MISSISSIPPI STATE UNIVERSITY™
ENVIRONMENTAL HEALTH
AND SAFETY

CHEMICAL HYGIENE PLAN

Updated January 2024

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INTRODUCTION AND SCOPE

Mississippi State University (MSU) is committed to supporting a safe and healthy environment throughout the campus community. This Chemical Hygiene Plan (CHP) details key considerations for recognizing, evaluating, and mitigating hazards affiliated with chemicals. The information presented in this CHP provides a broad overview of the standards that support the safe handling of hazardous chemicals. It is important to note that this plan is not all encompassing - specific departments, divisions, or other work units engaged in activities involving hazardous chemicals that are not explicitly addressed in this CHP are accountable for developing, implementing, and ensuring adherence with task-specific standard operating procedures (SOPs).

RESPONSIBILITIES

Responsibility for chemical safety rests within every level at the University. All at-risk personnel must be informed about the potential chemical hazards in their work areas. All chemical users are accountable for adhering to the standards outlined in this manual in order to maintain a safe and healthy campus environment. It is important that all personnel understand their role and responsibilities for maintaining a safe working environment for themselves and those around them.

Environmental Health & Safety

The Environmental Health & Safety is responsible for:

a. Developing Safety Guidelines in accordance with federal, state, and local regulations, University policy, and optimal safety practices.
b. Establishing and regularly updating this CHP in order to ensure chemical safety considerations and expectations are clearly communicated to the campus community.
c. Assisting all MSU personnel in maintaining compliance with all University policies and applicable local, state, and federal regulations.
d. Devising, providing, and ensuring completion of required EH&S safety training
e. Investigating accidents/incidents, near-misses, and other safety concerns.
f. Conducting laboratory safety reviews and hazardous waste satellite accumulation area audits.
g. Providing guidance as requested regarding the selection and application of controls and development of standard operating procedures.

Deans, Directors, Department Heads, and Unit Managers

All department heads, chairs, and directors are responsible for:

a. Ensuring activities comply with University policy, safety guidelines, and safety procedures.
b. Dedicating appropriate infrastructure and resources to ensure a safe working environment.
c. Taking action to ensure that identified hazards are instances of non-compliance are resolved in a timely manner.
d. Holding supervisors and Principal Investigators accountable for upholding safety in their areas.
e. Notifying EH&S of laboratory relocations, closings, and new lab space assignments.
f. Assigning a responsible party to control, maintain and supervise common use laboratories. This will include shared space, cold rooms, animal rooms, greenhouses, etc. If no person is assigned,

the responsibility remains solely with the department head, chair, or director.

g. Reporting unsafe conditions and safety concerns to EH&S for assistance in correcting unsafe conditions and investigating concerns, when needed.

Principle Investigators (PI) and Supervisors

All PI's and supervisors are responsible for:

a. Familiarizing themselves with this CHP, department specific manuals and standard operating procedures, and all other applicable University policies and manuals and ensuring compliance in their area by all employees, students, and visitors.
b. Developing standard operating procedures specific to the work with potentially hazardous chemicals, equipment, or processes.
c. Selecting and employing safety practices and equipment that reduce the potential for exposure to hazards.
d. Maintaining laboratory equipment and controls in good working order.
e. Training all employees, students, and visitors of the hazards associated with their area and the procedures to be taken to reduce risk of exposure and/or injury.
f. Correcting reported unsafe conditions and safety concerns and contacting EH&S for assistance in correcting unsafe conditions and investigating concerns when needed.

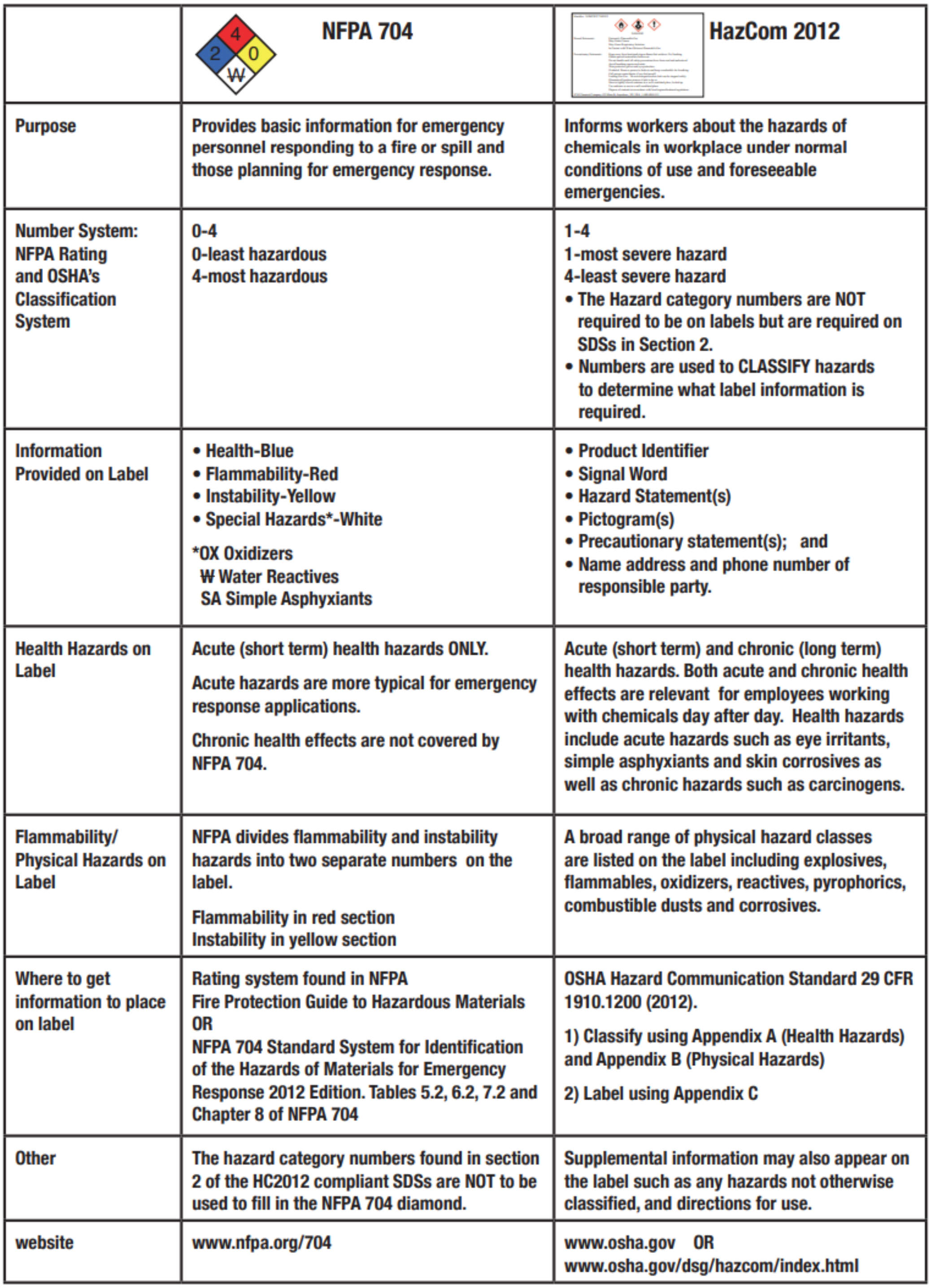
Employees and Students

All employees and students are responsible for:

a. Observing all applicable practices and procedures contained within this CHP, overarching MSU policies, accompanying EH&S safety guidance, as well as activity-specific safety procedures.
b. Reporting all incidents, near misses, unsafe conditions, and other safety concerns to their supervisor and EH&S
c. Participating in all University and department required training and applying the knowledge and concepts gained in the training.

HAZARDOUS CHEMICAL IDENTIFICATION

A hazardous chemical is broadly defined as any chemical that can cause physical or health hazard. There are multiple systems that can be used to classify chemical hazards that are nonsynonymous; thus, it is important for all employees to be aware of the differences in classification and hazard rating systems. The two most commonly utilized systems include the Globally Harmonized System (GHS) HazCom labeling as well as the National Fire Protection Association (NFPA) 704 Diamond. A brief comparison of these distinct hazard communications systems is as follows:



