nitrogen, oxidizers, plastics, sodium chloride, sulfur
Aluminum (powdered)	chlorinated hydrocarbons, halogens, carbon dioxide, organic acids
Anhydrous ammonia	mercury, chlorine, calcium hypochlorite, iodine, bromine, hydrofluoric acid
Ammonium nitrate	acids, metal powders, flammable liquids, chlorates, nitrites, sulfur, finely divided organic combustible materials
Aniline	Nitric acid, hydrogen peroxide
Arsenic compounds	Reducing agents
Azides	Acids
Bromine	Ammonia, acetylene, butadiene, hydrocarbons, hydrogen, sodium, finely divided metals, turpentine, other hydrocarbons
Calcium carbide	Water, ethanol
Calcium oxide	Water
Carbon, activated	Calcium hypochlorite, oxidizing agents
Chlorates	Ammonium salts, acids, metal powders, sulfur, finely divided organic or combustible materials
Chromic acid	Acetic acid, naphthalene, camphor, glycerin, turpentine, alcohols, flammable liquids
Chlorine	See bromine
Chlorine dioxide	Ammonia, methane, phosphine, hydrogen sulfide
Copper	Acetylene, hydrogen peroxide
Cumene hydroperoxide	Acids, organic or inorganic
Cyanides	Acids
Flammable liquids	Ammonium nitrate, chromic acid, hydrogen peroxide, nitric acid, sodium peroxide, halogens
Hydrocarbons	Fluorine, chlorine, bromine, chromic acid, sodium peroxide
Hydrocyanic acid	Nitric acid, alkali
Hydrofluoric acid	Aqueous or anhydrous ammonia
Hydrogen peroxide	Copper, chromium, iron, most metals or their salts, alcohols, acetone, organic materials, aniline, nitromethane, flammable liquids, oxidizing gases
Hydrogen sulfide	Fuming nitric acid, oxidizing gases

Hypochlorites	Acids, activated carbon
Iodine	Acetylene, ammonia (aqueous or anhydrous), hydrogen
Mercury	Acetylene, fulminic acid, ammonia
Mercuric oxide	Sulfur
Nitrates	Sulfuric acid
Nitric acid, concentrated	Acetic acid, aniline, chromic acid, hydrocyanic acid, hydrogen sulfide, flammable liquids, flammable gases
Oxalic acid	Silver, mercury
Perchloric acid	Acetic anhydride, bismuth and its alloys, ethanol, paper, wood
Peroxides, organic	Acids, avoid friction or shock
Phosphorous (white) potassium	Air, alkalines, reducing agents, oxygen, carbon tetrachloride, carbon dioxide, water, alcohols, acids
Potassium chlorate	Acids
Potassium perchlorate	Acids
Potassium permanganate	Glycerin, ethylene glycol, benzaldehyde, sulfuric acid
Selenides	Reducing agents
Silver	Acetylene, oxalic acid, tartaric acid, ammonium compounds, fulminic acid
Sodium	Carbon tetrachloride, carbon dioxide, water
Sodium nitrate	Ammonium salts
Sodium nitrite	Ammonium salts
Sodium peroxide	Ethanol, methanol, glacial acetic acid, acetic anhydride, benzaldehyde, carbon disulfide, glycerin, ethyl acetate, methyl acetate, furfural
Sulfides	Acids
Sulfuric acid	Potassium chlorate, potassium perchlorate, potassium permanganate (or compounds with similar light metals, such as sodium, lithium, etc.)
Zinc powder	Sulfur

Appendix E: Chemical and Particulate Spill Prevention and Control Procedure

Purpose

The Chemical Spill Prevention and Control Procedure provides guidelines for addressing chemical and particulate spills in a safe and expedient manner. This document supports American University Chemical Hygiene Plan and Hazard Communication Program.

Scope

This procedure covers all laboratory spills and applies to all American University laboratories unless where exceptions are noted.

Definitions and Acronyms

CHP: Chemical Hygiene Plan

CHO: Chemical Hygiene Officer

EH&S: Environmental Health and Safety

EPA: Environmental Protection Agency

HEPA: High Efficiency Particulate Air

IRCT: Ignitable, Reactive, Corrosive, Toxic

SDS: Safety Data Sheet

PPE: Personal Protective Equipment

RCRA: Resource Conservation and Recovery Act

SOP: Standard Operating Procedure

Materials Required

- Chemically resistant gloves, laboratory coat or apron, safety eyewear;
- Spill kit: sorbent materials (sorbent pads, pillows) and acid and caustic neutralizing agents;
- Detergent amended distilled deionized water.

