KANSAS STATE UNIVERSITY | Environmental Health and Safety

Kansas State University
Chemical Hygiene Plan

December 2017

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1.0 Purpose and Applicability

This Chemical Hygiene Plan (CHP) defines laboratory work practices, laboratory equipment, personal protective equipment (PPE), and procedures to help ensure that laboratory workers and those supporting laboratories at Kansas State University (KSU) are protected from the health hazards associated with the hazardous chemicals used in the laboratory work environment. The CHP fulfills the requirements set forth in the regulations by the U.S. Department of Labor Occupational Safety and Health Administration's (OSHA) "Occupational Exposures to Hazardous Chemicals in Laboratories" (29CFR 1910.1450), referred to as the Laboratory Standard within this document.

According to the Laboratory Standard, the CHP must include:

- Standard Operating Procedures (SOPs) relevant to safety and health considerations to be followed when laboratory work involves the use of hazardous chemicals;
- Criteria to determine and implement specific control measures to reduce employee exposure to hazardous chemicals, such as engineering controls and PPE;
- A requirement that an ongoing program be developed to ensure that fume hoods and other engineering controls are functioning properly and specific measures are taken to ensure proper and adequate performance of such equipment;
- Information and training requirements to ensure employees are apprised of the hazards of chemicals present in their work area;
- Circumstances under which a particular laboratory function will require "prior approval" before implementation;
- Provisions for medical consultation and medical exams for all employees who work with hazardous chemicals;
- Designation of a Chemical Hygiene Officer (CHO); and
- Additional precautions for additional employee protection for work with select carcinogens, reproductive toxins, and extremely toxic substances that have a high degree of acute toxicity.

This CHP has been developed by Environmental Health and Safety (EHS). It describes in detail the policies, practices, procedures, equipment, and facilities used by KSU to ensure that all persons who work with chemicals at this institution do so in a safe manner and in compliance with all applicable federal, state, and municipal regulations and University guidelines.

The CHP applies to every laboratory or related facility at KSU that uses or stores hazardous chemicals. Employees should direct questions about the CHP or the safe use of chemicals to their Department Safety Coordinator, their Laboratory Supervisor or Principal Investigator (PI), or EHS.

There are several committees that have authority to regulate certain aspects of

work in laboratories. These committees may include the Radiation Safety Committee, the Institutional Biosafety Committee, and the Institutional Animal Care and Use Committee. This document does not preempt any of the policies or procedures issued by these other committees. In cases where the jurisdictions of two committees overlap, the more stringent constraint applies.

This CHP must be available to all laboratory workers prior to the commencement of laboratory duties. In addition to the CHP, laboratory workers must be familiar with and adhere to all laboratory safety guidelines and procedures developed by their laboratory supervisor, EHS and other University departments, and any federal, state, or municipal regulatory agencies. Such information shall be provided at the time of an employee's initial assignment to a work area where hazardous chemicals are present and prior to assignments involving new exposure situations, including: permissible exposure limits (PELs) for OSHA regulated substances or recommended exposure limits for other hazardous chemicals where there is not applicable OSHA standard; signs and symptoms associated with exposures to hazardous chemicals used in the laboratories; and the location and availability of known reference material on the hazards, safe handling, storage and disposal found in the laboratory.

This CHP will be reviewed annually by EHS and the Campus EHS Committee.

2.0 Roles and Responsibilities

The chief element in this section is the designation of authority and responsibility for implementation of the CHP. The following are responsible for implementing the requirements of the CHP.

EHS Committee

The University Environmental Health & Safety Committee is responsible for acting as the oversight committee for the administrative units (Provost, VP for Administration & Finance, and VP for Institutional Advancement). Additionally, EHS committee is charged with evaluating college Environmental Health & Safety Committees and developing university-wide policies for Environmental Health & Safety.

The committee meets on a monthly basis. The duties of the committee include, but are not limited to:

- Review of written guidelines and training programs, as necessary; and
- Discussion on laboratory safety issues and incidents;
- Development of policies and practices regarding laboratory safety issues.

Environmental Health and Safety (EHS)

EHS responsibilities include, but are not limited to, the following:

- Design safety training programs;
- Conduct safety training programs that are not site-specific;
- Conduct site or topic specific trainings, as requested or required;
- Conduct laboratory safety inspections on a routine basis and by request;
- Conduct periodic and requested inspections of engineering controls;
- Make recommendations for corrective actions in cases of non-compliance;
- Provide technical assistance with hazard assessment and development of lab-specific SOPs, in consultation with the LSC as necessary;
- Investigate cases of suspected exposure or exposure due to accident;
- Provide chemical spill response, as needed;
- Maintain laboratory safety training records and ensure, in collaboration with the PI, that all laboratory workers complete the appropriate universal safety training;
- Assist the PI and laboratory workers with compliance with all aspects of this Plan;
- Maintain incident reports; and
- Manage the hazardous waste program.

Chemical Hygiene Officer (CHO)

The CHO is a staff member of EHS. Responsibilities of the CHO include, but are not limited to:

- Develop and implement appropriate laboratory safety policies, practices and procedures in collaboration or consultation with the Laboratory Supervisor or PI and with approval by the LSC, when appropriate;
- Ensure that the CHP is readily accessible to all employees, either as a paper copy, as an electronic copy online, or by another applicable means;
- Communicate to each Laboratory Supervisor or PI any relevant safety information or concerns pertaining to their laboratory;

Principal Investigator (PI)

The responsibility for ensuring that all work in KSU laboratories is safe and in compliance rests with the PI and EHS. The PI designation refers to the faculty member responsible for work in a specific laboratory facility. This person, in collaboration with EHS, must develop any laboratory-specific SOPs to be

followed in his or her laboratory. The PI can assign duties to a Laboratory Supervisor, but the PI is ultimately responsible for the safe and compliant conduct of work in his or her laboratory. His or her duties also include, but are not limited to, the following:

- Define the location of work areas where toxic substances, potential carcinogens, and other hazardous chemicals will be used;
- Ensure that an inventory of these and all other chemicals is provided to EHS, through utilization of the Chemical Inventory database in the EHS Assistant database;
- Assist EHS and the CHO in defining all hazardous operations, alerting employees to the hazards, and establishing safe procedures for these operations by selecting suitable engineering controls and PPE;
- Ensure, in collaboration with EHS, that all new laboratory workers complete appropriate universal safety training before working unsupervised in the laboratory and that all workers complete this training annually thereafter;
- Ensure that all laboratory workers receive instruction in safe work practices, proper use of PPE, and emergency procedures;
- Ensure that all laboratory workers are familiar with the CHP and where it can be found;
- Provide access to safety information and specific training to laboratory workers for the hazardous chemicals with which they work (which may include training when the employee's exposure changes or when new workers start in the laboratory);
- Ensure that the CHP is supplemented with SOPs applicable to the hazardous chemicals or operations used in the laboratory, as necessary;
- Provide, in collaboration with EHS, all appropriate and required PPE to laboratory workers;
- Assist the CHO or EHS personnel in fulfillment of their duties with respect to his or her laboratory;
- Correct deficiencies identified during inspections, as appropriate;
- Report all accidents or near-misses (which are unplanned events that did not result in injury, illness, or damage but had the potential to do so) that occur in their laboratory and take corrective measures so that these will not recur;
- Ultimate responsibility for the proper disposal of all laboratory waste including hazardous waste, biological waste, and sharps waste from his or her laboratory; and
- Maintain relevant safety information for the laboratory in the appropriate safety logbooks (i.e., Chemical Safety, Biological Safety, and Radiation

Safety) in a designated Safety Center within the laboratory.

Laboratory Managers of Shared Laboratory Facilities

A Laboratory Manager is a faculty member or administrator responsible for overseeing work in a shared laboratory facility. This person, in collaboration with EHS, may develop any laboratory-specific SOPs to be followed in the shared facility with the approval of EHS and the LSC.

- The Laboratory Manager may institute specific training or access requirements for work in the shared facility.
- Although the PI is ultimately responsible for all of the work carried out by laboratory workers, the Laboratory Manager of a Shared Laboratory Facility must always be made aware of the work conducted in the shared spaces.