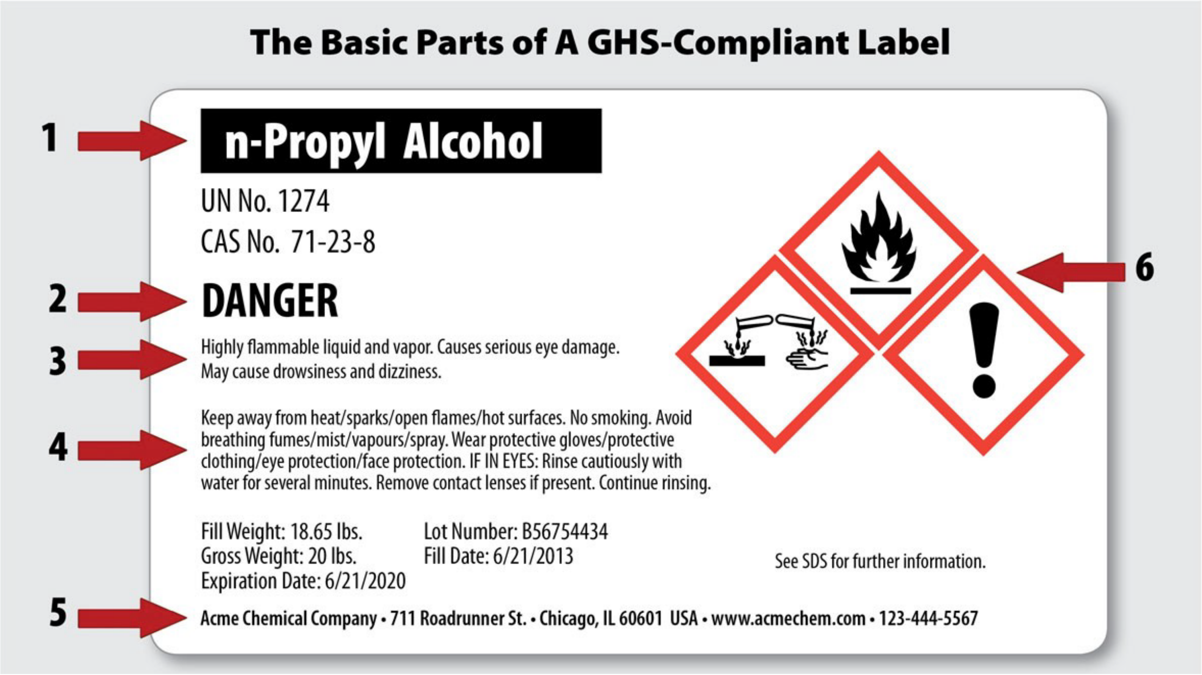
	NFPA 704	HazCom 2012
Purpose	Provides basic information for emergency personnel responding to a fire or spill and those planning for emergency response.	Informs workers about the hazards of chemicals in workplace under normal conditions of use and foreseeable emergencies.
Number System: NFPA Rating and OSHA's Classification System	0-4 0-least hazardous 4-most hazardous	1-4 1-most severe hazard 4-least severe hazard • The Hazard category numbers are NOT required to be on labels but are required on SDSs in Section 2. • Numbers are used to CLASSIFY hazards to determine what label information is required.
Information Provided on Label	• Health-Blue • Flammability-Red • Instability-Yellow • Special Hazards*-White *OX Oxidizers ~~W~~ Water Reactives SA Simple Asphyxiants	• Product Identifier • Signal Word • Hazard Statement(s) • Pictogram(s) • Precautionary statement(s); and • Name address and phone number of responsible party.
Health Hazards on Label	Acute (short term) health hazards ONLY. Acute hazards are more typical for emergency response applications. Chronic health effects are not covered by NFPA 704.	Acute (short term) and chronic (long term) health hazards. Both acute and chronic health effects are relevant for employees working with chemicals day after day. Health hazards include acute hazards such as eye irritants, simple asphyxiants and skin corrosives as well as chronic hazards such as carcinogens.
Flammability/ Physical Hazards on Label	NFPA divides flammability and instability hazards into two separate numbers on the label. Flammability in red section Instability in yellow section	A broad range of physical hazard classes are listed on the label including explosives, flammables, oxidizers, reactives, pyrophorics, combustible dusts and corrosives.
Where to get information to place on label	Rating system found in NFPA Fire Protection Guide to Hazardous Materials OR NFPA 704 Standard System for Identification of the Hazards of Materials for Emergency Response 2012 Edition. Tables 5.2, 6.2, 7.2 and Chapter 8 of NFPA 704	OSHA Hazard Communication Standard 29 CFR 1910.1200 (2012). 1) Classify using Appendix A (Health Hazards) and Appendix B (Physical Hazards) 2) Label using Appendix C
Other	The hazard category numbers found in section 2 of the HC2012 compliant SDSs are NOT to be used to fill in the NFPA 704 diamond.	Supplemental information may also appear on the label such as any hazards not otherwise classified, and directions for use.
website	www.nfpa.org/704	www.osha.gov OR www.osha.gov/dsg/hazcom/index.html

Global Harmonized System (GHS)

The Globally Harmonized System (GHS) was developed by the United Nations for standardizing hazardous chemical classification, labelling, and safety data sheets (SDSs). The GHS was adopted by OSHA in 2012 and has since been extensively implemented to inform workers about the hazards of chemicals in workplace under normal conditions of use and foreseeable emergencies.

Chemical manufacturers are required to use the GHS labeling system for the primary chemical container labels. There are six elements required in a GHS label:

1. A **product identifier** used on the Safety Data Sheet.
2. **Signal word** of either ‘Danger’ or ‘Warning’, if required by the hazard.
3. **Hazard Statement(s)** inform the user of the specific hazard(s) associated with the chemical.
4. **Precautionary Statement(s)** inform the user of steps to prevent or respond to an exposure, properly store, and dispose of the chemical. Not all information may be listed on the label but will be present in the SDS. This is indicated on the label by the use of ‘***’ at the end of the precautionary statement.
5. **Supplier Identification** and Contact Information.
6. **Pictogram(s)** for the health and physical hazards associated with the chemical.



The Basic Parts of A GHS-Compliant Label

n-Propyl Alcohol

UN No. 1274
CAS No. 71-23-8

DANGER

Highly flammable liquid and vapor. Causes serious eye damage. May cause drowsiness and dizziness.

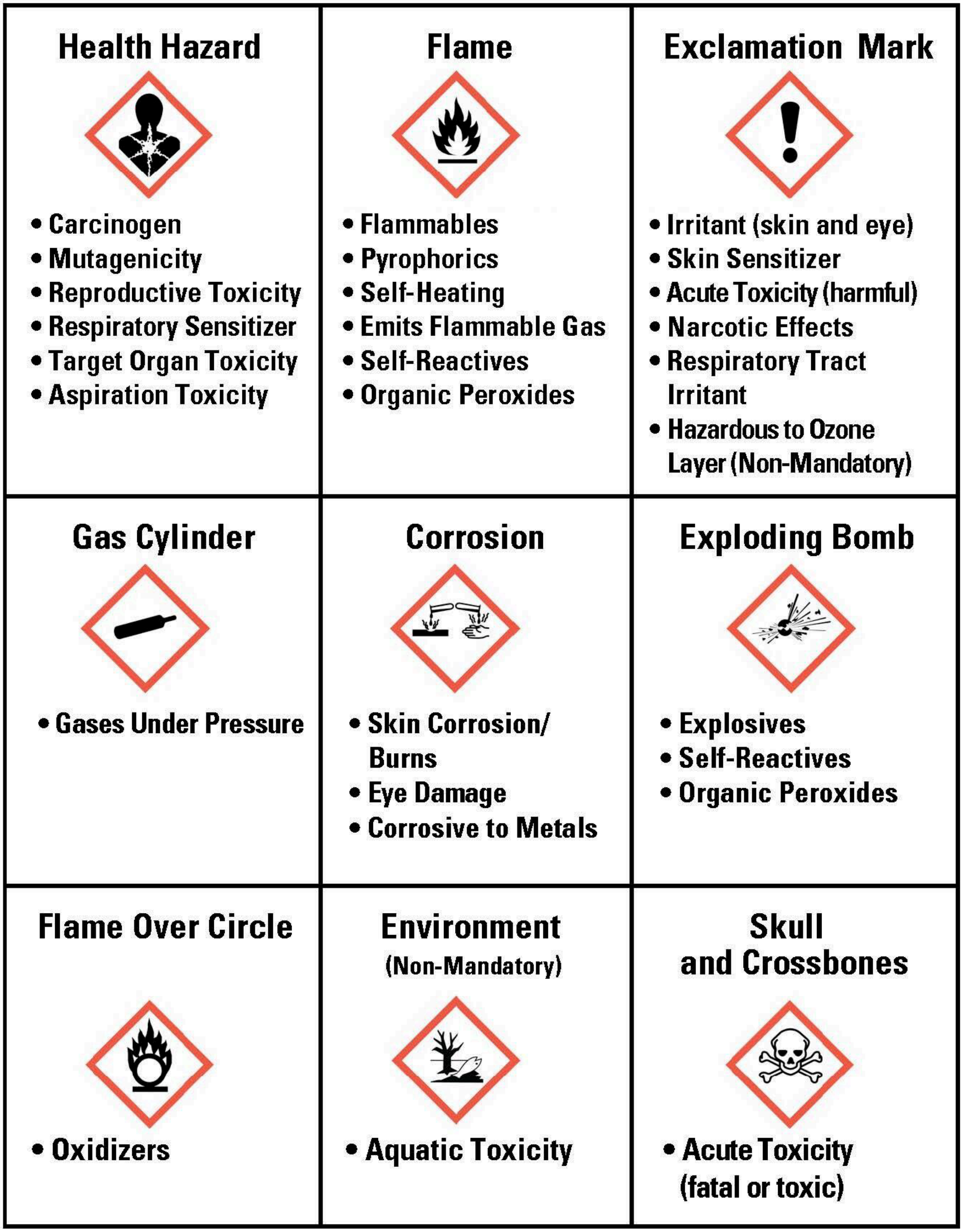
Keep away from heat/sparks/open flames/hot surfaces. No smoking. Avoid breathing fumes/mist/vapours/spray. Wear protective gloves/protective clothing/eye protection/face protection. IF IN EYES: Rinse cautiously with water for several minutes. Remove contact lenses if present. Continue rinsing.

Fill Weight: 18.65 lbs.
Gross Weight: 20 lbs.
Expiration Date: 6/21/2020
Lot Number: B56754434
Fill Date: 6/21/2013

See SDS for further information.

Acme Chemical Company • 711 Roadrunner St. • Chicago, IL 60601 USA • www.acmechem.com • 123-444-5567

