UWM
CHEMICAL HYGIENE PLAN

UNIVERSITY OF WISCONSIN-MILWAUKEE

Department of

University Safety & Assurances

Current Review Completed- February 2022-See last page for details

Revision Date: December 2018

Previous Revisions:
February 8, 2010,
June 21, 2007

EMERGENCY INFORMATION

University of Wisconsin-Milwaukee
Milwaukee Kenwood Campus/ University Services Research Building/ Kenilworth Square East.

University Safety and Assurances	414-229-6339
UWM Chemical Hygiene Officer	414-430-7508
Campus Police- Emergency	414-229-9911
Non-Emergency	414-229-4627
Fire/ Ambulance/ Hazardous Materials Response Team (Milwaukee Fire Dept.)	414-229-9911
911Norris Health Center	414-229-4716
Utility Problems	414-229-4742
Environmental Protection (Hazardous Waste Disposal)	hazwaste@uwm.edu

University of Wisconsin-Milwaukee
Global Water/ Great Lakes Research Facility/ Innovation Campus Accelerator Building

University Safety and Assurances	414-229-6339
UWM Occupational Health and Industrial Hygiene Program Manager	414- 313-9711
Police- Emergency	911
Non-Emergency	414- 935-7222
Fire/ Ambulance/ Hazardous Materials Response Team	911
Utility Problems	414-229-4742
Environmental Protection (Hazardous Waste Disposal)	hazwaste@uwm.edu

EMERGENCY INFORMATION

University of Wisconsin-Milwaukee
Waukesha County Campus

University Safety and Assurances		414-229-6339
UWM Chemical Hygiene Officer		414-430-7508
Police- Emergency		911
Non-Emergency		(262) 524-3831
Fire/ Ambulance/ Hazardous Materials Response Team		911
Utility Problems	We Energies	1-800-662-4767
	Jon Etta Associate Director of Facilities Services	262-808-6973
Environmental Protection (Hazardous Waste Disposal)		hazwaste@uwm.edu

University of Wisconsin-Milwaukee
Washington County Campus

University Safety and Assurances		414-229-6339
UWM Chemical Hygiene Officer		414-430-7508
Police- Emergency		911
Non-Emergency		(262) 335-4378
Fire/ Ambulance/ Hazardous Materials Response Team		911
Utility Problems	We Energies	1-800-662-4767
	Jon Etta Associate Director of Facilities Services	262-808-6973
Environmental Protection (Hazardous Waste Disposal)		hazwaste@uwm.edu

University of Wisconsin-Milwaukee
Chemical Hygiene Plan Training Certification

The individuals listed below have read and fully understand the Campus Chemical Hygiene Plan. The individuals have received training from their supervisor and are aware of all potential hazards and countermeasures related to working in a laboratory, how to practice good chemical hygiene, and where to find safety information to perform their duties in a safe manner.

	Lab Personnel Name:	Signature:	Date:
1.	_____	_____	_____
2.	_____	_____	_____
3.	_____	_____	_____
4.	_____	_____	_____
5.	_____	_____	_____
6.	_____	_____	_____
7.	_____	_____	_____
8.	_____	_____	_____
9.	_____	_____	_____
10.	_____	_____	_____

The above stated individuals have demonstrated the ability to work safely in a laboratory per the Chemical Hygiene Plan.

Principal Investigator's Name: _____

Principal Investigator's Signature: _____Date: _____

Laboratory Supervisor's Name: _____

Laboratory Supervisor's Signature:_____Date: _____

NOTE: each member of the lab should also attend ***Introductory Chemical Hygiene Plan and Laboratory Safety Training. Annual Lab Safety Review Training*** is expected to be attended annually thereafter. Both trainings are offered regularly from US&A. Scheduled classes will be listed on the US&A website. https://uwm.edu/safety-and-assurances/ . Certificates received from the ***Chemical Hygiene Plan and Laboratory Safety Training*** should be stored with the laboratory training records. Training from that class does not replace training on this document. Annual Lab Safety Review Training is

Hyperlink Use in This Manual

To take advantage of the Internet, this document is formatted to be a “front door” to other resources, including useful web links. Where appropriate, web links will be embedded within the document and identified as a hyperlinked word that can be clicked on to view the webpage. Please note, by clicking on these external resources you will be leaving the Chemical Hygiene Plan and will need to click the “Back” button on your browser to return to the manual. For those internal hyperlinks, including the Table of Contents, you can move around the document by clicking on the back and forward hyperlink arrow buttons located in the upper left-hand side of your toolbar. If this toolbar is not visible, then go to your menu command “View”, then “Toolbars”, and then select the “Web” or “Navigation” button to make the toolbar and hyperlink arrow buttons accessible.

If you encounter a broken weblink, please send an email to University Safety and Assurances safety-office@uwm.edu and they will contact the Chemical Hygiene Officer . Remember to include the section and page number of the manual and the name of the link you were trying to reach.

If you are viewing this document as a paper document you may go to the University Safety and Assurance Website under the Safety and Health Programs Tab; Laboratory Safety; Chemical Hygiene Plan Page found at this link: https://uwm.edu/safety-health/chem-hygiene/ to view the most up to date electronic version of the document and connect to the hyperlinks contained within this document

University of Wisconsin- Milwaukee
Chemical Hygiene Plan
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University of Wisconsin- Milwaukee
Chemical Hygiene Plan
Chapter 1 - Introduction

1. Purpose

The University of Wisconsin- Milwaukee Campus Chemical Hygiene Plan (CHP) is intended to cover and provide guidelines for individuals working in the campus laboratory community. The Laboratory Supervisors and / or Principal Investigators (PIs) are expected to customize their Lab Specific Chemical Hygiene Plan to supplement their individual needs and more accurately portray the hazards and controls of their laboratories. The laboratory supervisors or individual departments are responsible to produce standard operating procedures to accompany their Lab Specific Chemical Hygiene Plan. This CHP describes policies, procedures, equipment, personal protective equipment, and work practices that are capable of protecting laboratory personnel from the health hazards in laboratories. This Campus CHP is intended to meet the requirements of the federal Occupational Safety and Health Administration (OSHA) Laboratory Safety Standard, also known as "Occupational Exposure to Hazardous Chemicals in Laboratories" (Appendix A). The Laboratory Safety Standard is adopted by Department of Safety and Professional Services (DSPS) in Chapter 101 This CHP also addresses the federal Toxic Substance Control Act (TSCA).

This CHP is intended to safely limit laboratory workers' exposure to harmful chemicals. Laboratory workers must not be exposed to substances in excess of the Permissible Exposure Limits (PEL) specified in OSHA rule 29 CFR 1910, Subpart Z, Toxic and Hazardous Substances. PELs for regulated substances are provided in Appendix B or at the University of Wisconsin System, Office of Safety and Loss Prevention's "The Wisconsin PELs" web page. PELs refer to airborne concentrations of substances and are averaged over an eight-hour day. Compounds with individual standards generally have "action limits" (usually set at half the Threshold Limit Value). Action levels are air concentrations below the PEL and require that certain actions such as medical surveillance and workplace monitoring take place. A lab worker's workplace exposure to any regulated substance must be monitored if there is reason to believe that the exposure will exceed an action level or a PEL. If exposures to any regulated substance routinely exceed an action level or permissible exposure level, there must also be laboratory personnel medical exposure surveillance. Please refer to the individual chemical standards for details.

OSHA regulations require employers to evaluate their workplaces for the presence of hazardous substances, harmful physical agents, and infectious agents and to provide training to laboratory personnel concerning those substances or agents to which laboratory personnel may be exposed. Written information on agents must be readily accessible to laboratory personnel or their representatives. Laboratory personnel have a conditional right to refuse to work if assigned to work in an unsafe or unhealthful manner with a hazardous substance, harmful physical agent, or infectious agent. Labeling requirements for containers of hazardous substances and equipment or work areas that generate harmful physical agents are also included in the OSHA standards.

Toxic Substances Control Act (TSCA) requires that prudent laboratory practices be developed and documented for research involving new chemicals that have not had their health and environmental hazards fully characterized. Laboratories engaged in research must consider the applicability of the Toxic Substances Control Act (TSCA) on their operation. TSCA, administered by the U.S. Environmental Protection Agency (EPA) under the New Chemicals Program, is intended to ensure that the human health and environmental effects of chemical substances are identified and adequately addressed prior to commercial use or transport of those substances. A new chemical is a chemical substance that is produced or imported and not yet listed on the TSCA Chemical Substance Inventory. Each laboratory or research group that synthesizes or imports new chemicals must determine if and how TSCA applies to their laboratory activities – see Appendix D.

2. Scope and Application

The Laboratory Safety Standard applies where 'laboratory use' of hazardous chemicals occurs. Laboratory use of hazardous chemicals means handling or use of such chemicals in which all of the following conditions are met:

i. the handling or use of chemicals occurs on a 'laboratory scale', that is, the work involves containers which can easily and safely be manipulated by one person;
ii. multiple chemical procedures or chemical substances are used; and
iii. protective laboratory practices and equipment are available and in common use to minimize the potential for laboratory personnel exposure to hazardous chemicals.

At a minimum, this definition covers laboratory personnel (including student laboratory personnel, volunteers, technicians, supervisors, and Principle Investigators) that use chemicals in teaching, research, and clinical laboratories at the University of Wisconsin- Milwaukee. Certain non-traditional laboratory settings may be included under this standard at the option of individual departments within UWM.

This standard does not apply to laboratories whose function is to produce commercial quantities of material. Also, where the use of hazardous chemicals provides no potential for laboratory personnel exposure, such as in procedures using chemically impregnated test media and commercially prepared test kits, this standard will not apply.

3. Coordination with Other Standards and Guidelines

The Laboratory Safety Standard addresses occupational safety issues. Other federal, state (Appendix E), and University of Wisconsin System standards address use of hazardous chemicals and other materials. Contact the Department of University Safety and Assurances (US&A) if not positive of applicable standards. Particularly, chemicals with individual standards (Appendix C) generally have action limits (usually set at half the TLV), air monitoring requirements, and medical monitoring requirements. If a researcher is using one of these chemicals or in the unlikely event that there is a conflict between provisions of various standards, contact the Chemical Hygiene Officer or US&A at 229-6339.

4. Responsibilities

Implementation of the Laboratory Safety Standard at UWM is a shared responsibility. Laboratory personnel, supervisors, Laboratory Safety Officers, department heads, deans, upper administrative staff, and US&A staff all have roles to play. These roles are outlined below.

A. University–Wide

The University of Wisconsin-Milwaukee, in conjunction with its schools, colleges, and non-academic departments, is responsible for developing and supporting a broad-based chemical hygiene program that will protect its laboratory personnel from health effects associated with hazardous chemicals. Deans, Directors and Division Heads are responsible for integrating safety into all of their activities, for promoting the same attitude among all levels of employment at the University, and for providing adequate time and recognition for all laboratory personnel that are given laboratory safety responsibilities.