Department Safety Coordinators

The Department Safety Coordinator is assigned by the Department Head to assist with safety and compliance efforts in the laboratory, as necessary. The Department Safety Coordinator is authorized to represent the PI in matters related to the implementation of laboratory and worker safety, although the ultimate responsibility resides with the PI. The duties of the Department Safety Coordinator include, but are not limited to:

- Assist the PI with maintaining laboratory compliance;
- Serve as the primary laboratory contact with EHS for issues related to safety (i.e., biological, chemical, fire & general safety, controlled substances, etc.);
- Take positive actions to help reduce the potential for accidents and incidents associated with laboratory operations;
- Inform laboratory personnel and students of the safety hazards associated with their work and instruct laboratory personnel and students in safe work methods;
- Assist other laboratory personnel with reporting all accidents, near misses, or safety concerns to the PI and EHS;
- For established lab-specific SOPs, ensure that laboratory personnel and students are appropriately trained;
- Work with EHS to determine the best safe practices and procedures;
- Work with EHS to ensure that laboratory personnel and students complete all required safety trainings in a timely manner;

- Ensure that all deficiencies identified by EHS or outside regulatory inspectors are addressed and corrected within the time required;
- Participate in the incident review process;
- Stop operations that are in clear violation of the safety requirements, approved SOPs, or that may potentially result in injuries or potential exposures; and
- Maintain relevant safety information for the laboratory in the appropriate safety logbooks (i.e., Chemical Safety, Biological Safety, and Radiation Safety) in a designated Safety Center within the laboratory.

Laboratory Workers

Individuals who work in or frequently visit laboratories where hazardous chemicals are used or stored are responsible for performing their work in accordance with the CHP. Responsibilities of laboratory workers include, but are not limited to:

- Follow all University, Federal, State, and local health and safety standards, rules and regulations, as they apply to the laboratory;
- Report all hazardous conditions to their PI and EHS;
- Inform the PI or Department Safety Coordinator of any substantive changes in protocol or the introduction of new chemicals to the laboratory;
- Wear and use prescribed PPE;
- Follow all appropriate SOPs necessary for the safe operation of laboratory work, and if no such SOP currently exists, to contact and work with EHS to develop the necessary SOP;
- Report any suspected job-related injuries or illnesses to the immediate supervisor and ROHP, and seek treatment immediately;
- Refrain from the operation of any equipment or instrumentation without proper instruction and authorization;
- Remain aware of the hazards of the chemicals in the laboratory; and
- Request information and training when unsure of how to handle a hazardous chemical or procedure.

3.0 Laboratory Safety Training

All individuals who work in laboratories must be apprised of the hazards of chemicals present in their work area. This information must be provided before initial assignment and before new potential exposure situations. It is the responsibility of the PI to ensure that all laboratory workers have been properly trained.

Proper training serves as a dedicated time to communicate about hazards, safe practices, emergency procedures, and to identify safety information resources. Required training components include general training administered by EHS, specific training provided by PIs or lab supervisors on the hazards present in the lab, and training required by institutional committees, such as the IACUC, IBC, or IRB. To review EHS course offerings visit the **EHS training** page.

Laboratory Safety Training for Researchers

All laboratory workers who participate in laboratory activities that utilize hazardous chemicals or biological media, or generate or handle hazardous waste must participate in this training. All laboratory workers must complete University Laboratory Safety training, Hazard Communication Standard training, and Hazardous Waste Awareness training before conducting laboratory work without direct supervision and annually thereafter. An online training course may be completed to fulfill the annual requirement. Detailed information is available on the EHS website. University Laboratory Safety training, Hazard Communication Standard training, and Hazardous Waste Awareness training concentrate on the following Laboratory Safety topics:

- The University's CHP
- Emergency Procedures
- Medical Consultations and Examinations
- OSHA's Laboratory Standard
- Hazard Recognition
- Safety Data Sheets (SDS)
- Safety Equipment
- PPE
- Exposure Control
- Engineering Controls
- Chemical Management
- Biosafety
- Universal Precautions
- Sharps Safety and Disposal
- Electrical, Heat and Other Non-Chemical Hazards
- Defining Hazardous Waste
- Identifying Waste Streams & Weekly Compliance Inspections
- Proper Container Management and Storage
- Requesting Disposal

Site-Specific Training

The site-specific training consists of the details of local engineering and administrative control programs within the laboratories, as well as laboratory-specific policies and procedures. It is at the discretion of the PI, the Department Safety Coordinator, or the Laboratory Worker when site-specific training is necessary.

The PI is responsible for oversight of laboratory procedures and assessment of the necessity for developing new site-specific training before a laboratory worker uses a new hazardous chemical or conducts a new potentially hazardous procedure.

4.0 Medical Services and Surveillance

Laboratory personnel working with hazardous chemicals may receive medical attention as necessary. Specifically, medical attention, including any follow-up examination and treatment recommended by the examining physician, must be offered as per the following:

A medical consultation conducted to determine the need for a medical examination must be offered to any employee who is present in the work area when a spill, leak, explosion, or other accident occurs that results in a potential significant exposure to a hazardous chemical.

A medical examination must be provided to any employee who exhibits signs or experiences symptoms associated with exposure to a hazardous chemical used in the laboratory.

Medical surveillance will be performed a physician or other licensed health care professional (PLHCP) as directed by the relevant OSHA standard of the relevant hazardous agent whenever exposures of that particular agent exceed its ac action level or PEL as indicated by exposure monitoring by EHS. Please refer to Section 5: *Exposure Monitoring* for more information.

Additionally, the provisions of KSU's Respiratory Protection Program require that any employee required to wear a negative-pressure respirator in performance of his or her duties must undergo a medical evaluation in addition to a fit-test. Medical Evaluations do not need to be repeated unless the person wearing the respirator appears to have difficulties wearing it or gains or loses 10 pounds or more.

All medical consultations, examinations, and surveillances are free to University employees.

If the events triggering the request involve potential chemical exposure, you must also contact EHS for an investigation as to the extent of the exposure. The PLHCP needs the information gathered in EHS's investigation in order to appropriately scale their response. Any required records will be kept by EHS, as necessary; medical records kept by the PLHCP will be maintained as confidential.

In the event of an injury in the laboratory, Laboratory Supervisors or PIs must complete an Accident/Incident/Near Miss Investigation Form within 24 hours of the incident. See Appendix B: *Emergency Procedures and Reporting* for more information.

5.0 Exposure Monitoring

Employee exposure determination shall be done in accordance with paragraph (d) of 29 CFR 1910.1450.

Initial monitoring shall be performed by EHS whenever the Department Safety Coordinator has reason to believe that lab procedures may cause exposures greater than the action level or PEL of any agent known to increase chronic irreversible health effects. Consideration of initial monitoring is to take place whenever such an agent is first introduced to the respective laboratory or whenever laboratory practices change in ways that exposure levels of such agent could significantly increase.

The PELs for OSHA-regulated substances can be found in 29 CFR part 1910, subpart Z as indicated below:

TABLE Z-1 Limits for Air Contaminants. - 1910.1000 TABLE Z-1

www.osha.gov/pls/oshaweb/owadisp.show_document?p_table=STANDARDS&p_id=9992

TABLE Z-2 - 1910.1000 TABLE Z-2

www.osha.gov/pls/oshaweb/owadisp.show_document?p_table=STANDARDS&p_id=9993

TABLE Z-3 Mineral Dusts - 1910.1000 TABLE Z-3

www.osha.gov/pls/oshaweb/owadisp.show_document?p_table=STANDARDS&p_id=9994

Periodic monitoring will be conducted if the initial monitoring performed discloses employee exposure over the action level (or, in the absence of an action level, the PEL). KSU shall adhere to the exposure monitoring provisions of the relevant standard. Please refer to Section 4: *Medical Services and Surveillance* for more information.

Within 15 working days after the receipt of any monitoring results, the employee will be notified of these results in writing either individually or by posting results in an appropriate location that is accessible to employees.

Any KSU employee with a reason to believe that exposure levels for a substance exceed the action level or, in the absence of an action level, the PEL may request monitoring through the CHO or EHS office. Monitoring may be requested at any time. EHS is responsible for coordinating exposure monitoring requests.