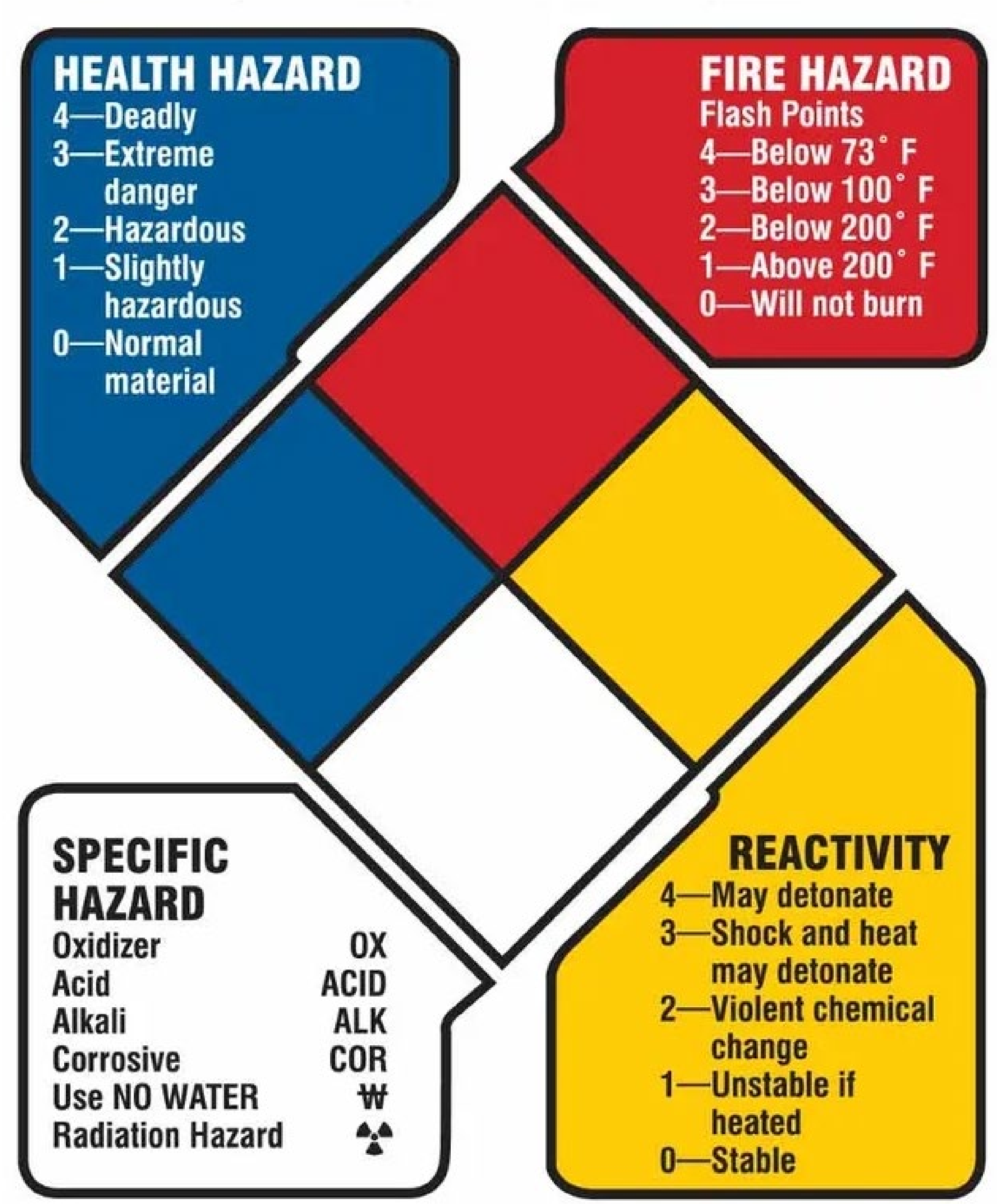
The GHS uses 9 pictograms to readily communicate hazards:



Health Hazard • Carcinogen • Mutagenicity • Reproductive Toxicity • Respiratory Sensitizer • Target Organ Toxicity • Aspiration Toxicity	**Flame** • Flammables • Pyrophorics • Self-Heating • Emits Flammable Gas • Self-Reactives • Organic Peroxides	**Exclamation Mark** • Irritant (skin and eye) • Skin Sensitizer • Acute Toxicity (harmful) • Narcotic Effects • Respiratory Tract Irritant • Hazardous to Ozone Layer (Non-Mandatory)
Gas Cylinder • Gases Under Pressure	**Corrosion** • Skin Corrosion/ Burns • Eye Damage • Corrosive to Metals	**Exploding Bomb** • Explosives • Self-Reactives • Organic Peroxides
Flame Over Circle • Oxidizers	**Environment** (Non-Mandatory) • Aquatic Toxicity	**Skull and Crossbones** • Acute Toxicity (fatal or toxic)

National Fire Protection Association (NFPA) 704

The NFPA 704 provides a standardized rating system for indicating the health, flammability, reactivity, and special hazards for many hazardous chemicals. Through use of the NFPA 704 Diamond, fundamental information for emergency personnel responding to a fire or spill and those planning for emergency response is readily communicated:



International Fire Code (IFC)

The International Fire Code (IFC) also defines hazardous material categories. The IFC chemical hazard classifications and the associated definitions are detailed below in **Appendix A.**

Safety Data Sheets

A Safety Data Sheet (SDS) is a standardized document that contains crucial occupational safety and health information. As mandated by the International Hazard Communication Standard (HCS), chemical manufacturers, distributors, or importers must provide SDSs in order to convey information pertaining to hazardous materials to the downstream users. An SDS is divided into 16 sections that provide critical information about hazards and safety precautions for a specific chemical or mixture. The 16 sections include:

- **Section 1**: Identification of the chemical and supplier information.
- **Section 2**: Hazard identification.
- **Section 3**: Composition and ingredient information.
- **Section 4**: First-aid measures.
- **Section 5**: Fire-fighting measures.
- **Section 6**: Accidental release measures.
- **Section 7**: Handling and storage.
- **Section 8**: Exposure control and personal protection.
- **Section 9**: Physical and chemical properties.
- **Section 10**: Stability and reactivity.
- **Section 11**: Toxicological information.
- **Section 12**: Ecological information.
- **Section 13**: Disposal considerations.
- **Section 14**: Transport information.
- **Section 15**: Regulatory information.
- **Section 16**: Other information.

Laboratory Hazard Communication

All laboratory entry doors must have posted signage to clearly disclose pertinent hazards. This information is essential for communicating hazards to all who enter the lab, especially emergency services. Lab door signs at MS State indicate hazardous chemicals through the use of adapted GHS pictograms. Please bear in mind that labs doors may have additional EH&S signage to communicate other concerns including biological, radiological, or laser hazards. In order to request a new or updated lab sign, please complete the linked [EH&S New Lab Sign Form]().

LABORATORY INFORMATION

IN CASE OF EMERGENCY CALL 911

BUILDING: DEPARTMENT: ROOM:

PRINCIPAL INVESTIGATOR:		(xxx) xxx - xxxx
		(xxx) xxx - xxxx
SECONDARY CONTACTS:		(xxx) xxx - xxxx
		(xxx) xxx - xxxx
		(xxx) xxx - xxxx

ADDITIONAL CONTACTS

DEPARTMENT MAIN OFFICE	(xxx) xxx - xxxx
UNIVERSITY POLICE	(662) 325 - 2121
EH&S MAIN OFFICE	(662) 325 - 0026
FACILITIES MANAGEMENT	(662) 325 - 2005

AUTHORIZED PERSONNEL ONLY

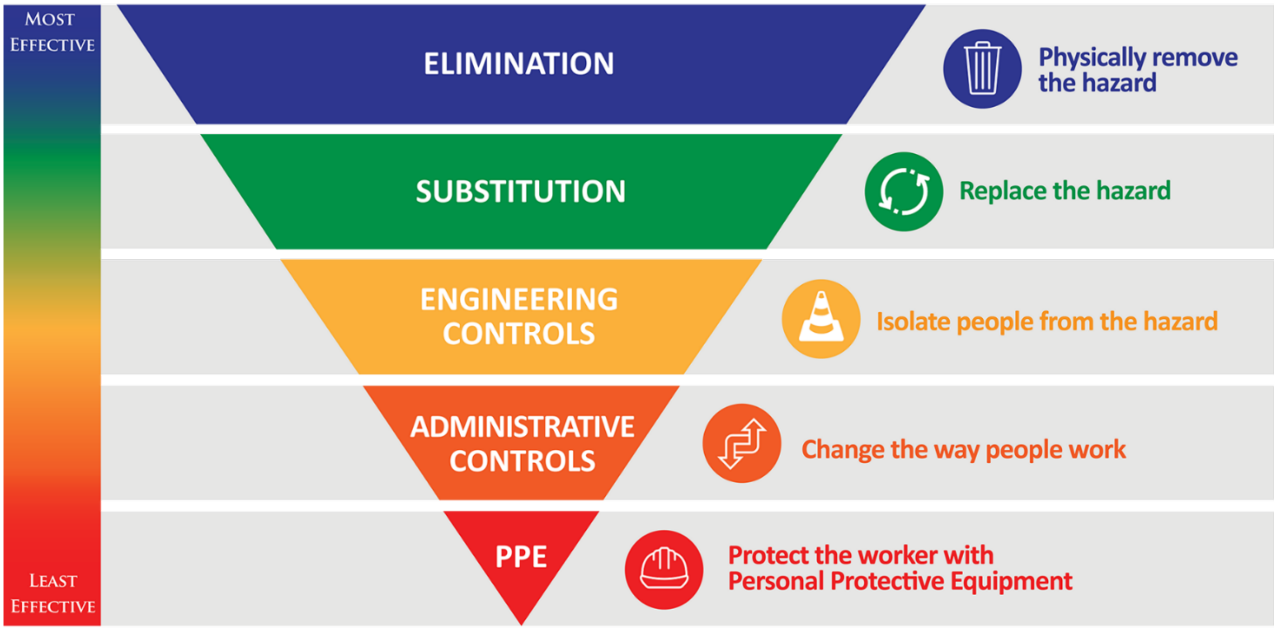
CHEMICAL HAZARDS PRESENT

SAFETY RATING

HAZARD MITIGATION

Hierarchy of Controls

Upon identification of hazards, it is imperative to implement appropriate methods of control in order to minimize risk. The hierarchy of controls categorizes control methods by measure of efficacy.



Elimination

The most efficacious means to mitigate risk is to eliminate the hazard. This involves modifying a work process in order to entirely exclude the hazard.

Substitution

When elimination is not feasible, efforts should be made to substitute hazards with less hazardous alternatives. When considering a substitute, always bear in mind the potential new risks the substitute may impart.

Engineering Controls

Engineering controls are devices or systems that exclude hazards or implement protective barriers between the hazard and personnel. There are an expansive array of engineering controls that may be used to protect workers from chemical hazards. Common engineering control measures are detailed in the subsequent sections.

Access Restriction and Ventilation

Hazardous materials must be appropriately secured. In a laboratory setting, doors leading into rooms that contain hazardous chemicals must be kept closed at all times and locked when vacant. All laboratory rooms in which hazardous materials are used should have fresh air ventilation with 100% of the exhaust venting directly outside, and laboratory rooms should not be integrated in recirculated air systems. In cases where this is not feasible, a formal hazard evaluation will be made by EH&S to determine what work can be done in the space and under what special conditions or limitations. Laboratory rooms should also maintain negative (inward) directional airflow relative to adjoining public access areas. It is imperative to keep lab doors closed in order to help ensure appropriate airflow dynamics are maintained.