The University of Wisconsin-Milwaukee Chemical Safety Committee (CSC) is a committee comprised of faculty and staff who support, promote, and critically evaluate University of Wisconsin–Milwaukee's chemical safety policies, practices, and controls intended to protect health, safety and the environment at UWM. This committee was established to better address chemical safety at UWM and satisfies a portion of UWM's University Workplace Safety Policy (S73), which calls for the establishment of a campus-wide health and safety committee. The committee can be contacted via email at uwm-chemsafety@uwm.edu

B. Schools, Colleges, and Non-academic Departments

Each school, college, and non-academic department that engages in the laboratory use of hazardous chemicals will identify at least one laboratory safety representative to serve as a focal point for laboratory health and safety activities within the unit and as liaison with the Department of University Safety and Assurances. Schools and colleges that are made up of several large laboratory-based departments are urged to assign laboratory safety representatives within each department. Each school, college, and non-academic department will modify the Area Specific Addition to the Chemical Hygiene Plan to incorporate location-specific information and will maintain a copy of the modified plan in the laboratory. This copy will be available as a reference for all lab personnel to train and document training. Each unit will also identify the assigned laboratory safety representative(s) within their units and will transmit that information to the Chemical Hygiene Officer. The University Safety and Assurances or Chemical Hygiene officer will confirm the presence of the CHP during Laboratory inspections and will document that it has been reviewed.

C. Department of University Safety and Assurances (US&A) (See Appendix H)

The Chemical Hygiene Officer for UWM is the Laboratory Safety Program Manager with University Safety and Assurances. US&A staff will participate in providing resources for departments in the development of their individual health and safety programs. The Department of University Safety and Assurances is responsible for:

- preparing and updating UWM's generic Chemical Hygiene Plan (CHP);
- distributing the CHP to departments or other units who will tailor and implement the plan;
- training designated departmental laboratory safety officers regarding their responsibilities for safety and compliance with regulations and UWM standards that apply to research;
- conducting annual audits of the research space under the supervisors' control; and
- monitoring the progress of departments toward achieving compliance.

D. Laboratory Supervisors/ Principal Investigators

The immediate supervisor of laboratory personnel is responsible for:

- assuring that potential hazards of specific projects have been identified and addressed before work is started;
- ensuring there are written, laboratory-specific standard operating procedures (SOPs) for the protocols carried out in the laboratory that incorporate directions about how to mitigate the hazards of the procedures;
- develop and implement a group Chemical Hygiene Plan, by filling out the 'Area Specific addition to the Chemical Hygiene plan";
- informing and training laboratory personnel and students regarding the specific hazards in their area and in the work they will be doing (See Wisconsin Employees' Right-to-Know Law);
- scheduling time for laboratory personnel to participate in training outlined in Chapter 5;
- documenting and maintaining records of safety training per Chapter 8 including certification that all lab personnel have read and understand the Campus Chemical Hygiene Plan as well as the Laboratory Specific Chemical Hygiene Plan.;
- enforcing UWM safety policies and safe work practices.
- conducting periodic audits of the research space under their control.
- reporting hazardous conditions to Department Chair or Dean; and
- investigate laboratory accidents, document the investigation (Worker's Compensation section or Appendix J), and send copies of form with recommendations to the Chemical Hygiene Officer for review.
- ensuring the Chemical Hygiene Plan easily accessible at all times for all lab staff so they may use it as a reference if they have any questions regarding its contents.

E. Group Safety Representatives

Laboratory supervisors/ Principal Investigators are encouraged to designate an individual from their research group to serve as the Group Safety Representative (GSR). The Group Safety Representative will serve as a liaison for US&A and will advise and assist their laboratory supervisors with:

- training new personnel.
- disseminating safety information.
- conducting inspections of their group's laboratories; and
- inspecting and ensuring the maintenance of group safety equipment (spill containment kits, fire extinguishers, safety showers, and eyewash facilities).

The GSRs will also be responsible for:

- safety and chemical hygiene issues delegated to them by the PI;
- evaluating and making recommendations for safety issues that concern the entire department; and
- participating in periodic safety inspections of department laboratories or shops. Including peer lab inspections.
- Assist with accident reporting and post-accident follow-up as delegated by the PI or Campus Safety.

F. Faculty, Staff, and Laboratory Personnel

Faculty, staff, and laboratory personnel who have significant responsibility for directing their own laboratory work are responsible for assuring that potential hazards of specific projects have been identified and addressed before work is started. All laboratory personnel, however, are responsible for:

- attending safety training sessions.
- following safety guidelines applicable to the procedures being carried out.
- assuring that required safety precautions are in place before work is started; and
- reporting hazardous conditions as they are discovered.

5. Acknowledgements

University Safety and Assurances wishes to thank Dawn Errede at the University of Minnesota and Jerry Gordon at Cornell University for their generous assistance in creating this document. Their chemical hygiene plans were used extensively as a model and framework to create this Chemical Hygiene Plan.

University of Wisconsin- Milwaukee
Chemical Hygiene Plan
Chapter 2 - Standard Operating Procedures

As noted in Chapter 1, Principal Investigators are responsible for ensuring there are written standard operating procedures (SOPs) for the research protocols conducted in their area. The SOPs must identify the hazards of the protocol, as well as measures to be taken to mitigate those hazards. The references listed below may provide enough detail to serve as the SOPs for some research protocols. Other protocols may require more tailoring, as described in Section 5 of this chapter.

1. Chemical Procedures

A. Laboratory-Specific Standard Operating Procedures

Each PI must have written Standard Operating Procedures (SOPs) for the research protocols conducted in his or her laboratory. Like the Chemical Hygiene Plan, the SOPs must be accessible to researchers at all times when they are in the labs. Keeping hard copies in the lab or having them on a computer in the laboratory fulfills the accessibility requirement. Note, if the SOPs are on the computer, they must be accessible at all times. For a list or copy of chemical-specific SOPs that have been developed through US&A, contact US&A at 229-6339.

Laboratory-specific SOPs are valuable research tools that may be used in addition to or supplement for the Chemical Hygiene Plan. The process of writing SOPs requires an individual to think through all steps of a procedure and perform a risk assessment before beginning work. The SOP provides a written means to inform and advise researchers about hazards in their workplace, allows for standardization of materials and methods, and improves the quality of the research. A well-written SOP can be used to comply with the federal Laboratory Safety Standard, which states that the Chemical Hygiene Plan must include:

"Standard operating procedures relevant to safety and health considerations to be followed when laboratory work involves the use of hazardous chemicals."

SOPs should include exposure controls and safety precautions that address both routine and accidental chemical, physical, or biological hazards associated with the procedure. A template for writing new SOPs is available in Appendix G or the University Safety and Assurances website forms page under Chemical: Standard Operating Procedure for Highly Hazardous Chemicals Use Blank. SOPs should include storage, use, spill and disposal aspects of chemicals used.

B. Prior Approval

The OSHA Laboratory Standard requires Chemical Hygiene Plans to include information on “the circumstances under which a particular laboratory operation, procedure, or activity shall require prior approval,” including “provisions for additional laboratory personnel protection for work with particularly hazardous substances” such as "select carcinogens," reproductive toxins, and substances which have a high degree of acute toxicity.

Prior approval ensures that laboratory workers have received the proper training on the hazards of particularly hazardous substances or with new equipment and to ensure that safety considerations have been considered BEFORE a new experiment begins.

While US&A can provide assistance in identifying circumstances when there should be prior approval before implementation of a particular laboratory operation, the ultimate responsibility of establishing prior approval procedures lies with the Principal Investigator, laboratory supervisor, or Department.

The Chemical Safety Committee (CSC) authorizes use of high hazard chemicals to ensure standard operation procedures (SOPs) development and institute controls to address the risks of these chemicals. Highly Hazardous Chemicals include, but are not limited to:

- Chemicals listed as Acutely Hazardous Waste,
- Chemicals regulated by Homeland Security under the CFATs regulations,
- Explosives
- Particularly Hazardous Substances
  - Select carcinogens.
  - Reproductive toxins
  - Mutagens
  - Teratogen a
  - Substances with a high degree of acute toxicity**

  **Any chemical displays acute toxicity with an animal LD50 (oral) < 500mg/kg, LD50 (dermal)< 200mg/kg, or LD50 (inhalation) < 200ppm/hr or <2000mg/m3/hr.,
- Anti-neoplastic Drug by NIOSH
- Peroxide-formers
- Pyrophoric Chemicals
- Toxic and Corrosive Gases
- Biotoxins
- Controlled Substances or DEA list items
- Formaldehyde and Related Chemicals used in animals not for preservation.
- Anesthetic Agents (i.e.: carprofen, Isoflurane, MS222)
- Laboratory synthesized chemicals for which a Safety Data Sheet does not exist and there is not hazard information available.

Principal Investigators, laboratory supervisors, or departments must identify operations or experiments that involve particularly hazardous substances (such as "select carcinogens," reproductive toxins, and substances which have a high degree of acute toxicity) and highly hazardous operations or equipment that require prior approval. They also must establish the guidelines, procedures, and approval process that would be required. This information should be documented in the laboratories or department's SOPs or CHP. Additionally, Principal Investigators, laboratory supervisors, and Departments are strongly encouraged to have written documentation such as “Prior Approval” forms (SOP Form) that are completed and signed by the laboratory worker, and signed off by the Principal Investigator or laboratory supervisor and kept on file.

Examples where Principal Investigators or laboratory Supervisors should consider requiring their laboratory workers to obtain prior approval include:

- experiments that require the use of particularly hazardous substances such as "select carcinogens," reproductive toxins, and substances that have a high degree of acute toxicity, highly toxic gases, cryogenic materials, and other highly hazardous chemicals or experiments involving radioactive materials, high powered lasers, etc.
- where a significant change is planned for the amount of chemicals to be used for a routine experiment such as an increase of 10% or greater in the quantity of chemicals normally used.
- when a new piece of equipment is brought into the lab that requires special training in addition to the normal training provided to laboratory workers; or
- when a laboratory worker is planning on working alone on an experiment that involves highly hazardous chemicals or operations. (See Working in Isolation Policy: Appendix K)

Some instances may require Prior Approvals by an entity outside of the Department for research involving:

- purchases involving Poison Inhalation Hazards or nanomaterials- contact the Chemical Hygiene Officer;

- recombinant DNA- contact the Institutional Biosafety Committee;
- use of Radioactive Materials- contact the Radiation Safety Officer;
- research using live vertebrate animals- contact the Animal Care and Use Committee; or
- use of Human Subjects- contact the Institutional Review Board

To determine if the chemicals or substances in your lab meet these guidelines and require a written Standard operating procedure you may use our Highly Hazardous Chemical Table search form located on the University Safety and Assurance website. https://uwm.edu/safety-and-assurances/ Standard Operating Procedures that require approval should be sent to the **Chemical Hygiene Officer**

C. Chemical Waste Disposal

Extensive and detailed policies regarding hazardous waste management are specified in the UWM Waste Disposal Guide. Please refer to this Guide for approved waste handling procedures or contact Environmental Protection at hazwaste@uwm.edu.