6.0 Laboratory Design and Engineering Controls

Engineering controls should be implemented within the laboratory to minimize exposure to hazardous chemicals. Engineering controls may include: general laboratory ventilation, chemical fume hoods, point-source ventilation, filtered enclosures, product substitution, secondary containment, and other physical systems used to minimize exposure.

It is the responsibility of the Division of Facilities to inform EHS when a laboratory is selected to be renovated or redesigned. EHS will meet with the Laboratory Supervisor or PI of the laboratory to understand the nature of the research, including which hazards may be present, and to recommend appropriate engineering controls for the new laboratory.

If implemented ventilation engineering controls are not working properly in the laboratory, the laboratory worker must immediately stop work, secure all chemicals, and contact the Division of Facilities for repair. A risk assessment will be made for any work performed during equipment down-time. The Division of Facilities service desk can be reached at 785-53**2-6389**.

The PI can contact EHS at any time to request an evaluation or meeting to discuss engineering controls in their laboratory.

A common engineering control installed in laboratories is the chemical fume hood. Details of chemical fume hood use, maintenance, and annual testing can be found in this manual under Section 7: *Standard Operating Procedures*.

In addition to reviewing and approving engineering controls in new laboratory design projects, EHS is responsible for the review of laboratory design plans to assist in assuring compliance with appropriate local, state, and federal environmental health and safety codes, regulations, and standards.

7. 0 Standard Operating Procedures (SOPs)

KSU has developed a program to provide the Laboratory Supervisor and PI with a set of rules comprising the basic precautions that should be included in an SOP, and which is applicable to the use of most chemicals under most circumstances.

The purpose of sections 7.1 through 7.15 is to define the baseline set of procedures and practices for employees, students, visitors, or any other persons working in a laboratory at KSU.

The following Policies and Procedures have been developed in order to help ensure a safe environment when working with chemicals:

7.1 Safe Work Practices

- Read and become familiar with the CHP and any SOPs developed specifically for the laboratory prior to working in the laboratory.
- In a laboratory setting, proper PPE is required, including close-toed shoes.
- Become familiar with the location and use of emergency equipment and facilities, such as:
    - eyewash and safety showers;
    - fire extinguishers;

- fire blankets, if applicable;
- fire alarm pull stations;
- emergency exits; and
- chemical spill equipment.

- Never eat, drink, smoke, chew gum, apply cosmetics, or manipulate contact lenses in the laboratory. Contact lenses may be prohibited in certain chemical laboratories, as indicated in laboratory-specific SOPs.
- Never leave exposed sharps, micropipettes, or broken glass on the bench or in washing facilities.
- Keep chemical containers closed unless actively in use.
- Clearly label all containers of any stored substances. If possible, include the concentration and any hazards of the substance. (For small quantities of synthesized chemicals (i.e., in multi-well plates, etc.), external reference documents may be kept nearby).
- Remove PPE (e.g., gloves, aprons, protective footgear, headgear) before leaving the laboratory space. Avoid wearing PPE in non-laboratory or non-laboratory support areas.
- Discard, decontaminate, clean, or sanitize PPE on a regular basis.
- Always wash hands after removing gloves before leaving the laboratory.

7.2 Working Alone

Working in a laboratory alone or in isolated areas presents unique risks and hazards. Working alone is prohibited in certain and is discouraged in all laboratories. The PI must define work that is considered hazardous and should not be conducted alone. In the event a worker must work alone in the laboratory, these guidelines should be followed:

- Schedule work so that hazardous tasks are performed during times when the worker is not alone.
- The worker should inform a co-worker, or a friend, family member, or colleague that they will be in the laboratory alone and give them information on who to contact in the event that the worker does not check in when coming from or going to the laboratory.

7.3 Safety Data Sheets (SDSs)

OSHA requires that SDSs are available to employees for potentially harmful substances. An SDS summarizes information about the material, including chemical components, hazard identification, first aid, spill, and firefighting procedures, incompatibilities, safe handling and storage requirements, and

disposal guidelines. The Laboratory Supervisor or PI, or their designee, is responsible for providing access to SDSs to workers in the laboratory. These guidelines should be followed:

- Workers should review an SDS prior to working with a chemical. SDSs should also be readily available for quick response to spills, medical emergencies, and other situations involving the chemical.
- PIs are encouraged to keep hard copies of SDSs in the laboratory. Hard copies can be obtained in two ways:
    - Chemical manufacturers often ship an SDS with a chemical or mail it to the laboratory separately. When a hard copy of an SDS is received in the laboratory, it should be saved for future reference. New copies should replace older versions.
    - SDSs are also often available online. Laboratory workers can download and print copies of SDSs from manufacturers' websites and keep them in or near the laboratory.
- Digital copies of SDSs are only acceptable if there is a computer station or stations available in the laboratory from which they can be accessed at all times. Laboratories are encouraged to use digital copies of SDSs to supplement their hard copies, not replace them.

7.4 Safe handling and storage of chemicals

By following these guidelines, the risks associated with the handling and storage of materials within the laboratory can be reduced considerably:

- Laboratory workers should date containers of chemicals that have the potential to form organic peroxides with the day, month, and year that they are first received and first opened.
- Laboratory doors should remain closed at all times.
- Work surfaces and laboratory furniture should be impervious to chemical spills.
- Workers should not use hazardous chemicals or equipment if they have not been trained to do so.
- The chemical storage guidelines should be used for work with specific chemical hazards; see Section 7.5: *General Chemical Safety Guidelines* below.

7.5 General Chemical Safety Guidelines

The Chemical Segregation and Storage Chart illustrates practical guidelines detailing the segregation of different types of chemicals. Always consult the SDS for detailed information.

Acids

- Store large bottles of acids on trays on low shelves or in acid cabinets, or in a cabinet marked “Corrosives.”
- Segregate oxidizing acids from organic acids and flammable and combustible materials.
- Segregate acids from bases, and acids from active metals such as sodium, potassium, and magnesium, and other incompatible materials.
- Use appropriate bottle carriers or a cart when transporting acid bottles.
- Have spill-control pillows or acid neutralizers available in the event of a spill. Do not use bases to neutralize acid spills.

Bases

- Segregate bases from acids and other incompatible materials.
- Store large bottles of liquid bases on trays in a cabinet marked “Bases” or “Corrosives.”
- Store solutions of inorganic hydroxides in polyethylene containers.
- Have spill-control pillows or caustic neutralizers available for caustic spills. Do not use acids to neutralize base spills.

Flammables *(e.g., Ethanol, Xylene)*

- Only store flammable liquids in a specially equipped, explosion-proof or flammable-safe refrigerator or flammables cabinet.
- Keep flammables away from sources of ignition.
- For flammable metals, have a Class-D fire extinguisher available. See the “Fire Extinguishers” part under Section 7.8: *Laboratory Safety Equipment* for more information.

Oxidizers *(e.g., Perchlorates, Nitrates)*

- Store oxidizers in a cool, dry area.
- Store oxidizers away from flammable and combustible materials, such as paper, wood, etc.

Peroxide-Forming Chemicals *(e.g., Isopropyl Ether, Sodium Amide)*

- All laboratories working with peroxide forming chemicals (PFC) must maintain an inventory control program for PFC to ensure these chemicals are removed from inventory as indicated, examined for signs of potential peroxides, and/or tested for peroxides.
- Order only quantities necessary to complete an experiment and that will be used up within six months or less.
- Purchase PFCs with added peroxide formation inhibitor, whenever possible. PFCs that have been purified of inhibitors must have inhibitors reintroduced upon storage.

- PFCs must be appropriately labelled, including the date opened and expiration date as according to manufacturer. Expired chemicals must be promptly disposed of by EHS as hazardous waste.
- Document on label the dates of peroxide testing and additions of inhibitors.
- Store in sealed, air tight, light resistant containers. Leave in original manufacturer containers whenever possible.
- Use oxygen exclusion practices whenever possible (i.e. purge with inert gas).
- Class I and Class III PFCs should be tested for the presence of peroxides prior to use and all PFCs should be tested prior to concentration, i.e. distillation, evaporation, etc. (see below).
- Do not concentrate solutions that may contain peroxides.
- Date the containers of these chemicals as to when received and when opened.
- Store these chemicals in airtight containers in a dark, cool, dry area.
- Check containers for the formation of peroxides, as needed, using appropriate indicator strips.
- Dispose of peroxide forming chemicals on or before the expiration date or one year after opening, whichever is first.