Chemical Fume Hoods

Chemical fume hoods are local ventilation devices that provide protection from exposure to hazardous chemicals or otherwise dangerous materials. Fume hoods are comprised of ducted and recirculating (ductless) units. The underlying principle is consistent amongst both types: air is drawn in from the front (open) side of the cabinet, and either expelled outside the building or made safe through filtration and fed back into the room. It is advisable to use a certified fume hood when working with any hazardous chemical. Fume hoods are evaluated for operation and certified by EH&S on an annual basis in accordance with the established Fume Hood Performance Certification standard operating procedure.

General Rules for Chemical Fume Hoods:

- Fume hoods are not to be used for work involving hazardous substances unless they have been certified by EH&S within the last year.
- Each fume hood must be equipped with at least one type of continuous quantitative monitoring device designed to provide the user with current information on the operational status of the hood. The monitoring device must be functional, accurate, and capable of visually/audibly alarming if the unit is not properly working.
- The sash of the chemical fume hood must remain shut when the hood is not actively being used. When is use, the sash should be opened as little as possible to provide maximum worker protection. The chemical fume hood should never be operated with the sash extended beyond the designated maximum operating position(s).
- Never put your head inside a chemical fume hood containing hazardous materials. The plane of the sash is the barrier between contaminated and uncontaminated air.
- Always handle hazardous chemicals more than 6 inches behind the plane of the sash.
- Chemical fume hoods should not be used for storage of any kind. Only items **needed** for the work being conducted should be present in the hood. Items needed in the hood should be placed as far back as possible without blocking the bottom baffle. Equipment should be separated and elevated to allow for air to flow easily around all apparatus.
- Do not obstruct the lower front airfoil or rear baffles. If bench paper is used in the hood, it is essential to ensure that the paper does not obstruct airflow. Bench paper should only be used during a set procedure and removed once the procedure is complete or the paper is contaminated.

- Adjustments to the sash and all movements in the hood should be made slowly as to not increase turbulence and thus reduce the efficiency of the hood.
- Large pieces of equipment should not be used in a chemical fume hood due to the dead space in airflow and reduced efficiency created. If a large piece of equipment emits fumes or produces heat, special-purpose hoods should be designed/installed for that particular device to increase efficiency and decrease energy expenditure.
- Do not make any modifications to chemical fume hoods, duct work, or the exhaust system without first contacting EH&S.

Gloveboxes

Gloveboxes may be used for working with reactive chemicals under an inert environment, working with very toxic substances in a completely closed system, or for providing a static atmosphere for weighing hazardous and/or reactive materials. When properly maintained and used appropriately, these units can provide exceptional containment. Gloveboxes need to be routinely tested for leaks to ensure cabinet integrity. The integrity of the glovebox should be checked prior to each use according to laboratory SOPs specific to the type of glovebox being used.

Canopy Hoods

Canopy hoods utilize a large volume of air to ‘capture’ non-hazardous materials such as heated air or water vapor from ovens, furnaces, autoclave, and other devices. The capture zone of canopy hoods is only a few inches below the opening of the hood. It is important to note that canopy hoods are not suitable alternatives to fume hoods or other hazardous chemical exhausting devices.

Downdraft Hoods

Also known as necropsy tables, downdraft hoods are specially designed areas that have ventilation slots on the sides of the work area. Downdraft hoods are useful for procedures such as animal necropsy where a greater degree of access is needed, relative to the single access face provided by a conventional fume hood. Downdraft hoods should only be used for protection from chemicals that have vapor densities heavier than air (such as formaldehyde).

Gas Cabinets

Highly toxic or flammable gases in compressed gas containers too large (larger than lecture size) to be stored and used in a chemical fume hood should be stored and used within UL approved gas cabinets. Gas cabinets are connected to the ventilation system and protect personnel from exposure in the event of a leak or rupture. The IFC 2012 requires that flammable and toxic gases over the maximum allowable quantity (MAQ) for each fire zone must be stored in a gas cabinet.

Biological Safety Cabinets (BSCs)

Biological safety cabinets provide protection to the user, the environment, and the materials contained within from particulate hazards and contaminants. Although all BSCs afford protection against microbial agents, certain BSC classifications are better suited for handling hazardous chemicals than others. Free-standing Class II Type A BSCs are only suitable for trace amounts of volatile organic chemicals; whereas, canopy "thimble" connected Class II Type A units may permit increased activities involving volatile compounds. Class II Type B BSCs, which have exhaust that is hard-ducted to the facility, are capable of supporting more extensive avenues of work involving hazardous chemicals. Class II Type C units may operate with either recirculating airflow or complete exhaust, so depending upon the operational status, suitability for handing volatile compounds may vary.

Broken Glass Boxes

Broken glassware should be collected separately from other waste to reduce the possibility of individuals being cut by shards of glass while handling waste.

- Clean, non-contaminated broken glass should be stored in a puncture resistant fiberboard box with a heavy plastic liner and clearly marked 'Broken Glass'. Most scientific vendors sell these boxes pre-labeled and with an appropriate plastic liner. When the container is nearly full, it should be taped shut and brought directly to a dumpster for disposal. Custodial staff are not recommended to remove broken glass boxes and containers. Other engineering controls, such as tong or a dust pan and broom, should be used to pick up broken glass to prevent injury.
- Contaminated broken glass should be collected using as sharps container as detailed below.

Sharps Containers

Sharps are defined as any device having corners, edges, or projections capable of cutting or piercing the skin. Sharps notably include, but are not limited to, needles, scalpels, razor blades, and microscope slides. Appropriate means of disposal will vary depending upon application:

- Sharps that are **NOT** contaminated with biological, chemical, or radiological materials should be disposed of in a non-red, unmarked, puncture resistant container. The container should be labeled as 'Non-Hazardous Sharps Waste' and disposed of in a broken glass box when full.
- Sharps that are contaminated with biohazardous materials must be disposed of in accordance with the OSHA Bloodborne Pathogen Standard. Receptacles containing these materials must be labeled with the universal biohazard symbol and treated as infectious waste. The container is considered full when ¾ full, and upon sealing, must be inactivated and/or disposed of in accordance with details outlined in the applicable IBC registration(s) and corresponding Lab-specific Biosafety Plan. For more information, please reach out to the EH&S Biosafety Officer.
- Sharps that are contaminated with hazardous chemicals or drugs should be disposed of in a dedicated puncture resistant container. The Hazardous Waste Officer must be consulted for proper disposal of the waste. Mixing sharps contaminated with different chemicals is not an acceptable practice.
- Sharps that are contaminated with radioactive materials must be disposed of in accordance with the Mississippi State University Radiation Safety Manual. The Radiation Safety Officer should be contacted for assistance.

Administrative and Work Practice Controls

Administrative controls consist of policies, safety guidelines, and safety procedures that work in concert to promote safe conduct. Administrative controls aim to communicate safety considerations, strategies to minimize risk, and detail incident/emergency response procedures. Administrative controls include work practice controls which are intended to reduce the likelihood of adverse events by changing the way a task is performed.

Chemical Inventory

All hazardous chemicals must be accurately inventoried. Among other benefits, an authentic chemical inventory assists with ensuring compliance with regulatory standards, assisting with tracking chemical expiration, and provides a clear picture of hazards in the unfortunate event of an accident or incident. To assist personnel in maintaining an up-to-date chemical inventory, the University utilizes On Site Systems EH&S Assistant software. In addition to managing chemical inventories for each investigator or area, the program also provides a means of controlling excessive inventories of chemicals by facilitating sharing of surplus chemicals resulting in the reduction of purchase and disposal costs. The program will also assist EH&S and emergency responders in the event of an incident involving a facility that houses chemicals by providing the most up to date information on the type of chemicals that are likely to be encountered or involved in the incident.

All departments that use chemicals as part of their function are to actively utilize the EH&S Assistant program as a part of their chemical inventory maintenance. Contact EH&S for enrollment in or assistance with the EH&S Assistant program.

Chemical Labeling

Chemical labels serve as an information source for all personnel who will come into contact with the chemical, including emergency and EH&S personnel. All chemicals must be properly labeled at all times, from the time they are brought onto campus, to the time they are removed for disposal. Federal regulations require manufacturers to provide vital information such as the chemical name, hazard, and handling information. The manufacturer’s label must not be removed or defaced during the life cycle of the chemical. Chemicals that are transferred to a process container or solutions made within the laboratory or work area must also be properly labeled.

The following provides guidelines for the proper labeling of chemicals from the manufacturer and those made in the work area.

Manufacturer Labels

- No chemical shall be accepted into University inventory without an adequate label.
- The manufacturer label must not be defaced during the life cycle of the chemical
- Damaged labels must be replaced as soon as possible.
- Chemicals should be dated when received, opened, and with an expiration date, if applicable. Dating of chemicals is of particular importance for peroxide forming

compounds and other chemicals that become more hazardous over time.

- Good laboratory practices recommend including the last name or initials of the responsible party on the label. This is imperative when storing chemicals in shared storage environments.

"In House' Labels

- If a chemical is repackaged into secondary containers, the new container must be labeled with all essential information from the manufacturer's label [full chemical name, composition of ingredients, CAS #, hazards, date received and opened, and expiration date (if applicable)]. Manufacturer information, catalog number, and lot number may also be included.
- All 'In House' labels for solutions and mixtures must contain the following information:
    1. Full chemical name (no abbreviations or structural formulae)
    2. Concentration of ingredients
    3. Date created (not applicable on hazardous waste containers)
    4. Last name or initials of the responsible party
- Additional recommended information for all 'In House' labels for solutions and mixtures include:
    a. Hazard information
    b. Hazard pictograms, NFPA diamond, or HMIS rectangle
    c. Storage requirements
- Newly synthesized or experimental materials may not have an understandable name and/or the hazards may not be known. These materials must be labeled with:
    1. Known reactants and possible products
    2. Possible hazardous properties
    3. Date of creation
    4. Name of the researcher

    <u>OR</u>

    1. Location in laboratory notebook with information regarding the reaction
    2. Date of creation
    3. Name of researcher
- All bottles and containers in the workplace must be labeled as to the contents to avoid 'unknown' chemicals. This includes items such as distilled water carboys and disinfectant spray/squeeze bottles.
- Damaged labels must be replaced as soon as possible.
- If a chemical is transferred to a process container that will be used within the workday by the person performing the transfer, the process container does not need to be labeled if it is not left unattended.
- Portable containers containing chemicals which are intended for immediate use which will not be left unattended for any length of time do not need to be labeled.