D. Other Hazardous Materials

I. Biohazard Material Procedures

All researchers working with human blood or body fluids, or other pathogens must follow the UWM Bloodborne Pathogens Exposure Control Plan, and complete UWM Bloodborne Pathogens Training available on the web. All researchers working with infectious material including attenuated lab and vaccine strains (bacteria, viruses, parasites, fungi, prions), biologically derived toxins, rDNA, and artificial gene transfer must follow requirements of the UWM Biosafety Program detailed in the Biosafety Manual.

II. Radioactive Material Procedures

All researchers using radioactive materials at the University of Wisconsin- Milwaukee must:

- obtain a permit for the possession and use of radioactive materials (contact the Radiation Safety Officer- 229-6339).
- complete required training modules; and
- comply with the radiation policies and procedures of the UWM Radiation Safety Program.

The Radiation Safety Manual contains information on a number of topics including license committees, the permitting process, purchasing procedures, transfer procedures, general safety, personnel dosimetry, waste management, emergency management (spill control), recordkeeping, and regulatory guides on occupational exposure and prenatal exposure.

III. Controlled Substances

In conducting research with controlled substances (DEA List of Controlled Substances), UWM authorized laboratory personnel must comply with federal and state laws and regulations regarding their uses including registration with the Drug Enforcement Administration (DEA), storage requirements, inventory maintenance, and substance disposal. Contact Environmental Protection (for disposal information. Guidance pertaining to controlled substances is available on the US&A website.

E. Information Sources

I. Safety Data Sheets (SDSs)

Safety Data Sheets (SDSs) are an important part of any Chemical Hygiene Plan to provide information to chemical users. SDSs provide useful information such as:

- the identity of the chemical substance.
- physical and chemical characteristics.
- physical and health hazards.
- primary routes of entry.
- OSHA Permissible Exposure Limits (PELs);
- carcinogenic and reproductive health status.
- precautions for safe handling and use (including PPE).
- spill response procedures.
- emergency and first aid questions; and
- date the SDS was prepared.

It is the responsibility of Principal Investigators and Laboratory Supervisors to ensure that staff and students working in laboratories under their supervision have access to SDSs (and other sources of information) for all hazardous chemicals used in laboratories under their control. See Wisconsin Employees' Right-to-Know Law.

Any chemical shipment received should be accompanied by a SDS (unless one has been shipped with a previous order). If you do not receive a SDS with your shipment, first check the chemical manufacturer's website (or call the manufacturer directly). You may also contact US&A at 229-6339 to request assistance in obtaining an SDS.

SDSs must be accessible at all times. Access to SDSs can mean paper copies in a binder in the lab (preferred method) or electronic copies saved on a hard drive or bookmarked via manufacturer's or other websites. All laboratory personnel in the workplace should know where to find the SDS and be trained on the use of computers to access SDSs.

If you have questions on how to read SDSs or about the terminology or data used in SDSs, you can contact US&A at 229-6339 for more information. Additional information, including how to read a SDS can be found in NIEHS tools or from OSHA.

Any accidents involving a chemical will require that a SDS be provided to emergency response personnel and to the attending physician so proper treatment can be administered.

The US&A "rule of thumb" is that any person working in a laboratory should be able to produce a paper copy of a SDS for any hazardous chemical found in the lab within five minutes.

SDSs for Newly Synthesized Chemicals

Newly synthesized chemicals that are going to be shipped off campus will need to be accompanied by an SDS as well as properly labeled, "For Research and Development Use Only." Contact US&A for the shipping of newly synthesized chemicals.

II. Prudent Practices in the Laboratory

Laboratory standard operating procedures found in *Prudent Practices in the Laboratory: Handling and Disposal of Chemicals* (National Research Council, 2011) (referred to as *Prudent Practices* in this Plan) are adopted for general use at the University of Wisconsin- Milwaukee. The entire contents are accessible on the web (Use link above) and free to download.

III. The American Chemical Society's "Safety in Academic Chemistry Laboratories"

The American Chemical Society's (ACS) "Safety in Academic Chemistry Laboratories" is another useful text. This manual presents information like that found in *Prudent Practices*, but in a considerably condensed format. The text is free to individuals via ACS's College and University Guidelines page.

IV. University Safety and Assurances Website

The University Safety and Assurances Chemical Safety Program and the Laboratory Safety Program website contains information and guidance pertaining to chemical procedures and Laboratory practices. The following are some of the topics with information available:

Chemical Safety:
- Flammable Liquid Storage
- Corrosive Liquid Storage
- Formaldehyde and Formalin Solutions
- Hydrofluoric Acid
- Mercury
- Picric Acid
- Lead
- Chemical Purchasing Approval Process
- Reactive Chemicals
- Combustible Metals
- Highly Hazardous Chemical Table

Laboratory Safety
- Chemical Hygiene Plan
- Laboratory Safety Signs
- Laboratory Equipment
- Laboratory Procedures
- New Lab Design process
- Personal Protective Equipment (PPE)
- Training

V. Patty's Toxicological

Patty's Toxicology (6th edition) Volumes 1-6 (John Wiley & Sons, Inc., 2012) offers toxicological data on industrial chemicals that pose potential health hazards to workers.

2. Emergency Procedures

A. Emergency Procedures for Chemical Spills/ Exposures

For ALL Milwaukee Campus emergencies, contact Campus Police-9-911 from a campus phone or 229-9911 from a cell phone.
ALL other Campuses (GLRF/ Global Water/ Waukesha County/ Washington County) contact 911

The procedures listed below are intended as a resource for your department in preparing for emergencies **before** they happen. Complete spill and exposure response procedures are described at the UWM Emergency Response: Chemical Spills web page. However, the following quick reference guide is included for convenience in this Chemical Hygiene Plan.

Chemical Spill/ Exposure Quick Reference Guide

Chemical Spill on Body
- Remove all contaminated clothing.
- Flood exposed area with running water from a faucet or safety shower for at least 15 minutes.
- Do not redon or wear contaminated clothing. The Department or US&A may have sweats or scrubs available to don.
- Have another individual contact the University Police: 9-911 from any hard-wired campus

phone or 229-9911 from a cell phone, to obtain medical attention.
- Report the incident to your supervisor or instructor and University Safety and Assurances.
- Fill out the appropriate accident reports.

Chemical Splashed in Eye

- Immediately rinse eyeball and inner surface of eyelid with water continuously for 15 minutes. Forcibly hold eye lid(s) open to ensure effective wash behind eyelids.
- Have another individual contact the University Police at x9-911 from any campus hard-wired phone, or 229-9911 from a cell phone to obtain medical attention.
- Report the incident to your supervisor or instructor and University Safety and Assurances.

Evacuate

- Leave the spill area; alert others in the area and direct/ assist them in leaving.
- Without endangering yourself, remove victims to fresh air, remove contaminated clothing, and flush contaminated skin and eyes with water for 15 minutes. If anyone has been injured or exposed to toxic chemicals or chemical vapors, call 9-911 (229-9911 from cell phone) and seek medical attention immediately.

Confine

- Close doors and isolate the area. Prevent people from entering spill area.

Report

- From a safe place, call the Campus Police at 9-911 or 229-9911 from a cell phone. (Campus Police will contact US&A personnel.)
- Report that this is an emergency and provide:
  1. your name, phone number, and location;
  2. location of the spill;
  3. the name and amount of material spilled;
  4. extent of injuries; and
  5. safest route to the spill.
- Stay on the phone, Campus Police dispatch will advise you as soon as possible.
- The Milwaukee Fire Department- Hazardous Materials Response Team or a contracted vendor will be contacted to clean up or stabilize spills that are considered high hazard (fire, health, or reactivity hazard). In the case of a small spill and low hazard situation, US&A (229-6339) will advise you on what precautions and protective equipment to use. After hours, contact University Police at 229-4627 (non-emergency).

Secure

- Until emergency response personnel arrive:
  1. block off the areas leading to the spill;
  2. lock doors;
  3. post signs and warning tape; and
  4. alert others of the spill.
- Post staff by commonly used entrances to the area to direct people to use other routes.

After an accident, supervisor(s) must complete and submit accident reporting forms within 24 hours. Worker's Compensation policy and reporting forms and General Incident forms are available on the University Safety and Assurances website forms page.

B. General Emergency Procedures

For ALL on UWM campus emergencies, contact Campus Police- 9-911 from a campus phone or 229-9911 from a cell phone.

For All UWM Off-campus emergencies, contact the Police department at 911.

The Emergency Information posting at the beginning of this plan should be completed and posted inside the laboratory near the phone for quick reference.

The procedures listed below are intended as a resource for your department in preparing for emergencies before they happen. Please access them via the hyperlinks.

UWM Emergency Preparedness

- Chemical Spills
- Fire Safety
- Radiation Spills
- Biohazardous Spill Cleanup Procedures
- Medical Emergencies
- Severe Weather (Tornado)
- Utility Outages
- Floods
- Elevator Malfunction
- Bomb Threats
- Workplace Violence

3. General Safety Procedures

A. Laboratory Use

I. Chemical Labeling

The simple rule for chemical labeling is: “If a container looks like it contains a chemical (even a clear liquid such as water), then it must be labeled with what it contains.” All chemical containers (both hazardous and non-hazardous) MUST be labeled. Chemical names must be written out in English. Proper labeling of chemicals is one way of informing people who work in laboratories of potential hazards that exist and is important in the prevention of generating unknown chemical containers. Proper labeling of chemicals is also necessary during emergencies, such as spill response and to facilitate medical treatment.

All personnel working in the laboratory must be fully trained on how to label chemicals using the system and how to understand the labeling system. Training must occur when a new person begins working in the laboratory, when new chemicals are introduced, and on a regular basis- annually at a minimum.

a. Manufacturer chemical containers
New chemical containers from manufacturers should have the proper labeling information on the chemical label. The OSHA Laboratory Standard requires that labels on all incoming containers must be maintained and not defaced. As part of laboratory good housekeeping and self-inspections, if any chemical labels appear to be falling off, then laboratory personnel should tape the label back on the container or re-label with a permanent label.

b. Non-original containers
Non-original containers (secondary use containers) such as wash bottles, squirt bottles, temporary storage containers, beakers, flasks, bottles, vials, etc. or any container that a chemical from an original container is transferred into, must be properly labeled. Laboratory personnel are strongly encouraged to use commercially available pre-labeled containers (such as squirt bottles) for chemicals that are used frequently. If you are using Chemical Abbreviation codes (i.e.: EtOH for Ethanol or H2O for Water) there must be a chemical identification Key (ID key) posted in an obvious spot in the lab indicating what that abbreviation code represents and what the main hazard for the material is.

c. Newly Synthesized Chemicals and Labels
Principal Investigators will be responsible for ensuring that newly synthesized chemicals are used exclusively within their laboratories and are properly labeled. If the hazards of a chemical synthesized in the laboratory are unknown, then the chemical must be assumed to be hazardous and the label should indicate the potential hazards of that substance have not been tested and are unknown.