Compressed Gases

- Store compressed gases in a secure and upright position.
- Secure cylinders individually with a chain or strap, 2/3 to 3/4 up the height of the cylinder from the floor.
- Indicate the status of the cylinder: “Full” or “In Use” or “Empty”.
- When not in use, replace the valve cap.
- For transport, use a cylinder cart.
- Remove all manifolds and regulators, secure the valve cap, and chain or strap the cylinder to the cart before moving.

Controlled Substances

- Require strict record keeping and security measures for receipt, use, storage and disposal. Please refer to the Controlled Substances program guidelines.

7.6 Laboratory Door Labeling

EHS has worked with Manhattan Fire Department and safety representatives on campus to develop the KSU Laboratory Sign system, which provides information

that aids lab workers, hazardous materials response teams, fire response efforts, and facilitates emergency communications.

Starting **January 17, 2017**, all laboratories on the Manhattan campus must have these signs posted at lab entrances.

Completing and *submitting* the sign form, registers your laboratory with EHS.

7.7 Personal Protective Equipment (PPE)

PPE is available in a variety of forms, depending on the type of hazard, the design of any available engineering controls, and the route of exposure.

The Laboratory Supervisor or PI is responsible for selecting, in collaboration with EHS, and providing the appropriate PPE for the laboratory.

The laboratory worker must wear PPE as directed, remove PPE upon exiting the laboratory or laboratory support area, and notify the PI if the PPE provided is damaged or inadequate.

EHS is available to assist in the selection of appropriate PPE and to train laboratory employees on proper use of the PPE. Additionally, minimum PPE standards for all laboratory staff are outlined in the KSU Laboratory Safety Manual.

7.8 Laboratory Safety Equipment

There may be many different types of safety equipment in laboratories at KSU. The Laboratory Supervisor or PI should ensure that laboratory workers are familiar with the location and proper operation of safety equipment available to the laboratory. EHS also verifies that this equipment is in place and functioning properly. A few of the more common pieces of laboratory safety equipment include:

Emergency Eye Wash Station

The emergency eye wash station provides a means to remove chemical contamination from the eyes and face. Laboratory personnel should follow these guidelines when using the eye wash station:

- Laboratory workers should flush their eye wash stations weekly to ensure clean water is available in the event of an emergency. Maintain a record of these checks.
- Eye wash stations should be clearly marked and kept free from obstructions.
- In the event of eye contamination, the laboratory worker should hold their eye open and rinse for a minimum of 15 minutes; then, they should seek

medical attention (see Appendix B: *Emergency Procedures and Reporting*).

- In the event of face contamination where the chemical has not reached the eye, the laboratory worker should leave any eye protection on to prevent secondary contamination from reaching the eyes and rinse the affected area for a minimum of 15 minutes; then, they should seek medical attention (see Appendix B: *Emergency Procedures and Reporting).*

Emergency Safety Shower

The emergency safety shower provides a means to remove gross chemical contamination from the body or to extinguish a fire on the body. Laboratory personnel should follow these guidelines when using the safety shower:

- Emergency safety showers should be clearly marked and kept free from obstructions.
- In the event of a fire on the body, initiate the KSU Fire Response, as you are able. The laboratory worker should activate the safety shower and stand under the water flow until the contamination is removed; then, they should seek medical attention (see Appendix B: *Emergency Procedures and Reporting).*
- In the event of gross chemical contamination on the body, the laboratory worker should remove contaminated clothing, activate the safety shower, and stand under the water for a minimum of 15 minutes; then, they should seek medical attention (see Appendix B*: Emergency Procedures and Reporting).*

Fire Blankets

Some laboratories have fire blankets. Fire blankets are not required. The laboratory is responsible for maintaining fire blankets and should have procedures for their use. EHS is available to assess the need for a fire blanket.

Fire Extinguishers

Fire extinguishers are provided to laboratories in the event a fire blocks a means of egress and the laboratory worker must fight a fire to save his or her own life or to extinguish small fires if able and have been properly trained. Laboratories should have the appropriate class of extinguisher for the fire hazards in the laboratory. In general, a class BC or class ABC extinguisher is appropriate. In some instances, this extinguisher is supplemented with a class D fire extinguisher, as required. EHS can provide guidance on the selection of the appropriate fire extinguisher including its placement.

EHS will provide specific fire extinguisher training as requested.

Fire extinguishers are inspected annually and replaced as needed. Laboratory personnel should report any issues with fire extinguishers to EHS at 785-53**2-5856**.

Chemical Spill Containment Kits

Chemical Spill Containment Kits are available in common areas to provide laboratories with basic equipment to contain a chemical spill. These kits are stocked with general material to help contain a large chemical spill. The Laboratory Supervisor or PI is responsible for determining whether additional spill containment or clean-up material appropriate to the chemicals used in the laboratory is required, and is responsible for providing that material, if necessary. Department Safety Coordinators should be trained in the proper use of chemical spill kits. Any chemical spills, whether involving medical exposure or a near-miss, should be reported to EHS (see Appendix B: *Emergency Procedures and Reporting* for more information).

Chemical Fume Hoods

Chemical fume hoods are the most common engineering control to protect against the inhalation of chemicals at KSU.

EHS coordinates the annual inspection of chemical fume hoods to ensure they are functioning properly.

The Division of Facilities repairs chemical fume hoods that are not functioning. If a laboratory worker suspects that a chemical fume hood is not functioning properly, he or she should contact the Division of Facilities at 785-53**2-6389**.

When using a chemical fume hood, laboratory workers should follow these guidelines:

- On sashes that open vertically, keep the sash as low as possible. The sash should never exceed the maximum sash height indicated on the inspection sticker.
- Keep only what is needed for the task in the hood. Excess equipment in the hood can reduce the provided protection.
- Work as far back in the hood as possible. At minimum 6” back from the sash opening.

7.9 Laboratory Waste Management

Solid, non-contaminated waste

Solid waste is waste that is not regulated for special disposal and therefore can be placed in a standard dumpster for disposal. Solid waste is removed from the

laboratory by custodial staff. Examples of solid waste include, but are not limited to:

- Recyclable waste: clean, non-contaminated recyclable waste should be recycled when possible using designated receptacles. Refer to the KSU Sustainability guidelines.
- Office waste: papers, plastics, and other non-contaminated trash. Office waste can be placed in a general trash receptacle.
- Glass waste: non-contaminated broken or whole glass, glass or plastic pipettes, or pipette tips. Glass waste should be placed in a sturdy, cardboard box with a top that is lined with a plastic bag. The box should be clearly marked “Broken Glass – Trash”.
- Uncontaminated animal bedding: Uncontaminated animal bedding should be placed in a sturdy bag and sealed.
- Autoclaved biological material: After the material has been confirmed to be sterile, biohazardous labels should be removed and the material should be placed in a sturdy bag.
- Empty chemical containers: For non-P-listed chemicals, deface containers and dispose of as solid waste.

Universal waste

- Batteries: Batteries may be collected in the laboratory’s hazardous waste area. Collect in a properly labeled plastic bag. Pickup can be arranged by filling out the Hazardous Waste form on the EHS website.
- Fluorescent lamps: Fluorescent lamps may be collected in the laboratory’s hazardous waste area. Do not place fluorescent lamps in the broken glass box. Collect in a properly labeled plastic bag or sturdy box. Pickup can be arranged by filling out the Hazardous Waste form on the EHS website.

Chemical waste

- Most chemical waste is regulated as hazardous waste. For assistance in making a waste determination, contact EHS.
- Collect chemical waste in an appropriately labeled container within the laboratory’s hazardous waste satellite accumulation area (SAA). Pickup can be arranged by filling out the Hazardous Waste form on the EHS website.

Biological and sharps waste

- Red bag waste: solid, non-sharp biohazardous waste that is not decontaminated before leaving the laboratory. Red bag waste placed outside the laboratory is removed by the custodians; red bag waste containers inside the laboratories are removed once they are ¾ full, sealed by the laboratory, and labeled with the laboratory name. Pickup

can be arranged by filling out the Hazardous Waste form on the EHS website.