- All information on the labels must be presented in English. Other spoken languages may be added to the label as long as the information is presented in English.
- When labeling samples, the secondary container (box or rack) may be utilized to house the required label information. However, it is vital that the sample could be identified if separated from the secondary container.

Safety Training

Training is a critical component of working safely with and around chemicals in any setting. There are two levels of training: general awareness and area/task/chemical specific. General awareness training is provided by Environmental Health & Safety; whereas, area/task/chemical specific training is provided by the supervisor prior to initiating work or entering a hazardous environment. It is important to note that additional training must be provided to all affected employees when a new hazard or increased hazard is introduced to the work area.

Completion of safety training must be documented. EH&S is responsible for maintaining training records of all general awareness training sessions. Supervisors are responsible for maintaining training records of area/task/chemical specific training.

Annual Hazardous Waste Management training is required for all personnel that generate hazardous waste and/or are responsible for hazardous waste generation areas. The immediate supervisor is responsible for ensuring that all employees that generate hazardous waste receive the training annually. EH&S provides Hazardous Waste Management training online via MyCourses as well as in-person training sessions. Scheduled live sessions may be viewed and enrolled in at ehs.msstate.edu.

Safety Data Sheets (SDSs)

As previously detailed in the HAZARDOUS CHEMICAL IDENTIFICATION section, SDSs convey critical information regarding hazardous compounds to the downstream users. An SDS must be readily available for each hazardous chemical used or stored on University grounds. The SDS can be made accessible electronically, such as in a shared folder/drive or through chemical inventory management software. Alternatively, an SDS may be made available as a hard copy. It is important to note that SDSs must meet current GHS format requirements.

Standard Operating Procedures (SOPs)

Standard Operating Procedures (SOPs) are a set of written instructions that document a routine or repetitive activity followed by a group. SOPs detail regular work processes to facilitate consistent conformance, minimize variation, and promote quality. The key benefits of well-written and properly adhered to SOPs include reduced work effort, improved comparability, credibility, and legal defensibility. Work with all hazardous materials should be outlined in SOPs that cover the associated hazard, procedures in which the hazard is involved, mitigation steps, emergency response, and procedure details. SOPs should be written by individuals' knowledgeable with the activity, applicable University policies, and the risk associated with the hazard. The SOP must contain enough detail so that someone with a basic understanding of the procedure or hazard could successfully reproduce the procedure safely and unsupervised.

Periodic review of SOPs is required to ensure that the information is up-to-date and that appropriate steps have been taken to mitigate risk. Review and revisions of SOPs should be recorded on the SOP. Checklists may be developed to as a part of the SOP to assist users in completing long or complex procedures. Each individual who performs a procedure should document or sign that they are aware and understand the procedure detailed in the SOP.

SOPs are not intended to be used as a substitute for training or mentoring. They are to be used to establish baseline behaviors and enhance consistency and safety when working with hazardous substances.

Departments and individual laboratories should develop SOPs for the specific hazards in their work areas to be used as a part of the guidelines and regulations defined in this manual. EH&S can assist personnel in conducting risk assessments and developing SOPs.

Working Alone

Working with hazardous materials and equipment always poses risks to health and safety. Risks are heightened when working alone due to the lack of immediate assistance in the event of an accident or incident. All efforts should be made to avoid working alone in a laboratory or with chemicals, particularly in an empty building or section of the building. Extreme caution should be taken before working alone in the laboratory. To reduce the risks of working alone:

- Do not perform tasks that are not appropriate for working alone.
- Reduce the amount(s) of hazardous materials used.
- Know the location of, and maintain clear access to, emergency equipment (e.g., safety shower, eye wash, fire extinguisher).
- Check alarm systems (e.g., oxygen sensors) frequently and immediately take action upon alarm activation.
- Implement a buddy system.

Before working alone, it is best to notify someone of your intention to work alone and let them know what you will be doing, where you will be, when you intend to check in or return, and an alternate method to check on you (ex. Lab colleague, University police, etc.). Again, this is not a recommended practice and should be avoided at all costs.

Food and Beverages in Laboratory Settings

Food, beverages, tobacco products, and the application of cosmetics are not permitted to be consumed or utilized in the active workspace where hazardous materials are present. These products present a risk of becoming contaminated with pertinent chemical, biological, and radiological hazards. Food, beverages, eating utensils, plates, and cups should not be present in locations where hazardous materials are stored or in use. Laboratory glassware shall not be used to prepare or consume food or drink, nor should laboratory sinks or drying racks be used to wash utensils, plates and cups. Additionally, dedicated laboratory equipment should never be used to prepare food or drink intended for human consumption.

Hand Washing

One of the most important behaviors that all personnel working with chemicals or in laboratories should develop is washing their hands before leaving the work area and after removing gloves. Washing hands is vital to reducing the risk of contamination. It is important that there is at least one hand washing sink present in every work area, preferably located by the exit door. The sink should contain both hand washing soap and paper towels (or some other method to dry hands).

Laboratory Housekeeping

According to Prudent Practices in the Laboratory, good housekeeping in the laboratory has many benefits. A well-kept laboratory can reduce the number of chemical hazards in the laboratory and help control the risk from hazards that can't be removed. Proper labeling and storage of materials reduces the risk of mixing incompatible materials. In terms of security, a well-organized laboratory makes it easier to spot out-of-place items. A laboratory with good housekeeping is also more likely to have less scientific error from reduced chances of contaminated samples or equipment and mislabeled reagents. Common injuries in the laboratory such as cuts, slips, trips, falls, and back injuries can also be the result of poor housekeeping. The e following are general housekeeping guidelines:

- Work areas should be cleaned up upon the completion of work or the end of the work day. All items should be returned to the proper storage locations.
- Bench tops and chemical fume hoods should not be used as storage locations.
- Chemical bottles should not be stored on the floor unless in secondary containment. Bottles should not be stored in egress pathways.
- Bench liners, if used, should be changed regularly and after any spill or contamination.
- Bench tops and laboratory equipment should be cleaned and/or disinfected after use.
- The floor should be kept dry at all times. Immediately attend to spills of chemicals or water, and notify other workers of potential slipping hazards.

Chemical Storage and Segregation

Proper chemical storage is of great importance to ensure a safe working environment. As previously detailed, Safety Data Sheets (SDSs) should be utilized in all instances to determine classification and ensure compatibility with other chemicals in the area. Prominent chemical classifications and suitable storage locations are detailed in the following table:

Classification	Storage Considerations	Incompatibility
Inorganic Acids 	Corrosive cabinet. Dedicated shelving, cabinets, or secondary containment.	Organic Acids Bases Oxidizers Flammables
Organic Acids 	Corrosive cabinet. Dedicated shelving, cabinets, or secondary containment. UL listed flammable cabinet, if applicable	Inorganic Acids Bases Oxidizers
Bases 	Corrosive cabinet. Dedicated shelving, cabinets, or secondary containment.	Acids Oxidizers Flammables
Flammable Liquids 	UL listed safety cabinet or can. Intrinsically safe fridge/freezer.	Oxidizers Inorganic Acids
Oxidizers 	Oxidizer cabinet. On laboratory shelving or in cabinet (not composed of wood or other combustible materials).	Flammables Reducing Agents
Water Reactive 	UL listed flammable cabinet, away from water and in secondary containment.	Aqueous solutions Acids Oxidizers
Compressed Gas 	Secured at all times. Capped or connected to regulator.	
Flammable Gas 	Secured at all times. Capped or connected to regulator. Staged away from oxidizers.	Oxidizers Combustibles

Chemical Limits and Fire Zones

Mississippi State University is required to follow the International Fire Code regulations which includes classification of chemicals and limits of storage/use for each classification. The International Fire Code (IFC) classification of chemicals and the associated definitions are detailed below in **Appendix A**. The code establishes physical areas called fire zones that meet certain structural characteristics. Each fire zone has a limited quantity called the maximum allowable quantity (MAQ) of each classification of chemical that can be stored/used based upon storage containers, fire protection equipment (i.e. sprinkler systems), and floor level. EH&S has established fire zones and MAQ's for each building on campus. Contact EH&S for information specific to your buildings fire zones and MAQ's.

Hazard-Specific Recommendations

Most, if not all chemicals pose hazards to the users under certain conditions of use. Chemicals that are particularly hazardous should be considered for special precautions and controls to protect the worker and environment. Specific SOPs must be generated for all procedures, and most importantly, those procedures involving particularly hazardous substances. Engineering controls, work practice controls, and PPE should be considered and applied to all procedures involving particularly hazardous substances to reduce exposure to as low a level as possible.

The following are classifications of chemicals that pose specific hazards to the worker and environment and general steps that should be taken to reduce risk. This is by no means an exhaustive list. SDS and best practices should always be consulted in generating SOPs for work with these and all substances. The guidelines listed below are to be used in addition to other guidelines and best practices listed in this manual.

Water Reactive Chemicals

Water reactive chemicals are chemicals such as elementary sodium, potassium and lithium that react violently with water, producing heat and flammable gases. Storage and handling guidelines for water reactive chemicals include:

- Store in a cool and dry location in secondary containment to protect chemicals from accidental wetting from sources such as sprinkler systems.
- The work area (laboratory) and storage location should be marked as containing water reactive chemicals.
- All work should be conducted in a chemical fume hood or in a glovebox when dry atmospheres are required.

Flammable Chemicals

Flammable liquids and solids are among the most common hazardous chemicals present on campus. Precautions must be taken to maintain a safe environment when working with flammable materials.

- Flammable materials should only be handled when no ignition sources are present, including open flames, electrical equipment, hot surfaces, and area's prone to static electricity. The vapor from flammable liquids can travel considerable distances, thus increasing the area at risk of fire.