In general, write out the full chemical name and any hazards associated with that chemical. However, labs may choose to label chemical containers in other ways such as:

1) Hazard Identification

- When labels are not readily available to portray the hazards of the chemical or space is limited to display the full hazards description, utilize OSHA's mandatory Health Hazard Criteria and also use GHS labeling
- Abbreviations – Structures and Formulas. The use of abbreviations such as structures, formulas, or acronyms is acceptable. However, if you use any abbreviations, you must post a “key” to the abbreviations in a visible location (preferably close to the chemicals and/or by the door). The “key” must contain the abbreviation and the name of the chemical. Including any

hazards present is also useful information. A sample fill-in the blank key is available in Appendix L. The abbreviation key must be readily available upon request by visitors, emergency responders, and state and federal regulatory agencies such as EPA, OSHA, or Wisconsin DCOM inspectors.

2) Small Containers and Sample Storage

For small containers, such as vials and Eppendorf tubes, which may be too small to write out a chemical name, structure, or formula, laboratories can implement other systems to identify the chemicals such as:

- Placing the vial or small container in a Ziploc bag or other type of overpack container (beaker, plastic bottle, etc.) and labeling the overpack container with the chemical name.
- Laboratories can also make use of tag labels in which the chemical name is written out on a tag, and the tag is then attached to the small container with string or a rubber band.
- For vials in a test tube rack – laboratory personnel can simply label the rack with the chemical name, and then label the vials with an abbreviation, color, number, or letter code that corresponds to the label on the test tube rack. Be sure that the number or letter code is clearly identifiable and would not be confused with other chemicals in the lab.
- For preserved specimens, bottles should be labeled with the preservative (i.e. ethanol or formaldehyde). Many these labels could easily be produced on the computer using mailing labels.
- For sample storage in refrigerators, laboratory personnel should label sample containers with one of the above methods, including labeling boxes that hold the small vials or chemical containers. Laboratories should also include a key to any abbreviations on the outside of the refrigerator in addition to the inventory list.

II. Laboratory Signage Program

Another form of hazard communication is the use of laboratory signs to notify entrants of the inherent dangers that are contained within the lab they are about to enter. Laboratory signage should include at a minimum:

- National Fire Protection Association (NFPA) 704 Hazard Identification (diamond or placard)
- Emergency Contact Information
  - Campus Police and phone number (9-911 or 229-9911 by cell phone)
  - Laboratory Principal Investigator or Supervisor and phone number
  - Alternate Contact and phone number
- “Authorized Personnel Only”

- Required hazard postings which include:
  - lasers,
  - ionizing radiation,
  - magnets,
  - biohazards,
  - toxic gases,
  - select carcinogens,
  - reproductive toxins, and
  - substances which have a high degree of acute toxicity.

UWM requires updated and custom-made signs for your laboratory visit the Laboratory Safety Signs and Postings web page. The sign database is shared with Campus police for emergency events on campus.

III. General Safe Laboratory Practices

There are several ways laboratory personnel can safely handle and use chemicals, these include: minimizing exposure to chemicals, proper training, understanding chemical hazards, proper labeling, proper storage and segregation, and proper transport.

The best way laboratory personnel can protect themselves from chemical hazards is to minimize exposure to chemicals in the first place. Simple steps that can be taken to minimize chemical exposure include:

Cold rooms / Confined Spaces.

- When working in cold rooms, keep all toxic substances tightly closed since colds rooms have recirculated atmospheres and there is no ventilation to prevent injury or inhalation.
- Flammables, combustibles, or volatile organic materials may not be used or stored in the cold room as cold-rooms only have recirculated atmospheres and do not have ventilation nor are they intrinsically safe.
- Corrosive Items may not be stored in cold rooms as the cold room has only recirculated atmospheres and there is no ventilation to prevent injury or inhalation. The corrosive nature of the material can easily corrode the recirculation fan and equipment.
- Be aware of the potential asphyxiation hazard when using cryogenic materials in confined areas such as cold rooms. Recommended use of Oxygen monitors for confined areas.
- Never use or store cryogenic material in a cold room.
- Never use gases in a confined space such as a cold room or environmental chamber.

Chemical Hazards.

- Whenever possible, eliminate unnecessary chemicals or substitute less hazardous chemicals for the hazardous chemicals used in your experiments.
- Always try to use the smallest possible quantities of chemicals for all experiments. Consider trying microscale experiments and activities.
- When possible, minimize chemical exposures to all potential routes of entry - inhalation, ingestion, skin and eye absorption, and injection by proper use of engineering controls and personal protective equipment.
- Be familiar with the hazardous properties of the chemicals you will use. Utilize Safety Data Sheets (SDS).
- Do not smell or taste chemicals. If it is necessary to see if a chemical has a particular odor, lab personnel should hold the chemical container away from their face and gently waft their hand over the chemical container without inhaling large quantities of chemical vapors.
- Do not underestimate the risk of exposure to chemicals, even for substances of no known significant hazard.
- Chemicals that are particularly hazardous substances require prior approval from your supervisor and require special precautions to be taken such as a written SOP for their use.
- All substances of unknown toxicity should be considered toxic until proven otherwise.

- Request exposure monitoring to ensure the Permissible Exposure Limits (PELs) of OSHA and the current Threshold Limit Values (TLVs) of the American Conference of Governmental Industrial Hygienists are not exceeded.
- When working with mixtures of chemicals, laboratory personnel should assume the mixture to be more toxic than the most toxic component used in the mixture and follow universal precautions.

Chemical Storage and Use.

- Perform all experiments that involve toxic, volatile, or malodorous materials in the hood or in an enclosed container such as a vacuum system or glove box.
- Do not attempt to scale up experiments until after you have run the experiment according to published protocols and you are thoroughly familiar with the potential hazards. When scaling up an experiment – change only one variable at a time, i.e. don't change the heat source, the volumes, and the glassware all at once. Be sure to have someone else check your setup prior to each run. Recommended maximum of 3% increase in size with approval.
- Laboratory personnel should carefully plan out experiments (including conducting dry runs) in advance to identify any potential hazards and include the specific measures that will be taken to minimize exposure to all chemicals to be used and proper positioning of equipment.
- Do not pipette or apply suction by mouth.
- Transfer chemicals between labs via cart or secondary containment that is easily handled by one person. Items should be placed on cart or in containment using gloves.

Laboratory Equipment.

- Make sure that you know the location of all safety equipment before beginning laboratory work.
- Do not operate equipment unless you have been instructed in its proper use and demonstrated knowledgeable operability of the equipment.
- Keep the laboratory free of clutter. Do not store chemicals on the floor. Keep exits and aisles unobstructed. Do not block access to areas of the lab due to poor storage of equipment.

Food / Drink and Laboratory Refrigerators/ Microwaves.

- Refrigerated laboratory storage of flammables MUST be in either a Flammable Storage refrigerator, an Explosion Resistant refrigerator, or Explosion Proof refrigerator. There is no low value of what an allowable volume is. If the material is flammable, it is in an appropriate refrigerator.
- To prevent exposure to chemicals, do not eat, drink, chew gum or apply cosmetics in areas where hazardous chemicals are being used.
- Keep all food and drink out of areas where chemicals are handled or stored such as refrigerators, freezers, and microwaves.
- Refrigerators used to store chemicals should be labeled as "Chemicals Only – No Food". Refrigerators used to store food should be labeled as "Food Only – No Chemicals". Microwaves must also be labeled for lab use or see Prohibition on Eating, Drinking and Smoking in University laboratories.
- Refrigerators and microwaves for food consumption may not be placed in a laboratory or area where chemicals are used.
- Do not eat or drink in laboratories, Consuming, storage or preparation of food and drink may only take place in areas separated from chemicals, radioactive or biohazardous agents by floor to ceiling walls with a door. Office areas or desks inside a lab that are not segregated by a wall and a door may not have food, drink or any equipment that supports food and drink use, preparation, or containment. Food, beverages, cups, and other drinking and eating utensils must not be stored in areas where hazardous chemicals are handled or stored.

- Glassware used for laboratory operations should never be used to prepare of consume food or beverages.
- Laboratory refrigerators, ice chests, cold rooms, ovens and so forth must not be used for food storage or preparation.
- Rooms that are adjacent, but separated by floor-to-ceiling walls, and do not have any chemical, radioactive or biohazardous agents present, may be used for food consumption, preparation or applying cosmetics at the discretion of the Principal Investigator or project director responsible for the areas.
- Laboratory water sources and de-ionized laboratory water should not be used for drinking water.

Personal Protective Equipment -P.P.E.

- Be sure to select the proper PPE and regularly inspect it (particularly gloves) for contamination, leaks, cracks, and holes.
- Used disposable gloves are to be disposed of in the trash after use. They should not be left on lab benches, in pockets or drawer handles (thus contaminating them)
- Wear proper attire- lab coat, pants, and closed-toe shoes. Confine long hair and loose clothing. Note: mesh tennis shoes, sandals, clogs and flip flops are not considered closed toe shoes.
- Always remove lab coats and other personal protective equipment (such as gloves) before leaving the lab.
- Gloves (contaminated and non-contaminated) are to be removed from the hands when walking down hallways or when using elevators and stairwells. A clean pair of gloves may be carried along with you in case of emergencies.

Miscellaneous.

- Protect your laboratory and laboratories and offices on floors below from floods.
- Always wash hands with soap and water after handling chemicals and especially before leaving the lab and eating – even if gloves were being worn during chemical handling.
- Do not smoke or use vape devices in any UWM facilities.
- Secure all compressed gas cylinders to walls or benches with metal chains or appropriate straps.
- Minors are restricted from laboratories and other campus areas where physical, chemical, biological or other potential health and safety hazards are present. ONLY minors that are authorized and trained are allowed in laboratories.
  (See Minors in Laboratories, Shops and Studios). Forms to fill out for hosting minors in a lab can be found on the US&A website forms page.
- Use of Cell phones or tablets is limited to use in areas where experimental manipulation is not occurring.

IV. Planning for Laboratory Shutdown

Researchers should develop written procedures to deal with events such as fire, loss of electrical power (affecting fume hoods, Bio Safety Cabinets, coolers, etc.) or other utilities (water), laboratory flood, or severe weather. Prepare procedures that meet your specific needs. Your research group should be trained on the procedures and be prepared to implement whenever a severe weather event has been issued. Post the procedures on the inside of the laboratory door for quick reference. Remember, you must take responsibility to protect your laboratory and research. Guidance on factors to consider when developing shut-down plans is available from US&A.
See Lab Hibernation/ Shutdown Template (Appendix N).