- Orange bag autoclave waste: solid, non-sharp biohazardous waste that is autoclaved by laboratory personnel prior to disposal as red bag waste or solid waste.
- Sharps waste: needles, syringes, Pasteur pipettes, pipette tips, razor blades and other metal sharps, regardless of whether they are contaminated with biohazardous materials. Sharps waste must be placed in approved sharps containers.

Mercury-Containing Chemicals and Equipment

- KSU discourages the use of mercury in chemicals or equipment anywhere on campus unless absolutely required for a particular use.

7.10 Laboratory Security

KSU laboratories often contain valuable equipment and materials, equipment and materials that may pose a danger to public safety, and equipment and materials that may pose a danger to an untrained visitor. Therefore, it is important that the laboratory remain secure at all times. Some laboratories may have special precautions given the nature of the materials stored in the laboratory. In general, all laboratories should follow these tips to help keep the laboratory secure:

- Question visitors. Do not hesitate to contact the authorities to report a suspicious person. Contact the KSU Police Department at 785-53**2-6412**.
- Always keep doors between the laboratory and hallways or other common places closed.
- Always lock the doors between the laboratory and hallways or other common places when leaving the laboratory unattended.

7.11 Laboratory Visitor Policy

A laboratory visitor is any person who is not assigned to work in the laboratory space on a regular basis. To protect the visitor and reduce the risk to the University, the following guidelines for visitors to laboratories should be followed:

- No person under the age of 18 should be allowed to work in a laboratory without the expressed, written permission of EHS. Contact EHS for more information.
- All visitors must be escorted and supervised by laboratory personnel at all times while the visitor is in the laboratory.
- Visitors to the laboratory are expected to follow the same requirements as the laboratory workers in regards to such items as PPE, proper dress, food and drink, etc.

- A student or other person regularly visiting the laboratory, even if just as a volunteer, should follow the requirements for a laboratory worker laid out in this plan, including the training requirements.

7.13 Transporting Chemicals between Laboratories

Laboratory workers and PIs are permitted to transfer chemicals between laboratories on the same campus. The preferred method for bulk transport of these materials is on a clean cart. The materials themselves must be in sealed containers, clearly labeled with the contents' name and applicable hazard(s) classification. The cart must be leak-proof and have ≥2 inch lip to contain a potential spill and prevent the container from sliding off.

If being carried by hand, or transported on a cart that does not meet the requirements above, the container must be sealed, clearly labeled as above, and packaged within *ANOTHER* tightly sealed, clean container or packaged just as it was when first shipped to the laboratory.

If chemicals must be transferred between campuses or to an off-campus location, EHS must be contacted for assistance in complying with applicable transport regulations.

7.14 Laboratory-Specific SOPs

If required by the task, the PI, the CHO or EHS, laboratories may be responsible for developing their own SOPs beyond what is described in this CHP's SOPs. The process of developing laboratory-specific SOPs is intended to characterize various toxicological, regulatory, and physical criteria or to identify conditions that might require additional control measures, as well as to aid in the identification of those control measures.

It is the responsibility of the Laboratory Supervisor or PI to review all materials and substances being used. Upon such review, a determination and implementation of more stringent Site-Specific SOPs will need to be developed by the individual laboratory, as necessary. Contact EHS for assistance in generating laboratory-specific SOPs.

7.15 Chemical Containment Levels (CCL)

The level of hazard presented by chemicals used or stored in the laboratory are ranked from 1 (lowest hazard), 2 (moderate hazard) to 3 (highest hazard). All laboratories that have chemicals in storage or use (regardless of the physical state or phase) will have a minimum of a Chemical Safety Level 1. Use of flammable liquids, generation of vapors, or the use of toxic materials in fume hoods (controlled hazards) or small quantities, presenting a moderate, nonlife threatening health risk if released will be designated CSL-2. A CSL-3 designation

is used when materials or procedures involving hazardous chemicals present a serious health risk to workers (e.g., work with OSHA 29CFR1910 Subpart Z carcinogens requiring special signage) or if released, is immediately dangerous to workers or emergency responders (risk of death or acute injury/illness). Additional guidance is provided in the section on how to fill out the form. This section may be left blank if there are no chemicals used in the laboratory (e.g., only hazard is a sealed radioactive source or biological specimen storage).

Appendix A: Commonly Used Acronyms and Glossary

CHO	Chemical Hygiene Officer
CHP	Chemical Hygiene Plan
EHS	Environmental Health and Safety
SDS	Safety Data Sheet
OSHA	Occupational Safety and Health Administration
PEL	Permissible Exposure Limit
PI	Principal Investigator
PPE	Personal Protective Equipment
SOP	Standard Operating Procedure

Most terms and abbreviations that are used in the Plan are defined below. For a complete list of abbreviations that are used in Safety Data Sheets, see the SDS glossary.

action level: concentration designated for a specific substance, calculated as an eight-hour time-weighted average that initiates certain required activities such as exposure monitoring and medical surveillance.

acute toxicity: harmful effects produced by a single or short-duration exposure. The effects usually appear immediately or within a short time after exposure. Examples of acutely toxic substances are hydrogen cyanide and other inorganic cyanides, carbon monoxide, phosgene and hydrofluoric acid.

autoignition temperature: the temperature at which a particular substance will ignite spontaneously without an external source of energy (flame, spark, etc.).

carcinogen: a cancer-causing substance that meets one of the following criteria: regulated by OSHA as a carcinogen, listed as “know to be carcinogen”, carcinogenic to humans” or “reasonably anticipated to be carcinogen”.

ceiling limit: an inhalation exposure limit (PEL or TLV) that may not be exceeded even for short periods of time.

Chemical Hygiene Officer: an employee of Kansas State University who is designated by KSU and who is qualified by training or experience to provide technical guidance in the development and implementation of the Chemical Hygiene Plan.

Chemical Hygiene Plan: a written plan that sets forth procedures, equipment, personal protective equipment and work practices that are capable of protecting

employees from the health hazards presented by hazardous chemicals used in that particular work place.

chronic toxicity: harmful effects that occur only after repeated or prolonged exposure, or that appear only after a prolonged latency period. Examples of chronically toxic substances are lead, mercury and carcinogens, such as benzene and vinyl chloride.

combustible: having a flash point of 37.8°C (100°F) or higher.

corrosive: causing visible destruction of, or irreversible alterations in living tissue by chemical action at the site of contact.

DOT: The Department of Transportation

designated area: an area that may be used for work with “select carcinogens”, reproductive toxins or substances that have a high degree of toxicity. A designated area may be the entire laboratory, an area of a laboratory or a device such as glove box or fume hood.

EPA: Environmental Protection Agency

explosive: a chemical that causes a sudden release of pressure, gas and heat when subjected to shock, an electric spark, high pressure or high temperature.
face velocity: the speed of airflow at the front of a fume hood and measured in feet per minute.

flammable: having a flash point less than 37.8°C (100°F).

flammable range: the range of concentrations in air, from the lower explosive limit (LEL) to the upper explosive limit (UEL), over which a vapor is flammable; expressed in percent by volume.

flash point: the lowest temperature at which the vapors from a liquid will ignite and sustain a flame under specified conditions.

fume hood: an enclosure exhausted through the back to keep fume or other emissions generated within it away from the user.

hazardous chemical: a chemical for which there is statistically significant evidence that acute or chronic health effects may occur in exposed employees. These include chemicals that are carcinogens, toxic or highly toxic agents, reproductive toxins, irritants, corrosives, sensitizers, hepatoxins, nephrotoxins, neurotoxins, agents that act on the hematopoietic systems and agents that damage the lungs, skin, eyes or mucous membranes.

laboratory: a facility where relatively small quantities of hazardous chemical are used on a non-production basis.

lower explosive limit (LEL): the lowest concentration in air at which a particular vapor will burn or explode when ignited by a source of energy.

SDS: safety data sheet

medical consultation: a consultation that takes place between an employee and a licensed physician for the purpose of determining what medical examinations or procedures, if any, are appropriate in cases where a significant exposure to a hazardous chemical may have taken place.