- Flammable materials should never be heated with an open flame.
- Flammable materials should be handled in a chemical fume hood to prevent an ignitable concentration of vapors.
- Flammable materials cannot be stored in refrigerators or freezers that are not flame-proof or explosion-proof.
- Flammable materials should not be stored in cold rooms or fume hoods.
- Category 1, 2 or 3 liquids (liquids with a flashpoint lower than 100° F) should be bonded and grounded during dispensing. Bonding and grounding is required when dispensing category 1-3 liquids from containers that are ≥4 liters.

Peroxide Forming Chemicals

Peroxide forming chemicals are compounds that can form unstable peroxides which may explode upon impact, heat or friction. The rate of peroxide formation varies depending upon the nature of the chemical, presence of stabilizers, as well as environmental storage conditions. To minimize risk of adverse events, it is important to adhere to the following general precautions and disposal considerations for the defined peroxide forming chemical classifications:

- Date containers when received.
- Date containers when opened.
- Store away from heat and light.
- If crystals are visibly present on or in the bottle or lid, **DO NOT TOUCH**! Contact EH&S immediately for disposal.
- Metal spatulas, stir bars, and other metal equipment should **NOT** be used. Metal contamination may promote unintentional explosive decomposition.
- Dispose of peroxide forming chemicals in accordance with the following parameters outlined per classification.

Class A: Severe Peroxide Hazard

- Chemicals that form explosive levels of peroxides without concentration. Severe peroxide hazard after prolonged storage even if unopened.
- Discard within 3 months of receipt, even if unopened.

Class A Peroxide Formers	
Acetaldehyde diethyl acetal (often referred to as acetal)	Potassium amide
Butadiene (Liquid)	Potassium metal
Chloroprene (Liquid) (2-chloro-1,3-butadiene)	Sodium amide (sodamide)

Diisopropyl ether (isopropyl ether)	Tetrafluoroethylene (Liquid) (TFE)
Divinylacetylene (DVA)	Vinylidene chloride (1,1-dichloroethylene)

Class B: Concentration Hazard

- Chemicals that can form explosive peroxides when concentrated by evaporation, distillation, etc. Repeated opening of their container can allow for evaporation and promote peroxide formation.
- Discard after 6 months of opening, or 12 months if unopened.

Class B Peroxide Formers	
2-Propanol	Cyclohexene
2-Butanol	Decahydronapthalene (decalin)
2-Cyclohexen-1-ol	Diacetylene (butadine, gas)
1-Phenylethanol	Diethyl Ether (ether)
2-Phenylethanol	Dioxanes
2-Heptanol	Diethylene glycol dimethyl ether (diglyme)
2-Hexanol	Ethylene glycol dimethyl ether (glyme)
2-Pentanol	Furan (compounds)
4-Penten-1-ol	Methylacetylene
Acetals	Methyl cyclopentane
Acetaldehyde	Methyl isobutyl ketone (MIBK)
Benzaldehyde	Tetrahydrofuran (THF)
Cumene	Tetrahydronaphthalene (tetralin)
Cyclohexanol	Vinyl ethers

Class C: Shock and Heat Sensitive

- Chemicals which violently auto-polymerize after internal peroxide accumulation.
- Discard after 6 months of opening, or 12 months if unopened.

Class C Peroxide Formers	
Acrylic acid	Styrene
Acrylonitrile	Tetrafluoroethylene (Gas)
Butadiene (Gas)	Vinyl acetate

Chloroprene	Vinyl acetylene
Chlorobutadiene	Vinyl chloride (Gas)
Chlorotrifluoroethylene (Gas)	Vinyl pyridine
Methyl methacrylate	Vinyladiene chloride

Perchloric Acid

Perchlorate salts, also known as perchloric acid crystals, are extremely shock-sensitive and unstable. Perchlorate salts can form during long-term storage if the solution becomes contaminated or if allowed to dry out. Perchlorate salts often form near the bottle neck or cap, presenting a risk of explosion upon opening the container. Perchloric acid must be dated upon receipt and disposed of either within 6 months of opening or upon 1 year of receipt.

Pyrophoric materials

Pyrophoric chemicals are a special class of reactive materials that spontaneously combust when in contact with air due to very rapid oxidation of the compound. Finely divided metals, metal hydrides, alloys of reactive metals, metal salts, and iron sulfide are pyrophoric.

Guidelines on storage and use of pyrophoric materials include:

- Pyrophoric materials should be stored under inert gas or kerosene as recommended by the SDS.
- Pyrophoric materials should NOT be stored with flammable materials or in a flammable cabinet. Pyrophoric materials should be stored in closed secondary containers. Flame- or explosion-proof refrigerators or freezers must be used as opposed to standard refrigerators or freezers.
- Like flammable materials, all sources of ignition should be removed from the storage and handling areas of pyrophoric materials.
- Properly maintained gloveboxes should be used to work with pyrophoric materials if inert or dry atmospheres are required. If chemical fume hoods are to be used, specific work practices must be adopted based upon manufacturer and industry recommendations and standards.
- Flame-resistant laboratory coats must be worn while working with pyrophoric chemicals.

Nanomaterials

Nanomaterials are materials with a typical size in the lower nanometer range and characteristic mesoscopic properties. Nanomaterials can be composed of a wide variety of materials (carbon, gold, silver, and selenium) and shapes (nanotubes, quantum dots, and nanowires). With a size between 1-100nm, the properties of nanomaterials may be vastly different than the bulk material. The risk and toxicity associated with nanoparticles is currently poorly understood or unknown for many substances. With research on the properties and toxicology of nanoparticles ongoing, detailed risk assessments should be conducted to provide protection to the worker and environment from these relatively unknown materials.

General precautions that are to be taken when working with nanomaterials include:

- Materials with a known lower risk should be selected when able over unknown or higher risk materials. Lower risk materials include solid materials with embedded nanostructures or nanostructures affixed to the surface, nanoparticles suspended in liquid, dry dispersible nanoparticles, nanoparticle agglomerates, and nanoparticle aggregates.
- Engineering controls should be utilized to reduce the chance of exposure. Negative pressure gloveboxes, glove bags, hard-ducted BSCs, or chemical fume hoods should be used depending on the type and form of nanoparticle. It is preferred that exhaust from the ventilation equipment be cleaned/scrubbed by filters and released outdoors. HEPA filters should be used to filter air prior to release into the environment.
- At a minimum, non-permeable full-coverage shoes, long pants without cuffs, sleeved shirts, laboratory coats, eye/face protection, and gloves (nitrile at minimum) should be worn for work with nanomaterials.
- Housekeeping practices specific to the type of nanomaterial must be established prior to beginning work.
- All nanomaterials should be considered and disposed of as hazardous waste.

Hydrofluoric Acid

Hydrofluoric acid (HF) is a weak inorganic acid that causes deep, severe burns and toxic effects which if untreated, may be fatal. HF is used to etch glass, clean metal, and as a laboratory reagent. Depending on the concentration, symptoms of HF exposure may be delayed between 1 and 24 hours. When in contact with metals, hydrogen gas is generated, posing an explosion hazard.

Routes and Symptoms of Exposure

Skin Contact: Both the liquid and vapor can cause severe burns that may not be immediately painful or visible. The fluoride ion readily penetrates the skin, causing deep destruction of the tissue. Burns over the body totaling 25 square inches of surface area (approximately the size of the palm of your hand) may also cause hypocalcemia and other fatal toxic effects such as fluoride poisoning. Concentrations over 50% will cause immediate, severe, burning pain, and white discoloration of the skin preceding blister formation. Concentrations between 20-50% will not result in symptoms until 1 to 8 hours after exposure. Concentrations between 0 and 20% will not result in symptoms until up to 24 hours post exposure.

Eye Contact: Contact of liquid or vapor HF can cause irritation, eye burns, and destruction of the cornea.

Ingestion: HF ingestion causes severe mouth, throat, and stomach burns. Ingestion of small, dilute quantities of HF has caused profound and fatal hypocalcemia and systematic toxicity if not immediately treated.

Inhalation: Mild exposure to HF may result in delayed symptoms such as nose, throat, and respiratory system irritation. Severe exposure (LC_{50} = 5,100 ppm/5 min in rats) causes nose and throat burns, lung inflammation, pulmonary edema, hypocalcemia, and systemic toxicity.

Emergency Response

For all potential and known exposures to HF, immediate medical attention must be sought.

Skin: Remove victim from contaminated area and rinse effected area with copious quantities of water for 5 minutes while removing all effected clothing. Immediately apply 2.5% calcium gluconate gel via continuous massage into the area until medical personnel arrive. Work with hydrofluoric acid is NOT permitted without a readily available supply of 2.5% calcium gluconate gel in the immediate area of use. Immediate medical attention must be sought after exposure or potential exposure.

Eyes: Irrigate eyes in eyewash station for a minimum of 15 minutes. Medical attention must be sought.

Ingestion: Drink large amounts of water, milk, or milk of magnesia. Do NOT induce vomiting. Seek immediate medical attention.

Inhalation: Move victim to fresh air and keep calm while awaiting immediate medical attention. If breathing has stopped, start artificial respiration at once.

Spills: For any HF spills, the area must be evacuated and the spill immediately reported to EH&S or MSU Police (after hours).

Guidelines for Storage of and Work with HF

- Regardless of the concentration of the stock solution, an in-date (1 year expiration) 2.5% calcium gluconate gel must be readily available in the HF working area.
- All personnel must be made aware of the hazards associated with HF, proper work procedures for the specific task, and exposure/emergency response (including location of 2.5% calcium gluconate gel, safety shower, and eye wash).
- The SDS for HF must be printed off and easily located in the HF work area. The SDS must be less than 5 years old.
- SOPs must be created for all procedures involving HF that include emergency response protocols.
- Work must be conducted within a properly functioning chemical fume hood.
- Non-absorbent, full-coverage shoes, pants, laboratory coat, acid resistant apron, chemical splash goggles, full face shield, and either 2 pairs of nitrile or neoprene gloves for brief use of dilute solutions (under 20%) or nitrile or neoprene gloves under medium or heavyweight (minimum 22mil thickness) Viton, nitrile, or neoprene gloves. The type and amount of gloves required is dependent upon the concentration being used and the task being performed.
- Work must be conducted during normal working hours while other personnel are available to assist in emergency response.
- All HF solutions must be stored in polyethylene, Teflon, or other compatible materials (no glass or metal).