Skills Required

Hazard Communication Training

Laboratory Safe Practice Training

Procedure

- Don all routine personal protective equipment: gloves, laboratory coat, safety glasses, and closed toe shoes.
- Hazard recognition: all laboratory personnel should be familiar with the hazards presented by the reagents and chemical processes in the laboratory.

- Do not store chemical reagents, sample preparations, or waste with incompatible chemicals or materials (see Appendix D).
- Notify the CHO or EH&S office in the event of a spill or leak requiring assistance. After hours and on weekends, notify Public Safety.
- Each laboratory should have a spill kit appropriate for the chemicals and materials in use. Contact EH&S for spill kit acquisition or replenishment.
- Spills frequently involve broken glass. Do not gather glass shards by hand. If glass is intermingled with spilled chemicals, do not attempt to separate the glass.
- All secondary chemical containers must be labeled with the appropriate label.
- All chemical waste containers must be labeled with a hazardous waste label.

Spill Prevention

- Laboratory personnel must take precautions to always work with chemicals and particulates on stable surfaces.
- Large volume reagent containers should be transported by cart.
- All reagent transfer should occur in the appropriate chemical fume hood.
- Reagent, sample preparation, and waste containers must have appropriate closure mechanisms to secure against spills and leaks.
- All reagent, sample preparation, and waste containers must be closed when not in use.
- Waste containers should reside within a catchment basin sufficient for spill containment.
- Reagents and waste containers should not be stored in chemical fume hoods or biosafety cabinets.

Spill Clean-Up

Laboratory personnel are responsible for samples and chemicals with which they work and are required to appropriately respond to any spill. Laboratory technicians must not attempt to clean a spill if the nature of the material spilled is unknown or if the employee is unsure of how to proceed. Under these circumstances, the employee must immediately contact the Departmental Chair and/or CHO. Consult the SDS for chemicals involved in the spill for safety precautions and spill cleanup. Notify the CHO of all spills involving ignitable, reactive, caustic, toxic (IRCT) materials, and all spills greater than 1 liter in volume.

Cleanup guidelines are intended for small volume spills and are general procedures only. They are superseded by information contained in an SDS or other specific directions. If the hood ventilation should fail evacuate the area and notify Public Safety.

Cleanup of Minor (< one liter) Liquid Spills, excluding concentrated acids and bases

Note: If a spill is contained on bench paper or lab wipes, dispose of the paper/wipes in accordance with appropriate waste procedures for the absorbed material(s).

If the spill contaminates the hood, floor or bench, clean as follows:

- Take all precautions to avoid personal exposure or contamination, then contain the spill using spill pillows, sorbents or spill slabs. If a toxic volatile compound is involved and a substantial spill is outside the hood, notify others to evacuate as you leave the area and call Public Safety.
- All spills/leaks must first be contained to keep the contaminated area as small as can be. Contain the spill by surrounding it with a berm of appropriate absorbent material, and then apply the material to the spill from the contained edges toward the center of the spill.
- If a spill occurs within a hood, maintain hood air exchange and work with the hood sash closed to the greatest extent possible. Do not lean into the hood to reach the spill.
- If the spill is outside of a hood, open the sash for maximum air exchange. The employee should not obstruct the flow in between the hood and the spill—this position will interfere with the flow of any vapors away from the employee's breathing zone.
- Once contained, spills should be cleaned from the area of least contamination towards the area of greatest contamination to avoid spreading the spill.

Solvent spills

- If the volume of solvent is larger than what can be absorbed with lab toweling (> 500 mL), and the solvent is minimally hazardous, use spill pillows, spill slabs, or other solvent absorbent material in the spill kit to contain the spill. If the spill is large or is in a poorly ventilated area, or is of a hazardous nature (e.g., benzene, methylene chloride, ethyl ether) vacate the area and notify the CHO and EH&S.
- Dispose of solid sorbents in accordance with disposal of the sorbed material.
- Allow solvent vapors to clear the area before returning to work.

Dilute acid and base spills

- Consult the SDS.
- Use neutralizing sorbents to contain liquid spills.
- Sweep up the sorbent and dispose as corrosive waste.
- Wash the affected area until a clean water rinse shows a neutral reaction to pH paper.

Sewage sludge or other biologically active samples

- Wear double gloves.
- Contain and absorb the spill with spill pillows or other absorptive material.
- Dispose of the sorbed material as you would the sample.
- Wash the area three times with soap and water, then apply an EPA registered disinfectant.
- Finally, rinse three times with water.

Other materials

Clean up according to the nature of hazard the sample represents. Absorb liquids and sweep up solids. Dispose of the sorbent or sweepings as you would the samples.

Concentrated solutions of analytes or pure compounds

Clean up first as you would for the hazard involved. The entire area must then be decontaminated to prevent contamination of future samples and lab ware. Triple washing and triple rinsing are the minimum cleanup expected. Consult the CHO or EH&S regarding the need to take wipes for analysis in confirmation of adequate cleanup.