OSHA: Occupational Safety and Health Administration. Also sometimes, the Occupational Safety and Health Act.

oxidizer: a substance that can support combustion. Examples of oxidizers include chlorates, permanganates, nitrates and halogens. Note that an oxidizer does not necessarily contain oxygen.

permissible exposure limit (PEL): an OSHA regulatory term that specifies a worker's maximum permissible exposure to a contaminant in air. PELs include 8-hour time-weighted average limits, short-term exposure limits and ceiling limits.

peroxidizable: able to react with oxygen from the air to form a peroxide. Most aliphatic ethers are peroxidizable compounds.

physical hazard: a chemical for which there is scientifically valid evidence that it is a combustible liquid, a compressed gas, explosive, flammable, an organic peroxide, an oxidizer, pyrophoric, unstable (reactive) or water reactive.

pyrophoric: igniting spontaneously upon contact with air.

RCRA: the Resource Conservation and Recovery Act.

SARA: The Superfund Amendments Reauthorization Act, also known as the Community Right-to-Know Act.

short-term exposure limit (STEL): an inhalation exposure limit (PEL or TLV) designed to limit worker exposure for a short time (usually 15 minutes).

threshold limit value (TLV): a maximum permissible exposure for a worker to a contaminant in air. Expressed either as parts per million or milligrams per cubic meter. TLVs include 8-hour time-weighted average limits, short-term exposure limits and ceiling limits.

time-weighted average: an average over time. Here, it applies to averaging the concentration of a contaminant in a worker's breathing air, usually over 8 hours. It is calculated by multiplying each different concentration value by the duration in hours the worker was exposed to that concentration adding these individual products, and dividing by 8 hours. There are PELs and TLVs that set limits on this time-weighted average exposure.

upper explosive limit (UEL): the highest concentration in air at which a particular vapor will burn or explode when ignited by a source of energy.

unstable (reactive): a chemical that will vigorously polymerize, decompose, condense or become self-reactive under conditions of shock, pressure or temperature.

water reactive: a chemical that will react with water to produce a gas that is either flammable or presents a health hazard.

Appendix B: Emergency Procedures and Reporting

B.1 EMERGENCY PROCEDURES AND RESPONSE

In the event of any type of emergency in a laboratory environment, quick and decisive action is important. Information specific to the laboratory must be provided by the PI, as appropriate.

University-wide Emergencies

K-State Alerts is Kansas State University's emergency notification system that gives campus authorities the ability to communicate emergency information quickly to the university community using some or all of the following channels:

- Text messaging
- Automated phone calls
- Broadcast e-mails to all @k-state.edu accounts
- Alert beacons
- Police public address systems
- Tornado warning sirens
- K-State staff carrying radios
- Postings to the K-State website and mobile app

Emergency Phone Numbers

- Environmental Health and Safety, 785-532-5856
- Office of Student Life, 785-532-6432
- K-State Counseling Services, 785-532-6927
- Lafene Student Health Center, 785-532-6544
- Facilities, 785-532-6369
- University Police, 785-532-6412

The Office of Student Life website contains helpful information regarding campus safety for students.

Medical Emergencies

Call 911 to report the emergency.

- Do not attempt to move a person who has fallen or appears to in pain.
- Provide first aid, if someone is ill or injured and requires immediate assistance.
- Limit your communication with ill or injured person to quiet reassurances.

Fire

- **If you detect a fire, call 911, pull the fire alarm and follow Evacuation procedures.**
- If you hear a fire alarm, Follow Evacuation procedures - **Do not** use elevators.
- The fire alarm in the building will not notify the fire department.

Chemical or Biological Spills

- Restrict access to or evacuate the spill area, as appropriate
- **Call 911 immediately.**
- Do not get near or touch the spilled material unless properly trained to do so.
- Contain the spill using absorbents, if possible.
- Clean up any small chemical spills, if you are able. The Department of Public Safety will assist if needed.
- Vacate the area and close the doors.

B.2. AFTER AN EMERGENCY OR INCIDENT: INJURY & ACCIDENT REPORTING

The Accident Report (1101-A) is to be completed by or for the injured employee, signed by the department head or designated official, and submitted to the Division of Human Resources within **three working days** of the accident/injury.

The 1101-A form can be found at http://www.k-state.edu/hcs/forms/docs/KWC1101A.pdf

Near Misses and Other Incidents:

Please fill out our Investigation Form in addition to KSU's Employer's Report of Injury form and submit it to the EH&S Office.

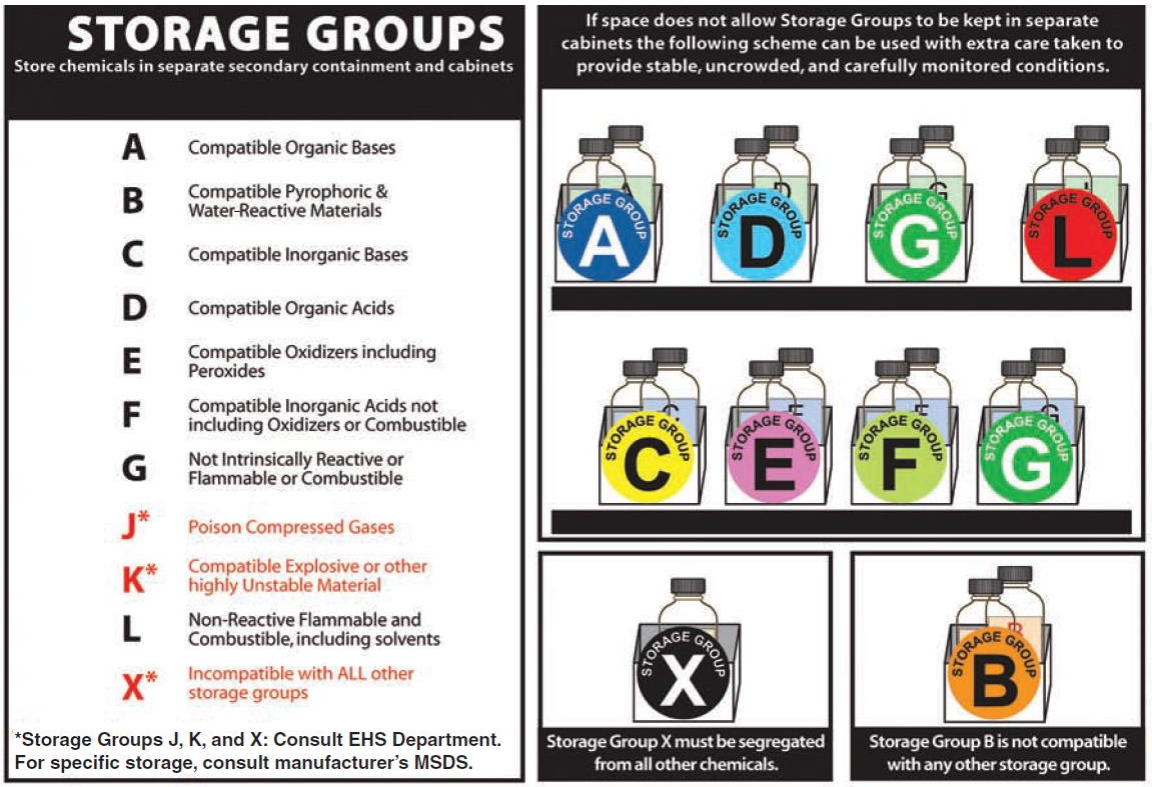
Root cause analysis is a structured approach that can assist the investigators in identifying underlying factors or causes of an incident. Understanding the contributing factors or causes to system or human failure can help to develop actions that result in corrective measures. The 5 Whys is a simple problem-solving technique to help get the root cause of a problem quickly.