V. Other Laboratory Use Safety Guidance

- Fume Hood Procedures and Practices
- Gas Cylinder Safety
- Eyewash and Shower Information
- Fire Safety and Extinguishers

B. Non-Chemical Safety Procedures

Other General Safety information is available on the University Safety and Assurances website via the following links:

- Lasers
- Autoclave Safety
- Hearing Conservation and Noise Control
- Lockout/ Tagout and Machine Guarding
- Safety Rules for Powered Equipment
- Hand Tools
- Ladder Safety
- Vacuum Systems
- Help Eliminate Fire Hazards
- Electrical Abuse- Extension cords
- Maintain Exit Routes in Lab

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Chapter 3 - Criteria for Implementation of Chemical Control Measures

Engineering controls, personal protective equipment, hygiene practices, and administrative controls each play a role in a comprehensive laboratory safety program. Implementation of specific measures must be carried out on a case-by-case basis, using the following criteria for guidance in making decisions. Assistance is available from the Department of University Safety and Assurances.

1. Engineering controls

A. Fume Hoods

The laboratory fume hood is the major protective device available to laboratory workers. It is designed to capture chemicals that escape from their containers or apparatus and to remove them from the laboratory environment before they can be inhaled.

Chemical characteristics to be considered in requiring fume hood use are:

1. physical state,
2. volatility,
3. toxicity,
4. flammability,
5. eye and skin irritation,
6. odor
7. the potential for producing aerosols.

A fume hood should be used if a proposed chemical procedure exhibits any one of these characteristics to a degree that:

1. airborne concentrations might approach the action level (or permissible exposure limit);
2. flammable vapors might approach one tenth of the lower explosion limit;
3. materials of unknown toxicity are used or generated; or
4. the odor produced is annoying to laboratory occupants or adjacent units.

Procedures that can generally be carried out safely outside the fume hood include those involving:

1. water-based solutions of salts, dilute acids, bases, or other reagents.
2. very low volatility liquids or solids.
3. closed systems that do not allow significant escape to the laboratory environment; and
4. extremely small quantities of otherwise problematic chemicals.

The procedure itself must be evaluated for its potential to increase volatility or produce aerosols.

In specialized cases, fume hoods will contain exhaust treatment devices such as water wash-down for perchloric acid use or charcoal or HEPA filters for removal of particularly toxic or radioactive materials.

B. Safety Shields

Safety shields such as the sliding sash of a fume hood are appropriate when working with highly concentrated acids, bases, oxidizers, or reducing agents, all of which have the potential for causing sudden spattering or even explosive release of material. Reactions carried out at non-ambient pressures (vacuum or high pressure) also require safety shields, as do reactions that are carried out for the first time or are significantly scaled up from normal operating conditions.

C. Biological Safety Cabinets

Biological Safety Cabinets (BSC), also known as tissue culture hoods or laminar flow hoods, are the primary means of containment for working safely with infectious microorganisms. Cabinets are available that either exhaust to the outside or recirculate HEPA filtered air to the laboratory. They are not to be used for working with volatile or hazardous chemicals unless they are specifically designed for that purpose and are properly vented. Generally, the only chemical work that should be done in a BSC is that which could be done safely on a bench top involving chemicals that will not damage the BSC or the HEPA filter. For proper cabinet selection and use see, the CDC publication Primary Containment for Biohazardshttps://www.cdc.gov/csels/dls/lcn/biosafety-campaign.html.

D. Other Containment Devices

Other containment devices, such as glove boxes or vented gas cabinets, may be required when it is necessary to provide an inert atmosphere for the chemical procedure taking place, when capture of any chemical emission is desirable, or when the standard laboratory fume hood does not provide adequate assurance that overexposure to a hazardous chemical will not occur. The presence of biological or radioactive materials may also mandate certain special containment devices. High strength barriers coupled with remote handling devices may be necessary for safe use of extremely shock sensitive or reactive chemicals.

Highly localized exhaust ventilation, such as is usually installed over atomic absorption units, may be required for instrumentation that exhausts toxic or irritating materials to the laboratory environment. Ventilated chemical storage cabinets or rooms should be used when the chemicals in storage may generate toxic, flammable, or irritating levels of airborne contamination.

2. Personal Protective Equipment

A. Skin Protection

Appropriate clothing and footwear in university laboratories is essential in the laboratory as skin must be protected from hazardous liquids, gases, and vapors. Long hair should be pulled back and secured and loose clothing (sleeves, bulky pants, or skirts) avoided preventing accidental contact with chemicals or open flames. Bare feet, sandals, and open-toed or perforated shoes (tennis shoes with mesh) are not permitted in any laboratory. Short pants and short skirts are not permitted unless covered by a lab coat. Long pants should be worn to cover skin that could be exposed during a spill.

Lab coats are strongly encouraged as routine equipment for all laboratory workers. It is the responsibility of the employer to purchase and wash lab coats for laboratory personnel who request them or are required to wear them. Lab coats are required when working with radioactive materials, biologically derived toxins, Biosafety Level II organisms, carcinogens, reproductive toxins, substances that have a high degree of acute toxicity, any Highly Hazardous designated chemical and any substance on the OSHA PEL list carrying a "skin" notation. See Appendix B for chemical listings. Lab coats cannot be assumed to provide complete protection against all agents but will provide an extra layer that can be removed if accidentally contaminated, buying time for the researcher to get to the emergency shower and minimize direct skin contact. For strong acids and bases, a lab apron impervious to liquids would be a more appropriate choice or addition. If working with flammable or reactive chemicals, flame-resistant lab coats are highly recommended to prevent severe burns. Synthetic lab coats and clothes melt onto the skin when exposed to fire increasing the severity of the burn.

Gloves made of appropriate material are required to protect the hands and arms from thermal burns, cuts, or chemical exposure that may result in absorption through the skin or reaction on the surface of the skin. Gloves are also required when working with particularly hazardous substances where possible transfer from hand to mouth must be avoided. Thus, gloves are required for work involving pure or concentrated solutions of select carcinogens, reproductive toxins, substances that have a

high degree of acute toxicity, strong acids and bases, and any substance on the OSHA PEL list carrying a "skin" notation.

Since no single glove material is impermeable to all chemicals, gloves should be carefully selected using guides from the manufacturers. General selection criteria are outlined in *Prudent Practices*, p. 132 and the US&A Gloves web page. However, glove-resistance to various chemicals materials will vary with the manufacturer, model, and thickness. Therefore, review a glove-resistance chart from the manufacturer you intend to buy from before purchasing gloves. When guidance on glove selection for a particular chemical is lacking, double glove using two different materials, or purchase a multilayered laminated glove such as a Silvershield®/ 4H®.

B. Eye Protection

Eye protection is required for all personnel and any visitors whose eyes may be exposed to chemical or physical hazards. Side shields on safety spectacles provide some protection against flying particles, but goggles or face shields are necessary when there is a greater than average danger of eye contact with liquids, fine solids or powders. A higher-than-average risk exists when working with highly reactive chemicals, concentrated corrosives, or with vacuum or pressurized glassware systems. Contact lenses may be worn under safety glasses, goggles, or other eye and face protection. Experts currently believe the benefits of consistent use of eye protection outweigh potential risks of contact lenses interfering with eye flushing in case of emergency.

C. Respiratory Protection

Respiratory protection is generally not necessary in the laboratory setting and must not be used as a substitute for adequate engineering controls. Availability of respiratory protection for emergency situations may be required when working with chemicals that are highly toxic and highly volatile or gaseous. If an experimental protocol requires exposure above the action level (or PEL) that cannot be reduced, respiratory protection will be required. Rarely, an experimental situation may potentially involve IDLH (immediately dangerous to life or health) concentrations of chemicals, which will require use of respiratory protection. All use of respiratory protective equipment is covered under the University of Wisconsin- Milwaukee Respiratory Protection Program.

3. Hygiene Practices

Eating, drinking, and chewing gum are all strictly prohibited in any laboratory with chemical, biological, or radioactive materials. Researchers must also be careful to restrict other actions (such as applying lip balm or rubbing eyes) which could inadvertently cause exposure to research materials. Consuming alcohol or taking illegal drugs in a research laboratory are strictly prohibited; as such actions potentially endanger the health and safety of not only the user, but everyone in the building.

Before leaving the laboratory, remove personal protective equipment/ clothing (lab coat and gloves) using the “inside-out removal” method and wash hands thoroughly. Do NOT wear laboratory gloves, lab coats, or scrubs in public spaces such as hallways, elevators, or cafeterias.

4. Administrative Controls

Supervisors shall consider the hazards involved in their research, and in written research protocols, detail areas, activities, and tasks that require specific types of personal protective equipment as described above. Researchers are strongly encouraged to prioritize research so that work with hazardous chemical, biological, or physical agents occurs only during working hours (8 am – 5 pm, Monday through Friday). After-hours work (on nights and weekends) should be restricted to non-hazardous activities such as data analysis and report writing. If hazardous materials must be used at night or on weekends, ensure that at least one other person is within sight and earshot to provide help in an emergency.

Undergraduate workers are prohibited from working alone (working in isolation) in the laboratory unless there is a review and formal approval by the supervisor and safety committee. See Appendix K.

Principal Investigators or laboratory supervisors should coordinate and/ or conduct inspections of laboratories in their area of responsibility and address any noted deficiencies. An audit checklist is available in Appendix F. US&A will conduct annual inspections using our electronic software of the labs with the PI and/ or Group Safety Representatives (GSRs). The GSRs are responsible for discussing the hazards that were recognized during the inspection with their PI or lab supervisor. The PI or lab supervisor is responsible for assigning corrective actions for the hazards identified and establishing target dates for the hazards to be corrected by as well as follow-up to ensure the corrective actions are completed.

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Chapter 4 - Management of Chemical Fume Hoods and Other Protective Equipment

1. Monitoring Safety Equipment

A. Fume Hoods and Biological Safety Cabinets

I. Laboratory Personnel

Fume hoods must be monitored daily by the user to ensure that air is moving into the hood. Any malfunctions must be reported immediately to Facility Services (229-4742) or https://uwm.edu/facility-services/ . See Section II for steps to take if hood does not pass annual inspection and has an "Out of Order" sign is attached. The hood should have a continuous reading device, such as a pressure gauge, to indicate that air is moving correctly.
Users of older hoods without continuous reading devices should attach a strip of tissue, yarn or plastic ribbon to the bottom of the vertical sliding sash to indicate the air flow. The user must ensure the hood and baffles are not blocked by equipment and bottles as air velocity through the face may be decreased.

Laboratory personnel should conduct a dry ice capture test with their fume hoods when using new materials for the first time or whenever substantial changes have been made to an experimental setup in a hood, such as the addition of more apparatus. The following is a description of the Dry Ice Capture Test

Visual Capture Test (Dry ice test)
A visual capture test is the surest way to tell if your fume hood is capturing properly so you may choose to conduct your own to see how well your hood is performing. ANSI/ ASHRAE 110-1995 provides a procedure to supplement face velocity with a visual test for capture called a dry ice test. US&A uses the following procedure as the basis for its own dry ice protocol.

***SAFETY:* Dry ice is extremely cold and can burn the skin on contact. Also, dry ice generates CO2 gas as it warms and in an enclosed space can produce an oxygen deficient environment. Laboratory personnel must read the dry ice MSDS and be aware of the hazards before handling any dry ice. If the hood is a Radiation hood, then talk to the lab personnel and make sure the hood is not contaminated before proceeding.