Other materials

Wear appropriate protective equipment, clean and decontaminate the area, and dispose of material according to the SDS. If a broom is used on spilled materials, decontaminate or dispose of the broom.

Clean-Up of Concentrated Acid or Base Spills

- Concentrated acid or base spills present serious hazards. Notify the CHO and EH&S in the event of this type of spill.
- Be cautious of adverse reactions with other reagents/materials in the vicinity of the spill.
- Do not attempt to absorb concentrated acid/base spills with laboratory toweling.
- Contain the spill with the appropriate sorbent material.
- The absorbent material should be scooped/swept into an appropriate waste container. DO NOT ATTEMPT TO GATHER THE MATERIAL BY HAND.
- Once the spill is removed, wash the affected area with DI water until a pH paper indicates neutrality.

Clean-Up of Particulate or Dry Reagent Spills

- All spills of fine-grained particulate matter must be wetted with amended water prior to sweeping.
- Once the gross debris is contained, vacuum only with a HEPA filtered vacuum or sweep into a scoop or pan. If HEPA vacuuming is not available, wipe with amended water until no visible residue is apparent.
- If the particulate spill involves asbestos and/or nanoparticulate matter, contact the Departmental Chair and CHO.
- If the spill is large in volume or area affected, respiratory protection should be used. Only American University employees participating in the respiratory protection program may don negative pressure respirators for any purpose.
- Immediately following spill containment and clean-up, doff all disposable PPE and discard it in the same manner that the spill clean-up materials were disposed. Wash your hands and verify that you are not tracking any of the spilled substance on your shoes before exiting the spill area.
- Except in cases of emergency evacuation, do not exit a laboratory while wearing personal protective equipment.

Clean-Up of Major Spills

All spills or releases beyond the minor spill volume must be reported immediately to the CHO and EH&S. Clean-up of spills that are large in volume and/or area affected may be followed by wipe and/or air monitoring of the affected area. All spills involving heavy metals or other toxic materials should be followed up with wipe and/or air monitoring. EH&S is responsible for initiating, reporting, evaluation, and retention of all wipe/air monitoring analytical reports.

If contamination of any surface is suspected, the area must be labeled as "Out of Service" and use of the area must be restricted until sampling confirms no contamination. The CHO or EH&S will determine when the use restriction may be rescinded.

Waste Management and Pollution Prevention

Excess reagents, samples, and method process wastes must be characterized and disposed of in an appropriate manner;

The authorized person using this procedure is responsible for the safe collection, preparation, and proper handling of waste in accordance with waste handling procedures;

All materials on the EPA RCRA P and U lists must be disposed of in accordance with RCRA provisions.

Advance arrangements for disposal of P and U listed materials must be made with the CHO or EH&S;

- **RCRA P List:** Materials on the P list are designated by the US EPA as acutely toxic. The material and its container as well as any materials in contact with the drug must be disposed of in a RCRA approved container;
- **RCRA U List:** Any materials that can cause waste to become ignitable, corrosive, reactive or toxic.

Recordkeeping

Large volume spills (> 1 liter), spills of IRCT materials, and spills resulting persistent contamination of a surface will be treated as accidents and reported to the CHO. The CHO will maintain accident reports on file for a period of not less than five years.

Appendix F: DEA Form 41

OMB APPROVAL NO. 1117-0007

Expiration Date 9/30/2017

U. S. DEPARTMENT OF JUSTICE – DRUG ENFORCEMENT ADMINISTRATION
REGISTRANT RECORD OF CONTROLLED SUBSTANCES DESTROYED
FORM DEA-41

A. REGISTRANT INFORMATION

Registered Name:	DEA Registration Number:	
Registered Address:		
City:	State:	Zip Code:
Telephone Number:	Contact Name:	

B. ITEM DESTROYED**1. Inventory**

	National Drug Code or DEA Controlled Substances Code Number	Batch Number	Name of Substance	Strength	Form	Pkg. Qty.	Number of Full Pkgs.	Partial Pkg. Count	Total Destroyed
<i>Examples</i>	16590-598-60	N/A	Kadian	60mg	Capsules	60	2	0	120 Capsules
	0555-0767-02	N/A	Adderall	5mg	Tablet	100	0	83	83 Tablets
	9050	B02120312	Codeine	N/A	Bulk	1.25 kg	N/A	N/A	1.25 kg
1.									
2.									
3.									
4.									
5.									
6.									
7.									