Appendix C: Chemical Segregation and Storage

Class of Chemicals	Recommended Storage Method and Additional Concerns	Common Chemical Examples	Common Incompatibles. (Always Consult MSDS)
Flammable Liquids	An approved flammable storage cabinet *Remember: peroxide-forming chemicals must be dated upon delivery and opening (consult Peroxide Forming-Chemical Handout)	Ethanol, Methanol, Acetone, Xylene, Toluene, *Diethyl Ether, *Tetrahydrofuran	Oxidizers, reactives, acids, bases
Toxics	In a ventilated, dry, cool area in a chemically resistant secondary container	Chloroform, Cyanides, Heavy Metal Compounds (e.g. Cadmium, Mercury)	Flammable liquids, acids, bases, reactive, oxidizers please consult EHS for assistance
Corrosive Acids- Inorganic	Store in corrosives cabinet (marked ACID), or on protected shelving and in secondary containment *Do NOT store acids on metal shelving	Hydrochloric Acid, Sulfuric Acid, Phosphoric Acid, Chromic Acid, Nitric Acid	Flammable liquids, flammable solids, bases and oxidizers, organic acids, cyanides, sulfides
Corrosive Acids- Organic	Store in corrosives cabinet, on protected shelving, secondary containment away from inorganic acids *Do NOT store acids on metal shelving	Acetic Acid, Trichloroacetic Acid, Formic Acid	Flammable liquids, flammable solids, bases and oxidizers, inorganic acids, cyanides, sulfides
Corrosive-Bases-Inorganic	Store in corrosives cabinet, or on protected shelving away from acids	Ammonium Hydroxide, Potassium Hydroxide, Sodium Hydroxide	Flammable liquids, acids, oxidizers, organic bases
Corrosive Bases-Organic	Store in corrosive cabinet, and separated from acids and inorganic bases	Hydroxylamine, Tetramethylethylamine Diamine, Triethylamine	Acids, oxidizers, hypochlorites, inorganic bases
Flammable Solids	Cool dry area away from oxidizers and corrosives	Carbon, Charcoal, Paraformaldehyde	Acids, bases, oxidizers
Oxidizers	Store in secondary containment with non-combustibles or inorganic material	Perchlorates, Permanganates, Nitrates	Flammables, combustibles and organic materials
Water Reactive	Store in a cool dry location. Protect from fire sprinkler system and sources of water. Label area for water-reactive storage	Sodium, Lithium, and Potassium Metals, Sodium Borohydride	Aqueous solutions, oxidizers, water sources. Please consult EHS, and MSDS for specific information
Explosives	Store in a secure location away from other chemicals, store in areas away from shock or friction	Trinitrophenol, Picric Acid, Diazoisobutylnitrile	Please consult the MSDS and EHS.
General Stock Chemicals	Storage on laboratory benches, or shelves with like chemicals	Sodium bicarbonate, Agar, Salt buffer	See chemical-specific MSDS

There are many systems for segregating chemicals into groups compatible for storage and this is only one of them. This system is recommended for use across KSU laboratory spaces for its conservative approach to safety and minimal laboratory expertise required by laboratory personnel to properly execute this system. The limitation of this system is that several separate chemical storage locations are required which may not be feasible in some small laboratory spaces. In these instances, other segregation systems may be used (such as Fisher Scientific's ChemAlert color system). Contact EHS for assistance.

Ten incompatible storage groups are identified in *Prudent Practices in the Laboratory: Handling and Management of Chemical Hazards*. These groups should each be stored in a separate cabinet, but at a minimum they must be separated by suitable secondary storage containers. Refer to the SDSs for storage incompatibilities of specific chemicals.



Some of these storage groups will require special storage conditions in addition to being separated from other chemicals. For information on pyrophorics, peroxides, and other highly unstable chemicals, see Error! Reference source not found. **in the Laboratory Safety Manual**.

Chemicals in Storage Group X are highly reactive, highly toxic, or some combination of the two and should be stored by themselves instead of collected in a group. Some examples include picric acid, phosphorous, sodium azide (not in solution), and sodium hydrogen sulfide.

Flammable Liquids

Flammable liquid storage is regulated by volume and the flashpoint of the chemicals. These chemicals should be stored in a flammables cabinet at all times. No more than 5 gallons per laboratory of flammable chemicals may be stored outside of a cabinet at one time. Flammables storage cabinets must meet National Fire Protection Agency and International Fire Code standards, including:

a. Made of flame resistant material
b. Labelled: FLAMMABLE – KEEP FIRE AWAY
c. Well fitted, self-closing doors equipped with three-point latch
d. Bottom of cabinet shall be liquid tight to a height of at least two inches

Radioactive Materials

Containers in which radioactive material is stored shall have a firmly affixed durable, clearly visible label bearing the radiation symbol and words CAUTION (or DANGER) RADIOACTIVE MATERIAL. Labels on storage containers shall also state the quantities and kinds of radioactive materials and date of measurement. Stored radioactive material should be kept in a locked container within a locked room. Reasonable protection shall be provided against loss or leakage by the effects of fire or water.

Equipment such as glassware used for radioactive material shall be kept separate from other equipment. Once used with radioisotopes, the equipment shall not be used for other work or shall not be sent to the repair or glass shop until demonstrated to be free of contamination. A storage cabinet marked with an official radiation symbol should be provided for glassware and tools used in radioisotope work.

Compressed Gases

Each tank must be properly and permanently identified when received. Never accept a cylinder on which the name of the contents is illegible. Do not rely on color codes for tank identification. Use appropriate regulators and do not attempt to modify or change cylinder valves or regulators.

Only those gas cylinders in immediate use shall be located in a laboratory. Replacement cylinders and empty cylinders shall be stored in a designated area, preferably outside the building. Do not store cylinders in hallways.

All compressed gas cylinders must be secured with a chain, clamp, or strap at all times when in use, storage, or transport. Three points of contact should be made with the sides of the cylinder at all times whether in transit, storage, or use. When not in use or while in transit, regulators shall be removed and valve protection caps put in place.

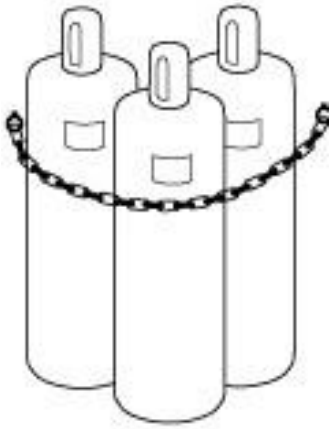


Figure 1 - example of proper three points of contact while storing gas cylinders

Use all of the contents of a cylinder whenever possible. Even though the cylinder may seem empty, continue to use recommended handling procedures for compressed gas cylinders. Return the empty cylinder to the manufacturer, if possible. Cylinders that cannot be returned and are empty or are no longer wanted are handled through the hazardous waste program.

Appendix D: Safety Data Sheets (SDS)

The new SDS contain 16 standardized sections. All SDS must contain the following sections, except for sections 12-15 which are optional:

Product identification

This section identifies the chemical on the SDS as well as the recommended uses. It also provides the essential contact information of the supplier. The required information consists of:

- Product identifier used on the label and any other common names or synonyms by which the substance is known.
- Name, address, phone number of the manufacturer, importer, or other responsible party, and emergency phone number.
- Recommended use of the chemical (e.g., a brief description of what it actually does, such as flame retardant) and any restrictions on use (including recommendations given by the supplier).

Hazard identification

This section identifies the hazards of the chemical presented on the SDS and the appropriate warning information associated with those hazards. The required information consists of:

- The hazard classification of the chemical (e.g., flammable liquid, category[1]).
- Signal word.
- Hazard statement(s).
- Pictograms (the pictograms or hazard symbols may be presented as graphical reproductions of the symbols in black and white or be a description of the name of the symbol (e.g., skull and crossbones, flame).
- Precautionary statement(s).
- Description of any hazards not otherwise classified.
- For a mixture that contains an ingredient(s) with unknown toxicity, a statement describing how much (percentage) of the mixture consists of ingredient(s) with unknown acute toxicity. Please note that this is a total percentage of the mixture and not tied to the individual ingredient(s).

Chemical composition

This section identifies the ingredient(s) contained in the product indicated on the SDS, including impurities and stabilizing additives. This section includes information on substances, mixtures, and all chemicals where a trade secret is claimed. The required information consists of:

- Chemical name with common name and synonyms and CAS #
- Impurities and stabilizing additives, which are themselves classified and which contribute to the classification of the chemical.

- The concentration (i.e., exact percentage) of all ingredients which are classified as health hazards and are:
    - Present above their cut-off/concentration limits or
    - Present a health risk below the cut-off/concentration limits.
- The concentration (exact percentages) of each ingredient must be specified except concentration ranges may be used in the following situations:
    - A trade secret claim is made,
    - There is batch-to-batch variation, or
    - The SDS is used for a group of substantially similar mixtures.