- HF must be stored in a compatible secondary containment tray.

Compressed Gases

All compressed gasses are hazardous and can create very dangerous working environments if not properly stored, handled, and utilized. The quantity of compressed gases should be kept to an absolute minimum and are subject to IFC maximum allowable quantities (MAQ's) for each fire zone.

There are three major types of compressed gases: liquefied, non-liquefied, and dissolved.

1. Liquefied gases are gases that can become liquids at normal temperatures when under pressure in a cylinder. The gases exist in a liquid-gas equilibrium in the cylinder. Liquefied gas cylinders must be stored in an upright position so that the pressure relief valve is in direct contact with the vapor/gas space of the container. Examples of liquefied gases include anhydrous ammonia, chlorine, propane, and carbon dioxide.
2. Non-liquefied gases are gases that do not become liquid at normal temperatures, regardless of the pressure. Common non-liquefied gases are oxygen, nitrogen, helium, and argon.
3. Dissolved gases are gases that are absorbed into a solvent to increase the stability of the gas. The only common dissolved gas is acetylene, which is dissolved in acetone. Dissolved cylinders must be stored in an upright position so that the pressure relief valve is in direct contact with the vapor/gas space of the container. The discharge pressure must be 15psig or less.

Storage Guidelines for Compressed Gases

Compressed gas tanks must be strapped to a stationary object at all times when not in transport.

- Compressed gas tanks should be secured to a fixed structure (wall or lab bench/ cabinet) by a chain or strap capable of holding the weight of the tank. The chain or strap must be located approximately ¾ the way up the tank and tight enough that rocking of the tank is not possible. Two chains or straps, located at the top and bottom of the tank, may be used as long as they prevent rocking of the tank.
- Only items designed and manufactured to store compressed gas tanks or I-hooks drilled directly into a wall stud or properly anchored can be used. C-clamps attached to bench tops are not appropriate for compressed gas storage.
- A maximum of 3 compressed gases can be chained or strapped together. Tanks must be positioned with at least one side touching a stationary object and the other sides touching another tank or secured by a chain or strap. If multiple tanks are chained or strapped together, the chain or strap must be attached to I-hooks properly secured to the wall or other fixed structure or to a compressed gas wall-mounted bracket.
- If a compressed gas tank storage rack is purchased, the number of tanks held within the rack cannot exceed the manufacturers' storage maximum.
- Items such as rope and bungee cords are not appropriate securing materials.
- These requirements apply to compressed gas storage and filling locations.

The protective cap must be in place when the tank is not in use.

- The protective cap or device must be tightly secured to the tank to protect the valve stem when the tank is not in use or in storage. A tank is considered to be in use if it is connected via an appropriate regulator to a piece of equipment or currently connected for use.

Transportation of compressed gases shall utilize a hand cart/ truck or other mobile device designed for the secure movement of compressed gas tanks or cylinders.

- Carts and trucks approved for moving compressed gas cylinders are designed so that the cylinder/tank are secured against dropping and striking against one another or other surfaces.
- The chains or straps on the hand carts or trucks must be utilized and should be tight against the body of the tank.
- Tanks should not be drug, carried, or transported on devices not designed for such use.

Additional information of proper storage locations and positioning of tanks.

- Compressed gas tanks cannot be stored in egress pathways.
- Compressed gas tanks should be segregated from incompatible materials, extreme temperatures (above 125⁰F or below sub-ambient), falling objects, sources of ignition, or chemicals which could damage the integrity of the tank.
- Tanks should be stored and used in well-ventilated locations.
- If outdoor storage is utilized, tanks must be protected from direct contact with soil or unimproved surfaces. The surface should be graded to prevent the accumulation of water.
- All tanks must be stored in an upright position, unless recommended by manufacturer.
- Full cylinders must be stored separately from empty cylinders. Empty cylinders should be picked up by the distributor as soon as possible.
- Cylinders should be used in the order in which they were received. Only the quantity of cylinders needed for current work should be kept. Unused cylinders and cylinders that have no indented future use must be returned to the vendor.

Cylinder Use Guidelines

- The hazard associated with each gas should be known and understood by all users.
- The hazards associated with using compressed gases with the equipment being used should be known, understood by all users, and written procedures should be followed to mitigate those risks.
- Only the approved CGA regulator for each specific gas may be used. Regulators must be attached prior to opening the gas cylinder valve.
- Do not force cylinder valve connections that do not fit. Thread sealer, Teflon tape, etc. must not be used on valve fittings.
- Open the cylinder slowly after being connected to the process. Check for leaks via an appropriate bubbling solution or gas detector.
- ‘Hard’ piping made of materials such as copper or stainless steel should be used whenever possible. Cast iron pipe and fitting should never be used.
- Teflon tape should be used only on low pressure connections post regulator. All regulator connections need to be direct metal to metal. (Compression fittings)

- If flexible tubing must be used, the tubing must be compatible with the properties of the gas in use and the tubing must remain 'in sight' (not through walls or ceilings). Flexible tubing cannot be used with toxic gases.

Compressed Gas Cylinder Information and Labels

- The shipping label on the shoulder of the tank must indicate the shipping name and identification number. Pure products will also have the grade assigned to the gas on the shoulder.
- The applicable DOT hazardous material placard(s) must be present on the label at all times.

Cryogenic Liquids

Cryogenic liquids, or cryogens, are gases at normal temperatures and pressures but liquids at low temperatures. Cryogens have a temperature roughly below –150°C and very low boiling points. When vented from compressed gas cylinders, cryogens release very cold vapors that condense into highly visible fog. Very small quantities of cryogens 'boil off' into very large volumes of gas.

There are four main hazards associated with cryogens.

1. Physical hazards such as contact burns and asphyxiation are prevalent when working with cryogens.
    - Contact burns are similar to heat burns in which contact can locally freeze and tear or remove skin and damage eye tissue. Due to the nature of cryogens low viscous nature, they will easily penetrate woven and other porous clothing material much faster than water. Touching materials that are kept at these low temperatures can also cause contact burns. The following PPE should be worn while working with cryogens: full-face shield over safety glasses, loose-fitting thermal insulated (cryogenic) gloves, long sleeve shirt and/or laboratory coat, pants without cuffs, and full-coverage non-absorbent shoes. Cryogenic gloves are only intended for short-term contact, not immersion.
    - Cryogens rapidly boil off at room temperature producing large quantities of gas relative to the liquid volume. The gas produces a fog cloud where the vapor is still cold, but expands far beyond the fog cloud. This large and rapid out-put of gas can easily cause asphyxiation of any personnel in the area, especially if the area is not well ventilated. Some gases will displace oxygen in the air. Cryogens should only be released in well-ventilated areas.

Liquefied Gas	Boiling Point Centigrade	Volume Expansion to Gas (L)
Helium-3	-269.9	757 to 1
Helium-4	-268.9	757 to 1
Hydrogen	-252.7	851 to 1
Neon	-245.9	1438 to 1
Nitrogen	-195.8	696 to 1
Argon	-185.7	847 to 1
Oxygen	-183.0	860 to 1
Methane	-161.4	578 to 1
Nitrous oxide	-89.5	666 to 1
Carbon dioxide	-78 5(b)	553 to 1

2. Some cryogens are flammable gases, such as hydrogen, methane, and acetylene, and the flammable concentration of the gas can easily be reached when boiling- off if proper ventilation is not used. Liquid oxygen quickly creates oxygen-rich environments that can cause organic materials to react explosively in some situations. Flammable cryogenic gases and liquid oxygen must be used in intrinsically safe rooms with no flammable or combustible materials. Contact EH&S for assistance in working with cryogenic oxygen and/or flammable gases.

3. Cryogens are under high pressure like all other compressed gases. It is vital that the pressure relief valve is working properly to allow venting of off-gases produced during storage. On average, a 160 liter tank will vent ~2 liters of liquid a day, depending on storage conditions. Excessive venting or ice-build up on vessel wall may indicate an issue with the pressure relief valve. In this instance, the area should be evacuated, marked as hazardous, and the distributor should be contacted to remove the tank.

4. Due to the low temperatures, many materials cannot be used with cryogens. Rubber, plastic, and carbon steel become brittle and can break with minimal stress applied after being exposed to cryogens. Only use materials that are certified by the manufacturer for use with cryogenic materials. All cryogenic material containers must be properly ventilated.

Chemical Waste Management

Hazardous waste may be generated from laboratory operations, construction, maintenance, and renovation activities, photo processing, and a variety of other activities at the University. The proper disposal of waste chemicals is of serious concern, and every effort must be made to do it safely and efficiently. The responsibility for the identification and proper management of waste chemicals within the University prior to pick-up by EH&S rests with the individuals who have generated the waste.

Procedures for Hazardous Waste Generators

The following summary provides a general overview of regulatory requirements applicable to hazardous waste generators.

1. **Waste Identification:** Hazardous waste includes materials that possess hazardous characteristics (e.g. toxic, ignitable, corrosive or reactive), or substances that are listed as hazardous waste by the Mississippi Department of Environmental Quality and the Environmental Protection Agency. EH&S should be contacted if any questions arise as to whether a substance is regulated.
2. **Containers and Labeling:** Separate containers must be used for different types of chemical wastes and the container must be compatible with the waste contained. Only compatible wastes can be consolidated. Empty containers in the lab can be reused for collecting hazardous waste provided that:
    1. No material remains in the container that may be incompatible with the waste to be added.
    2. The material of construction of the container is compatible with the waste to be added.

Any old label or marking on the container not indicative of the waste to be added should be completely removed or, at minimum, taped over or rendered illegible. Any chemicals spilled on the outside of the container must be immediately cleaned off. Containers that store hazardous waste must be properly and clearly labeled. Labels must include:

1. The words "Hazardous Waste";
2. The chemical names of constituents written-out with no abbreviations (e.g. "ethanol").
3. An indication of the hazards. (i.e Toxic, Flammable, Corrosive)

Accumulation & Storage

The U.S. Environmental Protection Agency (EPA) and the state of Mississippi regulations allow for two types of hazardous waste management areas: less than 90-day storage areas (90-day areas) and satellite accumulation areas (SAA). The 90-day storage areas are managed and maintained by EH&S.