- Eye protection and insulated gloves should be worn when handling dry ice or conducting this test. Tongs may be used to handle the dry ice in place of thermal gloves.
- Pelleted dry ice should be obtained from your department. If unable to obtain dry ice, contact US&A at 229-6339.
- Place dry ice into an insulated container.
- The sash should be positioned at 18 inches or the height marked for safe use by US&A. Fill a container about half-way with hot water. Put 5 or 6 pellets of dry ice into the container and wait a few seconds. Place the container at the center of the hood with the edge of the bowl 6 inches from the plane of the sash and wait a few seconds. If the hood is too crowded, place the bowl as close to 6 inches from the sash as you can.
- Observe for about 15 seconds. If no vapors or a trivial amount of vapors break the plane of the sash, then the test passes. If, however, vapors consistently break the sash plane, then the test fails.

- Challenge the hood during the test by reaching into the hood or crossing in front of the hood to create possible eddy currents. You may also move the bowl closer to the hood face and operate any equipment while testing. These actions can simulate actual conditions encountered by the lab personnel and may give indication of what could contribute to leakage. This information can be considered in your assessment.
- Make sure all doors are closed and test for negative pressure by cracking the door open and putting the dry ice near the opening outside the door. The vapors should be sucked into the room.
- When disposing of the dry ice, pour the left-over pellets into the sink holding the bowl next to the side. Try not to let the pellets go into the drain since it could freeze the trap and burst the pipe.

If biological safety cabinets are used for Biosafety Level 1 or 2 work including handling human cells, they must be certified annually by an outside contractor. It is the responsibility of the department to schedule and pay for the contractor to perform annual certification.

II. Facility Services or University Safety and Assurances Staff
Facility Services or University Safety and Assurances (US&A) staff will measure the average face velocity of each fume hood annually as well as perform the Visual Capture Test. A record of monitoring results will be made.

If a hood is found to be unacceptable, an "Out of Order" sign indicating the hood did not pass inspection and does not provide optimum protection will be attached in a conspicuous location. The warning sign will include the proper individuals to contact for the status of the fume hood.

Under no circumstances should laboratory personnel continue to use a fume hood that has not passed inspection and has a warning sign attached, even if the fume hood appears to have airflow. Laboratory personnel must make arrangements with other laboratories with functioning fume hoods if their procedures require the use of a fume hood.

B. Emergency Eyewashes and Showers, Fire Extinguishers, and Other Protective Equipment

Eyewashes must be flushed weekly by the lab personnel. This will ensure that the eyewash is working, and that the water is clean, should emergency use become necessary. The lab personnel should check that their emergency showers and eyewashes are checked annually and notify Facility Services (229-4742) if not up-to-date. Fire extinguishers will be checked and maintained monthly by UWM Facility Services. The user is responsible for checking regularly to ensure that other protective equipment is functioning properly. Facility Services or US&A staff can assist with these evaluations should assistance be necessary. Clear signage indicating the presence of the Eyewash and Shower should be posted in the lab.

C. General Laboratory Monitoring

General laboratory conditions must be monitored periodically by the users. A laboratory audit form is included in Appendix F, and may be tailored for use by individual laboratories. The PI or laboratory supervisor may also use this form for spot-checks of the laboratories. The Group Safety Representative and UWM's Chemical Hygiene Officer or a member of US&A will also utilize this form for lab audits.

2. Acceptable Operating Range

The acceptable operating range for fume hoods is 80 to 120 linear feet per minute, at the designated sash opening (usually 18 inches). For bypass hoods, the sash height that 100 linear feet per minute (considered safe level) is achieved will be labeled at the side of the hood during the annual check. This is

the height that the sash can safely be opened to while conducting chemical processes; however, it is best to work with the sash in the lowest position safely possible for shielding and chemical containment. Low-flow fume hoods provide the same level of safety as other hoods, but at a lower acceptable operating range, as low as 50 linear feet per minute. These also will be labeled during the annual check.

If, during the annual check, a hood is operating outside of these ranges, US&A staff may request that you check to ensure the baffles are adjusted properly and that the exhaust slots are not blocked by containers and equipment. If these adjustments do not help, US&A staff will report the deficiency to Facility Services for servicing and notify the building chair and laboratory supervisor or PI.

3. Maintenance

During maintenance of fume hoods, laboratories must clean out, decontaminate the fume hood, if necessary, and restrict use of chemicals to ensure the safety of maintenance personnel. Facility Services should notify the laboratory of the maintenance as well.

4. Training

Training in the appropriate use and care of fume hood systems, showers, eyewashes, and other safety equipment must be included in the initial and update training described in Chapter 5.

5. New Systems

When new ventilation systems, such as low-flow fume hoods, are installed in UWM facilities, specific policies for their use will be developed and laboratory personnel will be promptly trained on use of the new equipment.

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Chapter 5 - Laboratory Personnel Information and Training

All laboratory researchers and their supervisors (Principal Investigators included) must be trained according to the requirements of the Laboratory Safety Standard. Academic and non-academic departments that engage in the laboratory use of hazardous chemical, physical, or biological agents are responsible for identifying such laboratory personnel. The laboratory personnel must be informed about their roles and responsibilities as outlined in this standard, as well as hazards associated with their work and how to work safely and mitigate those hazards.

US&A provides in person and web-based training modules on the basic information and training topics described below on the Training and Resources: On-Line Training Modules page of the US&A website. Training that laboratory personnel should receive is indicated in Appendix O. A current listing of training offerings such as Introductory Chemical Hygiene Plan and Laboratory Safety Training and Annual Lab Safety Review Training can be found on the US&A website Upcoming Events Calendar. **Refresher training must be provided at least annually.**

In addition, each PI or laboratory supervisor is responsible for ensuring that laboratory personnel are provided with training about the specific hazards present in their laboratory work area, and methods to control such hazards. Such training must be provided at the time of initial assignment of laboratory personnel to a work area, prior to assignments involving new potential exposures, and documented. Training includes reading through and documenting training on the laboratory Specific Chemical Hygiene Plan and Lab Specific Orientation Checklist. **Refresher training must be provided at least annually.**

If a PI or lab supervisor is considering having volunteers conducting research in their lab, they should fill out the forms available on our website and forward the completed forms to US&A or call 414-229-6339. If a PI or lab supervisor is considering having volunteer minors or other non-UWM-affiliated individuals working in their lab, they should fulfill the needs on the minor volunteer checklist and fill out the forms available on our website and send them to US&A Risk Management or call 414-229-3669 **prior** to the minor or volunteer working in the laboratory.

1. Information

It is essential that laboratory personnel have access to information on the hazards of chemicals and procedures for working safely. Supervisors must ensure that laboratory personnel are informed about and have access to the following information sources:

- **The contents of the OSHA Laboratory Safety Standard**

  "Occupational Exposure to Hazardous Chemicals in Laboratories" and its appendices (29 CFR 1910.1450). A copy of this federal standard can be found in Appendix A of this Chemical Hygiene Plan.

- **The University of Wisconsin- Milwaukee's Chemical Hygiene Plan (CHP)**

  This generic CHP is available to all laboratory personnel on the Department of University Safety and Assurances' web site. Individual department Chemical Hygiene Plans are available within those departments. Lab Specific Chemical Hygiene documents are to be filled out and stored for available use in each laboratory.

- **The Permissible Exposure Limits (PELs)**

  PELs for OSHA regulated substances can be found in Appendix B. Also included in Appendix B are the ACGIH Threshold Limit Value (TLV) list, a list of OSHA health hazard definitions, lists of "select carcinogens" and reproductive toxins, and chemicals having a high degree of acute

toxicity.

- **Signs and symptoms associated with exposures to hazardous chemicals.**

  Laboratory Chemical Safety Summaries (LCSSs) are included on pages 235-413 of *Prudent Practices*. LCSSs are similar to Safety Data Sheets (SDS) but are tailored to the hazards of laboratory use of those chemicals. The LCSSs include toxicity information and signs and symptoms of exposure to the chemicals.

- **Safety Data Sheets (SDSs)**
- **Laboratories are to determine their method to access all pertinent SDS for their laboratories which will be confirmed during a lab safety inspection. SDSs may be accessed on the Department of University Safety and Assurances' SDS web site. Hard copies of SDS for many laboratory chemicals are also available from US&A or departmental offices. Individual researchers are encouraged to keep hard copies in an easily accessible location for materials that are used in large quantities or frequently or that are particularly toxic. Information on chemical waste disposal and spill response**

  The University of Wisconsin- Milwaukee Waste Disposal Guide details information on proper waste handling procedures. See Chapter 2 for information pertaining to chemical spill response.

2. Training

Laboratory personnel training programs will include, at a minimum, the following subjects:

- **Laboratory Specific Safety Orientation**. Each lab should have a check list for each researcher indicating the lab specific emergency procedures, location of emergency equipment and routine operations. A blank fillable form is available in the Laboratory Specific Chemical Hygiene Plan Documentation.
- **Methods of detecting the presence of hazardous chemicals;**

  Methods include visual observation, odor, real-time air monitoring, time-weighted air sampling, etc.

- **Basic toxicological principles;**

  Principles include toxicity, hazard, exposure, routes of entry, acute and chronic effects, dose-response relationship, LD50, threshold limit values and permissible exposure limits, exposure time, and health hazards related to classes of chemicals.

- **Prudent laboratory practices;**

  Prudent laboratory practices include general techniques designed to reduce personal exposure and to control physical hazards, as well as specific protective mechanisms and warning systems used in individual laboratories. Appropriate use of fume hoods is to be specifically addressed. As noted in Chapter 2, the text *Prudent Practices in the Laboratory: Handling and Disposal of Chemicals* (National Research Council, 1995) details general procedures to be followed in UWM laboratories.

- **Description of available chemical information;**

  Container labels, Safety Data Sheets, laboratory signage, etc.

- **Emergency response actions appropriate to individual laboratories;**

  Lists of emergency phone numbers, location of fire extinguishers, deluge showers, eyewashes, etc.

- **Applicable details of the departmental Chemical Hygiene Plan;**

  Details should include general and laboratory-specific Standard Operating Procedures.

- **An introduction to the UWM's Waste Disposal Guide.**

3. Updates

Update training for Hazardous Waste Generators is required for all laboratory researchers and Lab Supervisors or Principal Investigators (PI's) **at least annually**. Lab supervisors and PI's are responsible for coordinating and tracking update training. Often, PI's and lab supervisors may arrange for research group or departmental-wide update-training sessions, focusing on results of laboratory audits, and highlighting issues that may need improvement. Individual PI's may conduct research group-specific safety reviews to supplement or even stand in place of departmental update sessions. However, documentation (paper or electronic) of safety training must be maintained according to the requirements outlined in Chapter 8 of this Chemical Hygiene Plan.