2. Collected Substances

	Returned Mail-Back Package	Sealed Inner Liner	Unique Identification Number	Size of Sealed Inner Liner	Quantity of Packages(s)/Liner(s) Destroyed
<i>Examples</i>	X		MBP1106, MBP1108 - MBP1110, MBP1112	N/A	5
		X	CRL1007 - CRL1027	15 gallon	21
		X	CRL1201	5 gallon	1
1.					
2.					
3.					
4.					
5.					
6.					
7.					

Form DEA-41

See instructions on reverse (page 2) of form.

DEA-41 Pg. 2

C. METHOD OF DESTRUCTION

Date of Destruction:	Method of Destruction:	
Location or Business Name:		
Address:		
City:	State:	Zip Code:

D. WITNESSES

I declare under penalty of perjury, pursuant to 18 U.S.C. 1001, that I personally witnessed the destruction of the above-described controlled substances to a non-retrievable state and that all of the above is true and correct.

Printed name of first authorized employee witness:	Signature of first witness:	Date:
Printed name of second authorized employee witness:	Signature of second witness:	Date:

E. INSTRUCTIONS

- Section A. REGISTRANT INFORMATION:** The registrant destroying the controlled substance(s) shall provide their DEA registration number and the name and address indicated on their valid DEA registration, in addition to a current telephone number and a contact name, if different from the name on the valid DEA registration.
- Section B. (1) Inventory:** This part shall be used by registrants destroying lawfully possessed controlled substances, other than those described in Section B(2). In each row, indicate the National Drug Code (NDC) for the controlled substance destroyed, or if the substance has no NDC, indicate the DEA Controlled Substances Code Number for the substance; if the substance destroyed is in bulk form, indicate the batch number, if available. In each row, indicate the name, strength, and form of the controlled substance destroyed, and the number of capsules, tablets, etc., that are in a full package (pkg. qty.). If destroying the full quantity of the controlled substance, indicate the number of packages destroyed (number of full pkgs.). If destroying a partial package, indicate the partial count of the capsules, tablets, etc. destroyed (partial pkg. count). If destroying a controlled substance in bulk form, indicate that the substance is in bulk form (form) and the weight of the substance destroyed (pkg. qty.). In each row, indicate the total number of each controlled substance destroyed (total destroyed).
- Section B. (2) Collected Substances:** This part shall be used by registrants destroying controlled substances obtained through an authorized collection activity in accordance with 21 U.S.C. 822(g). In each row, indicate whether registrant is destroying a mail-back package or an inner liner. If destroying a mail-back package, enter each unique identification number separated by a comma and/or as a list in a sequential range and total quantity of packages being destroyed. If destroying an inner liner, enter each unique identification number separated by a comma and/or as a list in a sequential range based on the size of the liners destroyed and the total quantity of inner liners being destroyed. In the case of mail-back packages or inner liners received from a law enforcement agency which do not have a unique identification number or clearly marked size, include the name of the law enforcement agency and, if known, the size of the inner liner or package. **DO NOT OPEN ANY MAIL-BACK PACKAGE OR INNER LINER; AN INVENTORY OF THE CONTENTS OF THE PACKAGES OR LINERS IS PROHIBITED BY LAW AND IS NOT REQUIRED BY THIS FORM.**
- If additional space is needed for items destroyed in Section B, attach to this form additional page(s) containing the requested information for each controlled substance destroyed.
- Section C. METHOD OF DESTRUCTION:** Provide the date, location, and method of destruction. The method of destruction must render the controlled substance to a state of non-retrievable and meet all applicable destruction requirements.
- Section D. WITNESSES:** Two authorized employees must declare by signature, under penalty of perjury, that such employees personally witnessed the destruction of the controlled substances listed in Section B in the manner described in Section C.
- You are not required to submit this form to DEA, unless requested to do so. This form must be kept as a record of destruction and be available by the registrant for at least two years in accordance with 21 U.S.C. 827.

Paperwork Reduction Act Statement: The information collected on this form is necessary for DEA registrants to record controlled substances destroyed in accordance with the Controlled Substances Act (CSA). The records that DEA registrants maintain in accordance with the CSA must be kept and be available, for at least two years, for inspection and copying by officers or employees of the United States authorized by the Attorney General. 21 U.S.C. 827. DEA estimates that it will take approximately 30 minutes to complete this form, including the time for reviewing instructions, searching existing data sources, gathering and maintaining the data needed, and completing and reviewing the collection of information. The completion of this form by DEA registrants that destroy controlled substances is mandatory in accordance with 21 U.S.C. 827. Please note that an agency may not conduct or sponsor, and a person is not required to respond to, a collection of information unless it displays a currently valid OMB control number. Comments regarding this information collection, including suggestions for reducing the burden estimate, should be directed to the Drug Enforcement Administration, DEA Federal Register Representative/ODL, 8701 Morrisette Drive, Springfield, Virginia 22152.