A statement that the specific chemical identity and/or exact percentage (concentration) of composition has been withheld as a trade secret is required.

First-aid measures

This section describes the initial care that should be given by untrained responders to an individual who has been exposed to the chemical. The required information consists of:

- Necessary first-aid instructions by relevant routes of exposure (inhalation, skin and eye contact, and ingestion).
- Description of the most important symptoms or effects, and any symptoms that are acute or delayed.
- Recommendations for immediate medical care and special treatment needed, when necessary.

Fire-fighting measures

This section provides recommendations for fighting a fire caused by the chemical. The required information consists of:

- Recommendations of suitable extinguishing equipment, and information about extinguishing equipment that is not appropriate for a particular situation.
- Advice on specific hazards that develop from the chemical during the fire, such as any hazardous combustion products created when the chemical burns.
- Recommendations on special protective equipment or precautions for firefighters.

Accidental release measures

This section provides recommendations on the appropriate response to spills, leaks, or releases, including containment and cleanup practices to prevent or minimize exposure to people, properties, or the environment. It may also include recommendations distinguishing between responses for large and small spills

where the spill volume has a significant impact on the hazard. The required information may consist of recommendations for:

- Use of personal precautions (such as removal of ignition sources or providing sufficient ventilation) and protective equipment to prevent the contamination of skin, eyes, and clothing.
- Emergency procedures, including instructions for evacuations, consulting experts when needed, and appropriate protective clothing.
- Methods and materials used for containment (e.g., covering the drains and capping procedures).
- Cleanup procedures (e.g., appropriate techniques for neutralization, decontamination, cleaning or vacuuming; adsorbent materials; and/or equipment required for containment/clean up)

Handling and storage

This section provides guidance on the safe handling practices and conditions for safe storage of chemicals. The required information consists of:

- Precautions for safe handling, including recommendations for handling incompatible chemicals, minimizing the release of the chemical into the environment, and providing advice on general hygiene practices (e.g., eating, drinking, and smoking in work areas is prohibited).
- Recommendations on the conditions for safe storage, including any incompatibilities. Provide advice on specific storage requirements (e.g., ventilation requirements)

Exposure controls and Personal Protective Equipment

This section indicates the exposure limits, engineering controls, and personal protective measures that can be used to minimize worker exposure. The required information consists of:

- OSHA Permissible Exposure Limits (PELs), American Conference of Governmental Industrial Hygienists (ACGIH) Threshold Limit Values (TLVs), and any other exposure limit used or recommended by the chemical manufacturer, importer, or employer preparing the safety data sheet, where available.
- Appropriate engineering controls (e.g., use local exhaust ventilation, or use only in an enclosed system).
- Recommendations for personal protective measures to prevent illness or injury from exposure to chemicals, such as personal protective equipment (PPE) (e.g., appropriate types of eye, face, skin or respiratory protection needed based on hazards and potential exposure).
- Any special requirements for PPE, protective clothing or respirators (e.g., type of glove material, such as PVC or nitrile rubber gloves; and

breakthrough time of the glove material).

Physical and chemical properties

This section identifies physical and chemical properties associated with the substance or mixture. The minimum required information consists of:

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

The SDS may not contain every item on the above list because information may not be relevant or is not available. When this occurs, a notation to that effect must be made for that chemical property. Manufacturers may also add other relevant properties, such as the dust deflagration index (Kst) for combustible dust, used to evaluate a dust's explosive potential.

Stability and reactivity

This section describes the reactivity hazards of the chemical and the chemical stability information. This section is broken into three parts: reactivity, chemical stability, and other. The required information consists of:

- Description of the specific test data for the chemical(s). This data can be for a class or family of the chemical if such data adequately represent the anticipated hazard of the chemical(s), where available.

- Indication of whether the chemical is stable or unstable under normal ambient temperature and conditions while in storage and being handled.
- Description of any stabilizers that may be needed to maintain chemical stability.
- Indication of any safety issues that may arise should the product change in physical appearance.
- Indication of the possibility of hazardous reactions, including a statement whether the chemical will react or polymerize, which could release excess pressure or heat, or create other hazardous conditions. Also, a description of the conditions under which hazardous reactions may occur.
- List of all conditions that should be avoided (e.g., static discharge, shock, vibrations, or environmental conditions that may lead to hazardous conditions).
- List of all classes of incompatible materials (e.g., classes of chemicals or specific substances) with which the chemical could react to produce a hazardous situation.
- List of any known or anticipated hazardous decomposition products that could be produced because of use, storage, or heating. (Hazardous combustion products should also be included in Section 5 (Fire-Fighting Measures) of the SDS.)

Toxicological information

This section identifies toxicological and health effects information or indicates that such data are not available. The required information consists of:

- Information on the likely routes of exposure (inhalation, ingestion, skin and eye contact). The SDS should indicate if the information is unknown.
- Description of the delayed, immediate, or chronic effects from short- and long-term exposure.
- The numerical measures of toxicity (e.g., acute toxicity estimates such as the LD50 (median lethal dose)) - the estimated amount [of a substance] expected to kill 50% of test animals in a single dose.
- Description of the symptoms. This description includes the symptoms associated with exposure to the chemical including symptoms from the lowest to the most severe exposure.
- Indication of whether the chemical is listed in the National Toxicology Program (NTP) Report on Carcinogens (latest edition) or has been found to be a potential carcinogen in the International Agency for Research on Cancer (IARC) Monographs (latest editions) or found to be a potential carcinogen by OSHA

Ecological information

This section provides information to evaluate the environmental impact of the chemical(s) if it were released to the environment. The information may include:

- Data from toxicity tests performed on aquatic and/or terrestrial organisms, where available (e.g., acute or chronic aquatic toxicity data for fish, algae, crustaceans, and other plants; toxicity data on birds, bees, plants).
- Whether there is a potential for the chemical to persist and degrade in the environment either through biodegradation or other processes, such as oxidation or hydrolysis.
- Results of tests of bioaccumulation potential, making reference to the octanol-water partition coefficient (Kow) and the bioconcentration factor (BCF), where available.
- The potential for a substance to move from the soil to the groundwater (indicate results from adsorption studies or leaching studies).
- Other adverse effects (e.g., environmental fate, ozone layer depletion potential, photochemical ozone creation potential, endocrine disrupting potential, and/or global warming potential).

Disposal considerations

This section provides guidance on proper disposal practices, recycling or reclamation of the chemical(s) or its container, and safe handling practices. To minimize exposure, this section should also refer the reader to Section 8 (Exposure Controls/Personal Protection) of the SDS. The information may include:

- Description of appropriate disposal containers to use.
- Recommendations of appropriate disposal methods to employ.
- Description of the physical and chemical properties that may affect disposal activities.
- Language discouraging sewage disposal.
- Any special precautions for landfills or incineration activities

Transport information

This section provides guidance on classification information for shipping and transporting of hazardous chemical(s) by road, air, rail, or sea. The information may include:

- UN number (i.e., four-figure identification number of the substance) [1].
- UN proper shipping name[1].
- Transport hazard class.
- Packing group number, if applicable, based on the degree of hazard[2].
- Environmental hazards (e.g., identify if it is a marine pollutant according to

the International Maritime Dangerous Goods Code (IMDG Code)).

- Guidance on transport in bulk (according to Annex II of MARPOL 73/78[3] and the International Code for the Construction and Equipment of Ships Carrying Dangerous Chemicals in Bulk (International Bulk Chemical Code (IBC Code)).
- Any special precautions which an employee should be aware of or needs to comply with, in connection with transport or conveyance either within or outside their premises (indicate when information is not available).

Regulatory information

This section identifies the safety, health, and environmental regulations specific for the product that is not indicated anywhere else on the SDS. The information may include:

- Any national and/or regional regulatory information of the chemical or mixtures (including any OSHA, Department of Transportation, Environmental Protection Agency, or Consumer Product Safety Commission regulations)

Other information

This section indicates when the SDS was prepared or when the last known revision was made. The SDS may also state where the changes have been made to the previous version. You may wish to contact the supplier for an explanation of the changes. Other useful information also may be included here.