University of Wisconsin- Milwaukee
Chemical Hygiene Plan
Chapter 6 - Medical Consultation and Examination

1. Laboratory Personnel Who Work with Hazardous Substances

All faculty, staff, and student laboratory personnel who work with hazardous substances will have an opportunity to receive medical attention, including any follow-up visits that the examining physician determines to be necessary under the following circumstances:

- Signs or symptoms of exposure

  Whenever laboratory personnel develop signs or symptoms associated with a hazardous substance or organism to which the laboratory personnel may have been exposed in the laboratory, the laboratory personnel will be provided an opportunity to receive an appropriate medical examination.

- Exposure monitoring

  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, medical surveillance will be established for the affected laboratory personnel as prescribed by the particular standard.

- Exposure incident

  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 affected laboratory personnel will be provided an opportunity for a medical consultation. Such consultation will be for the purpose of determining the need for a medical examination.

- Physical Injury

  Whenever laboratory personnel are physically hurt or injured on the job, the affected laboratory personnel will be provided an opportunity for a medical consultation and/ or examination. Physical injuries include, but are not limited, to cuts, burns, punctures, and sprains.

Contact the Chemical Hygiene Officer whenever the need for medical consultation or examination occurs, or when there is uncertainty as to whether any of the above criteria have been met. Non-employees should seek medical assistance from their personal health care provider.

2. Medical Examinations and Consultations

In the event of a life-threatening illness or injury, please call the **UWM Police Department at 9911** on a campus phone or **(414) 229-9911** on a cellphone or off-campus phone. 911 may be used from off-campus locations or from your cellphone to reach City of Milwaukee police, fire and ambulance services. Laboratory personnel with urgent, but non-life-threatening illnesses or injuries should be accompanied to the nearest medical clinic. When seeking medical attention, it is highly recommended, that you stay within the network of hospitals and medical providers included in your own health insurance when possible. There is no guarantee that Worker's Compensation will cover the costs of a claim that is treated outside of your approved hospital/ physician.

Students may go to the UWM Norris Health Center. If off-hours medical attention is required, the laboratory personnel should be taken to the nearest desired emergency room. All medical examinations and consultations will be performed by or under the direct supervision of a licensed physician and will be provided without cost to the laboratory personnel, without loss of pay, and at a reasonable time and place, if the laboratory personnel were working within the scope of employment at the time of the injury or illness. Students and research assistants may not be covered by Worker’s Compensation based on their employment status.

3. Worker's Compensation Procedures and Forms

It is very important that even minor job-related injuries or illness are reported. These statistics help the Department of University Safety and Assurances track trends that may indicate occupational hazards that need evaluation. To report an illness or injury, utilize information and forms located on the UWM Department of Human Resources Worker's Compensation website (Appendix I) or call 229-5652.

As long as the illness or injury is not life threatening, the supervisor should provide the laboratory personnel with the following forms to be completed and submitted to the Worker's Compensation office:

- the UWM "Worker's Compensation Fact Sheet";
- an "Employee's Work Injury and Illness Report"; and
- the "Authorization to Release of Medical Records" form.

Within 24 hours, the supervisor should complete and submit to the Worker's Compensation office:

- a State of Wisconsin "Employer's First Report of Injury or Disease" form.
- a UWM "Supervisor's Accident Analysis and Prevention Report"; and
- a UWM "Supervisor's Evaluation of Repetitive Motion and/or Materials Handling Activities."

When receiving medical attention for a Worker's Compensation claim, it is highly recommended that you stay within the network of hospitals and medical providers included in your own health insurance. There is no guarantee that Worker's Compensation will cover the costs of a claim that is treated outside of your approved hospital/ physician. Medical documentation is required to substantiate disability payments under Worker's Compensation.

4. Information Provided to Physician

The laboratory worker's supervisor or department will collect and transmit the following information to the examining physician at the time the laboratory personnel is examined:

- Safety Data Sheet(s) providing chemical information and the identity of the hazardous substance(s) to which the laboratory personnel may have been exposed.
- A description of the conditions under which the exposure occurred including quantitative exposure data, if available; and
- A description of the signs and symptoms of exposure that the laboratory worker is experiencing, if any.

The above information should also be provided to the Worker's Compensation office with the completed forms requested in Section 3.

5. Information Provided to the University of Wisconsin- Milwaukee

Supervisors should request that the examining physician provide them with a written report including any recommendation for time off or restrictions and further medical follow-up.

The following will be requested by the Worker's Compensation office or should be submitted to the Worker's Compensation office because of HIPPA rules and regulations:

- The results of the medical examination and any associated tests;
- Any medical condition that may be revealed during the examination that may place the laboratory worker at increased risk as a result of exposure to a hazardous chemical found in the workplace; and
- A statement that the laboratory worker has been informed by the physician of the results of the consultation or medical examination and any medical condition that may require further examination or treatment.

The written opinion will not reveal specific findings of diagnoses unrelated to occupational exposure.

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Chapter 7 - Additional Laboratory Personnel Protection for Work with Particularly Hazardous Substances

Additional laboratory personnel protection will be considered for work with particularly hazardous substances. These include “select carcinogens,” reproductive toxins, and substances that have a high degree of acute toxicity (see Appendix B). Pp. 90-93 of *Prudent Practices* provides detailed recommendations for work with particularly hazardous substances. Laboratory supervisors and Principal Investigators are responsible for assuring that laboratory procedures involving particularly hazardous chemicals have been evaluated for the level of laboratory personnel protection required. Specific consideration will be given to the need for inclusion of the following provisions:

1. Planning;
2. Establishment of a designated area- can indicate areas on Laboratory Signage Program or post sign warning of use in specified area;
3. Access control;
4. Special precautions such as:
    - use of containment devices such as fume hoods or glove boxes;
    - use of personal protective equipment;
    - isolation of contaminated equipment;
    - practicing good laboratory hygiene; and
    - prudent transportation of very toxic chemicals.
5. Planning for accidents and spills; and
6. Special storage and waste disposal practices.

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Chemical Hygiene Plan

Chapter 8 - Recordkeeping & Review and Update of Chemical Hygiene Plan

1. Recordkeeping

- **Exposure evaluation**

  Any records of exposure evaluation carried out by individual departments (including continuous monitoring systems) will be kept within the department and also sent to the Department of University Safety and Assurances. Results of exposure evaluations carried out by US&A will be kept by US&A and sent to the affected department. Raw data will be kept for one year and summary data for the term of employment plus 30 years.

- **Medical consultation and examination**

  Results of medical consultations and examinations will be kept by the medical provider for a length of time specified by the appropriate medical records standard. This time will be at least the term of employment plus 30 years as required by OSHA.

- **Training**

  Training records must be kept by the individual's department or college for **five years**. Training records for laboratory volunteers must also be maintained for at least **five years**. The records must include the name and title of the trainer, the trainee, the date, and the content of training. A blank training record template may be utilized as documentation. (Appendix M)

- **Fume hood monitoring**

  Data on annual fume hood monitoring will be kept in the Department of University Safety and Assurances. Fume hood monitoring data are considered maintenance records and as such the raw data will be kept for one year and summary data for 5 years.

- **Laboratory audits**

  Laboratory supervisors and PI's must coordinate and/ or conduct formal audits of laboratories in their sphere of responsibility at least annually. An inspection form is available in Appendix F. Laboratory audits should be kept for at least 5 years.

- **Accident investigation reports**

  Worker's Compensation will maintain records of accident investigations. Reports should be kept for at least 5 years.

2. Review and Update of Chemical Hygiene Plan

On an annual basis, this Chemical Hygiene Plan will be reviewed and evaluated for effectiveness by the Department of University Safety and Assurances and updated as necessary.

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Chemical Hygiene Plan

Table 1 - Poisonous Gases

The gases on this list are either on the Department of Transportation's Category 1 list, or the Linde Specialty Gas's Group 6 – Very Poisonous list. These chemicals are highly toxic gases at ambient temperature and pressure. They have an extremely high potential for causing significant harm if not adequately controlled. See also the US&A Poison Gases webpage. If you choose to work with these items you will need to follow the Highly Hazardous Chemical Purchasing Process in addition to completing an Standard Operating Procedure for using this chemical

Arsine	Boron trichloride	Chlorine pentafluoride
Chlorine trifluoride	Cyanogen	Cyanogen chloride
Diborane	Dinitrogen tetroxide	Fluorine
Germane	Hydrogen selenide	Nitric oxide
Nitrogen dioxide	Nitrogen trioxide	Nitrosyl chloride
Oxygen difluoride	Phosgene	Phosphine
Phosphorus pentafluoride	Selenium hexafluoride	Stibine
Sulfur tetrafluoride	Tellurium Hexafluoride	Tetraethyldithiopyrophosphate
Tetraethylpyrophosphate		

Guidance: Departments may choose to add other chemicals to the above list. For example, sulfur-containing compounds such as mercaptans can cause significant odor problems when used in the laboratory. Pre-approval of the conditions under which they can be used may prevent odor complaints.

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Table 2 - Shock Sensitive Chemicals

The classes of chemicals listed below may explode when subjected to shock or friction. Therefore, users must have appropriate laboratory equipment, information, knowledge, and training to use these compounds safely. See also the US&A Reactive Chemicals webpage for additional information.

- Acetylenic compounds, especially polyacetylenes, haloacetylenes, and heavy metal salts of acetylenes (copper, silver, and mercury salts are particularly sensitive)
- Acyl nitrates
- Alkyl nitrates, particularly polyol nitrates such as nitrocellulose and nitroglycerine
- Alkyl and acyl nitrites
- Amminemetal oxosalts: metal compounds with coordinated and hydrazine, or similar nitrogenous donors and ionic perchlorate, nitrate, permanganate, or other oxidizing group
- Azides, including metal, nonmetal, and organic azides
- Chlorite salts of metals, such as AgClO2 and Hg(ClO2)2
- Diazo compounds such as CH2N2
- Diazonium salts, when dry
- Fulminates such as mercury fulminate (Hg(CNO)2)
- Hydrogen peroxide (which becomes increasingly treacherous as the concentration rises above 30%, forming explosive mixtures with organic materials and decomposing violently in the presence of traces of transition metals
- N-Halogen compounds such as difluoroamino compounds and halogen azides
- N-Nitro compounds such as N-nitromethylamine, nitrourea, nitroguanidine, and nitric amide
- Oxo salts of nitrogenous bases: perchlorates, dichromates, nitrates, iodates, chlorites, chlorates, and permanganates of ammonia, amines, hydroxylamine, guanidine, etc.
- Perchlorate salts (which can form when perchloric acid mists dry in fume hoods or associated duct work. Most metal, nonmetal, and amine perchlorates can be detonated and may undergo violent reaction in contact with combustible materials)
- Peroxides and hydroperoxides, organic
- Peroxides (solid) that crystallize from or are left from evaporation of peroxidizable solvents (see the following Section 3)
- Peroxides, transition-metal salts
- Picrates, especially salts of transition and heavy metals, such as Ni, Pb, Hg, Cu, and Zn
- Polynitroalkyl compounds such as tetranitromethane and dinitroacetonitrile
- Polynitroaromatic compounds especially polynitrohydrocarbons, phenols, and amines (e.g., dinitrotoluene, trinitrotoluene, and picric acid)

Note: Perchloric acid must be used only in specially designed perchloric acid fume hoods that have built-in wash down systems to remove shock-sensitive deposits. Before purchasing this acid, laboratory supervisors must arrange for use of an approved perchloric acid hood.

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Table 3 - Pyrophoric Chemicals

The classes of chemicals listed below will readily oxidize and ignite spontaneously in air. Therefore, users must demonstrate to the department that they have the appropriate laboratory equipment, information, knowledge, and training to use these compounds safely.

- Grignard reagents, RMgX
- Metal alkyls and aryls, such as RLi, RNa, R3Al, R2Zn
- Metal carbonyls such as Ni(CO)4, Fe(CO)5, Co2(CO)8
- Alkali metals such as Na, K
- Metal powders, such as Al, Co, Fe, Mg, Mn, Pd, Pt, Ti, Sn, Zn, Zr
- Metal hydrides such as NaH, LiAlH4
- Nonmetal hydrides, such as B2H6 and other boranes, PH3, AsH3
- Nonmetal alkyls, such as R3B, R3P, R3As
- Phosphorus (white)

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Table 4 - Peroxide-Forming Chemicals

The chemicals listed below can form explosive peroxide crystals on exposure to air, and therefore require special handling procedures after the container is opened. Some of the chemicals form peroxides that are violently explosive in concentrated solution or as solids, and therefore should never be evaporated to dryness. Others are polymerizable unsaturated compounds and can initiate a runaway, explosive polymerization reaction. All peroxidizable compounds should be stored away from heat and light. They should be protected from physical damage and ignition sources. A warning label should be affixed to all peroxidizable materials to indicate the date of receipt and the date the container was first opened. Due to these special handling requirements, users must have the appropriate laboratory equipment, information, knowledge, and training to use these compounds safely.
See also the US&A Reactive Chemicals for additional information.

A. Severe Peroxide Hazard with Exposure to Air (discard within 3 months from opening)

- diisopropyl ether (isopropyl ether)
- divinylacetylene (DVA)
- vinylidene chloride (1,1-dichloroethylene)
- potassium metal
- sodium amide (sodamide)
- potassium amide

B. Peroxide Hazard on Concentration

Do not distill or evaporate without first testing for the presence of peroxides (discard or test for peroxides after 6 months)

- acetaldehyde diethyl acetal (acetal)
- cumene (isopropylbenzene)
- cyclohexene
- cyclopentene
- decalin (decahydronaphthalene)
- diacetylene (butadiene)
- dicyclopentadiene
- diethyl ether (ether)
- diethylene glycol dimethyl ether (diglyme)
- dioxane
- ethylene glycol dimethyl ether (glyme)
- ethylene glycol ether acetates
- ethylene glycol monoethers (cellosolves)
- furan
- methylacetylene
- methylcyclopentane
- methyl isobutyl ketone
- tetrahydrofuran (THF)
- tetralin (tetrahydronaphthalene)
- vinyl ethers

C. Hazard of Rapid Polymerization Initiated by Internally-Formed Peroxides

Liquids
(discard or test for peroxides after 6 months)

- chloroprene (2-chloro-1,3-butadiene)
- vinyl acetate
- styrene
- vinylpyridine

Gases
(discard after 12 months)

- butadiene
- vinylacetylene (MVA)
- tetrafluoroethylene (TFE)
- vinyl chloride

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Chemical Hygiene Plan

Table 5 - Carcinogens, Reproductive Toxins, or Highly Toxic Chemicals

The chemicals listed below are extremely hazardous. Workers must have knowledge of the dangers of these chemicals prior to use and documentation of training in safe working procedures. See also the US&A Carcinogens, Reproductive Health Hazard Information, Poison Gases, or Highly Hazardous Materials Disposal web page.

Biologically active compounds:

- protease inhibitors (e.g. PMSF, Aprotin, Pepstatin A, Leopeptin);
- protein synthesis inhibitors (e.g. cycloheximide, Puromycin);
- transcriptional inhibitors (e.g. a-amanitin and actinomycin D);
- DNA synthesis inhibitors (e.g. hydroxyurea, nucleotide analogs (i.e. dideoxy nucleotides), actinomycin D, acidicolin);
- phosphatase inhibitors (e.g. okadaic acid);
- respiratory chain inhibitors (e.g. sodium azide);
- kinase inhibitors (e.g. NaF);
- mitogenic inhibitors (e.g. colcemid); and
- mitogenic compounds (e.g. concanavalin A).

Castor bean (Ricinus communis) lectin: Ricin A, Ricin B, RCA toxins

Diisopropyl fluorophosphate: highly toxic cholinesterase inhibitor; the antidote, atropine sulfate and 2-PAM (2-pyridinealdoxime methiodide) must be readily available

Jaquirity bean lectin (Abrus precatorius)

N-methyl-N'-nitro-N-nitrosoguanidine: carcinogen (this chemical forms explosive compounds upon degradation)

Phalloidin from Amanita Phalloides: used for staining actin filaments

Retinoids: potential human teratogens

Streptozotocin: potential human carcinogen

Urethane (ethyl carbamate): an anesthetic agent, potent carcinogen and strong teratogen, volatile at room temperature

Annual Review Documentation - January 2022
Changes made by Jennifer Herriges – Laboratory Safety Coordinator

1. Throughout text: Confirmed all electronic document links and e-mail links updated where needed
2. Throughout the text updated minor grammar and punctuation.
3. Page iii: added "**Introductory**" to ***Chemical Hygiene Plan and Laboratory Safety*** Training and Added, "***Annual Lab Safety Review Training*** is expected to be attended annually thereafter. Both trainings are offered regularly from US&A.
4. Page vii: changed Appendix K – University of Wisconsin System Guidelines for Students Working Alone Safely to "University of Wisconsin System Working in Isolation Policy"
5. Page 1, Chapter 1. Changed, "Wisconsin Department of Commerce (DCOM) in Chapter Comm 32. " to "Department of Safety and Professional Services (DSPS) in Chapter 101"
6. Page 8 Chapter 1, E, I, changed, "Interactive Learning Paradigms Incorporated's (ILPI's) SDS FAQ and a glossary of terms used in MSDSs can be found in ILPI's "Hyperglossary".to 'can be found in NIEHS tools or from OSHA."
7. Page 8 Chapter2 section 1 E II, changed, "" from "and free to download."
8. Page 8 Chapter2 section 1 E III, changed, "The text is free to individuals via ACS's "Chemical Safety in the Classroom" web page to "The text is free to individuals via ACS's College and University Guidelines page.
9. Page 9 Chapter 2 section 1 E V removed hyperlink to Knovel.com as we no longer have Institutional access.
10. Page 10 Chapter 2 Section A final paragraph changed from, "After an accident, supervisor(s) must complete and submit accident reporting forms within 24 hours. Worker's Compensation policy and reporting forms are available on the UWM Human Resourceswebsite. General Incident forms are available at the US&A Risk Management website " to "After an accident, supervisor(s) must complete and submit accident reporting forms within 24 hours. Worker's Compensation policy and reporting forms and General Incident forms are available on the University Safety and Assurances website forms page.
11. Page 12 Chapter 3 Section A I c 1 removed, " utilize the Hazard Materials Identification System (also see http://www.ilpi.com/msds/ref/hmis.html), which is explained by utilizing the hyperlinks." And added, "utilize OSHA's mandatory Health Hazard Criteria and also use GHS labeling".
12. Page 20, Chapter 3 Section 4 added "(working in isolation)" to the statement, "Undergraduate workers are prohibited from working alone (working in isolation) in the laboratory unless there is a review and formal approval by the supervisor and safety committee."
13. Page 20 chapter 3, section 4 second paragraph, added, "with the PI and/or" to the statement, "US&A will conduct annual inspections using our electronic software of the labs with the PI and/ or Group Safety Representatives (GSRs)."
14. Page 22 Chapter 4 section 1 A 1 removed "or Caution" from the statement, "See Section II for steps to take if hood does not pass annual inspection and has an "Out of Order" or "Caution" sign is attached."
15. Page 25,Chapter 5 paragraph 2, added "introductory" and "and Annual Lab Safety Review Training" to the statement, "A current listing of training offerings such as Chemical Hygiene Plan and Laboratory Safety Training can be found on the US&A website Upcoming Events Calendar.
16. Page 25,Chapter 5 paragraph 2 added the sentence, " Refresher training must be provided at least annually.
17. Page 25, Chapter 5, Paragraph 3 added the sentence, "Training includes reading through and documenting training on the laboratory Specific Chemical Hygiene Plan and Lab Specific Orientation Checklist."

Annual Review Documentation - January 2021
Changes made by Jennifer Herriges – Laboratory Safety Coordinator.

18. Throughout text: Confirmed all electronic document links and e-mail links updated where needed
19. Throughout the text updated minor grammar and punctuation.
20. Page iv: added non- electronic Link location information. "If you are viewing this document as a paper document you may go to the University Safety and Assurance Website under the Safety and Health Programs Tab; Laboratory Safety; Chemical Hygiene Plan Page found at this link: https://uwm.edu/safety-health/chem-hygiene/ to view the most up to date electronic version of the

document and connect to the hyperlinks contained within this document”

21. Page 5 Chapter 2, 1. A Added, “or the University Safety and Assurances website forms page under Chemical: Standard Operating Procedure for Highly Hazardous Chemicals use Blank “ to the end of the sentence, "A template for writing new SOPs is available in Appendix G”.
22. Chapter 2 1. B: Added the following Categories to the Highly Hazardous Chemical list
    - Anti-neoplastic Drug by NIOSH
    - Biotoxins
    - Controlled Substances Or DEA list items
    - Formaldehyde and Related Chemicals used in animals not for preservation.
    - Anesthetic Agents (i.e.: carprofen, Isoflurane, MS222)
    - Laboratory synthesized chemicals for which a Safety Data Sheet does not exist and there is not hazard information available.
23. Chapter 2 1. B Changed “Appendix G” to “SOP form”
24. Chapter 2 1 B Added “Working Alone Guidance” and updated link to Appendix K.
25. Chapter 2 3 IV added title of Document, “Lab Hibernation/ Shutdown Template” in front of “(Appendix N)”
26. Chapter 5 Intro Added, “A current list of training offerings such as Chemical Hygiene Plan and Laboratory Safety Training can be found on the US&A website Upcoming Events Calendar. “
27. Chapter 6 2. Added “When seeking medical attention, it is highly recommended, that you stay within the network of hospitals and medical providers included in your own health insurance when possible. There is no guarantee that Worker's Compensation will cover the costs of a claim that is treated outside of your approved hospital/ physician.”
28. Chapter 6 2 Changed “the emergency room at Columbia St. Mary’s” to, “the nearest desired emergency room.