SAA must be established at or near the point of generation and remain under the control of the person generating the waste. SAAs must be clearly defined and posted with the sign “Hazardous Waste Satellite Accumulation Area.” EH&S has “Hazardous Waste Satellite Accumulation” signs available upon approval of the proposed area and located in Appendix F. The following are requirements for

SAA:

- A maximum of 55 gallons of hazardous waste or 1 quart of acutely hazardous waste (P- coded) may be accumulated at each SAA. Only one in-use container is allowed per type of waste. Hazardous waste containers must be tightly closed unless waste is actively being added to the container.
- Whenever possible, hazardous liquid waste should be kept within secondary containment. Additionally, containers of incompatible wastes must be kept segregated and stored in separate secondary containers.
- Bulk containers are available from EH&S for cost efficient disposal of large quantities of waste. Containers in size ranging from 5 to 55 gallons are available upon request. Bulk containers will be properly labeled by EH&S staff and the label must not be defaced or edited in any way.
- Hazardous waste containers in SAAs must be labeled as described in the previous section (Procedures for Hazardous Waste Generators).
- Once a hazardous waste container is filled, the container must be removed from the satellite accumulation area within three business days. A bulk container is considered full when the waste is 2 inches from the top of the container. EH&S provides a hazardous waste pick-up service for waste ready for disposal. Hazardous waste pick-up can be requested online at: ehs.msstate.edu or by calling the Environmental Health & Safety at (662-325-0026). An account number to which disposal cost will be charged must be submitted with the pick-up request.

Hazardous Waste Site Inspections

Hazardous waste areas (satellite accumulation areas and 90-day storage areas) must be inspected on a weekly basis. Personnel managing satellite accumulation areas are responsible for conducting their area's weekly inspections. EH&S personnel will conduct unannounced inspections of SAA.

Guidelines for Waste Reduction

A plan for the disposal of all waste should be developed and approved prior to purchasing chemicals or the initiation of a project. Disposing of large quantities of waste can be very costly. It is in everyone's best interest to keep quantities of waste to a minimum.

The following suggestions may help to reduce the quantity of waste:

- Order only the amount of material you need for your project or experiment even if you can get more quantity for the same money.
- Use only the amount of material that is needed for conclusive results.
- Avoid storing excess material, particularly if it is an extremely toxic or flammable material, as this often only adds to the waste stream. The most common laboratory waste from MSU is unopened/ unused chemicals.
- Before disposing of unopened, uncontaminated chemicals check with others in your

department and with EH&S for assistance in finding others who may be able to use them.

- Upon termination of a research project or completion of a thesis/dissertation, all unused chemicals that have no intended use should be disposed of as hazardous waste.
- Make sure all samples and products to be disposed of are properly identified, labeled with its chemical name or contents, and containerized. Do not leave them for others to clean up after you.

Empty Containers

Empty metal or plastic chemical containers may be disposed of as ordinary trash or empty glass chemical containers may be disposed of in a broken glass box if:

- All material has been removed.
- A container which held a potential P-coded (acutely hazardous) waste must be triple rinsed or cleaned by a tested, approved method.
- Pesticide containers must be triple rinsed before disposal. The pesticide rinsate may be tank mixed and applied as a form of disposal. If application is not an option, the rinsate should be collected and disposed of as a hazardous waste.
- Containers that contained corrosive materials must be rinsed prior to disposal.

Disposal Procedures for Specific Materials

- **Gas cylinders** are to be returned to the supplier. Some small lecture bottles are non-returnable, which become a disposal problem when empty or near empty with a residual amount of gas. The Environmental Health & Safety Office will arrange for disposal of lecture bottles. However, the Principal Investigator/Lab Group is responsible for the cost of disposal.
- **DEA controlled substances** to be discarded ***cannot be disposed of as hazardous waste.*** Please refer to Office of Research Compliance & Security guidance regarding controlled substance maintenance, recordkeeping, and disposal.
- **Broken glass or sharp objects** that do not contain radioactive materials, bio-hazardous materials, or regulated chemicals should be placed in a puncture-resistant disposal box. When the box is full, the lid should be taped shut and can then be disposed of as ordinary trash in a MSU owned dumpster. Laboratory personnel are responsible for carrying the box to the dumpster. These boxes should not be placed in the hallway for custodial staff to handle.
- **Used Oil** is oil that is not contaminated with regulated RCRA materials and that is free of PCB materials. Used oil refers to used petroleum products and includes motor oil, hydraulic fluid, vacuum pump oil, etc. It should be placed in a container that must be tightly sealed and labeled “Used Oil”. Containers of 5 gallons or less will be collected by EH&S personnel and disposed of at no charge. Containers larger than 5 gallons will have

disposal fees associated with their disposal. Users generating large quantities of used oil may utilize drums or tanks for collection that must be labeled "Used Oil". All used oil containers must be keep closed at all times unless oil is being added. The area around these drums or tanks must be keep clean at all times and any spillage of used oil must be cleaned up immediately. It is recommended that drums be stored in a covered area if outside, to prevent rainwater from accumulating in the drum. Used oil recyclers will not accept used oil that has become mixed with water and the drum or tank would then be considered and be disposed of as hazardous waste. It is recommended that tanks utilized to collect used oil be less than 660 gallons. If tanks larger than 660 gallons are needed, EH&S personnel must be contacted for additional regulations.

Universal Waste Disposal

Universal waste materials are common commercial items that contain hazardous materials and must be disposed of properly in accordance with RCRA regulations. Following are the two common universal waste streams on campus:

- **Batteries (excluding non-rechargeable alkaline batteries)** Batteries subject to the universal waste regulations include lead-acid (Pb-acid) batteries, lithium (Li-ion) batteries, nickel-metal hydride (NiMH), silver oxide batteries, nickel-cadmium (NiCd) batteries and mercury-containing (Hg) batteries. Batteries are recycled by a third party.
    - For disposal of batteries contact the Environmental Health & Safety Office. You can do this by submitting an online hazardous waste pickup request ehs.msstate.edu or calling the office at (662-325-3294).
- **Fluorescent bulbs that contain mercury vapor** Bulbs that have green tips or green writing are mercury-free and can be disposed of as ordinary trash. Older fluorescent lamps (i.e., without green tips or green writing) and high intensity discharge (HID) lamps will containing mercury vapor and must be disposed of as universal waste.
    - For disposal of fluorescent bulbs, please contact Facilities Management at (662-325-2005).

Personal Protective Equipment (PPE)

Personal protective equipment, or PPE, is the final step in providing protection to a worker from a hazard. PPE is used to protect workers from hazards that engineering controls and work practices cannot reduce to an acceptable level and should be utilized as the last line of defense. PPE differs from engineering controls in that PPE are items that the worker wears to provide protection and engineering controls create a physical barrier between the worker and the hazard.

The PPE to be worn in each work area should be selected based upon the results of a risk assessment completed by the area supervisor. In most cases, all personnel in a set area should be dressed to the highest hazard in the laboratory, not necessarily the hazard they are directly working with.

Appropriate Attire

The clothing that you wear when working provides a barrier between you and the hazards you are working with (chemical, biological, radiological, and physical). Clothing that leaves large areas of skin uncovered is not recommended in areas where hazardous materials are in use. Adequately covering the skin (long pants or skirt, shoes that cover the entire foot, shirts with sleeves) will delay or prevent the hazardous action of all hazards affecting those areas. Open toed shoes, shorts, short skirts, sleeveless shirts, and sandals are not recommended to be worn in laboratories or when working with any chemical. Very tight or loose fitting clothing, jewelry, and loose hair should be avoided. Tight clothing will hold any spilled material against the skin. Loose clothing, jewelry, and hair can be entangled in machinery, accidently come into contact with hazardous materials, or knock items over.

Gloves/ Hand Protection

It is first important to note that **NO** single glove materials can provide protection for all uses. Multiple types of gloves may need to be available and in some cases, more than one type of glove may need to be worn at the same time to protect the worker.

Permeability, degradation, and dexterity are the three main factors to consider when selecting a glove material. Please view the glove comparison chart below for assistance in selecting the proper material for your use. EH&S can assist personnel in selecting the proper glove for hazards and the manner in which the hazard is used.

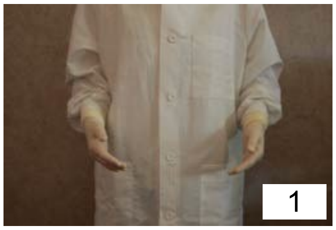
Most laboratories use latex, nitrile, or neoprene gloves which are not intended for re-use. These gloves should be removed, hands washed, and a new pair of gloves put on after any contamination of the gloves. Latex gloves provide poor chemical durability and some personnel may be allergic or develop sensitivities to latex. Latex gloves are not recommended for most procedures.

When wearing re-usable gloves, be sure to inspect gloves for holes or tears before each use and to appropriately wash the gloves after use. A pair of standard gloves, such as nitrile or neoprene gloves, should always be worn under re-usable gloves to prevent accidental skin contact if breakthrough occurs.

Gloves should be removed prior to entering the hallways or touching common items such as door knobs, keyboards, pens, and elevator buttons to prevent the accidental spread of hazardous substances. If transporting laboratory materials through a hallway, non-contaminated secondary containment and/or carts should be utilized so that gloves are not necessary.

Glove Comparison Chart			
Glove Material	**Intended Use**	**Advantages**	**Disadvantages**
Latex	Incidental Contact	- Good for biological and water based materials	-Poor for organic solvents -Little chemical protection -Hard to detect puncture holes -Latex allergies
Nitrile	Incidental and Extended Contact	- Excellent general use glove. - Good for solvents, oils, greases, some acids and bases - Clear indication of tears and breaks	
Butyl Rubber	Extended Contact	- Good for ketones and esters	-Poor for gasoline and aliphatic, aromatic and halogenated hydrocarbons.
Neoprene	Extended Contact	- Good for acids, bases, alcohols, fuels, peroxides, hydrocarbons and phenols. - Good for most hazardous chemicals.	-Poor for halogenated and aromatic hydrocarbons
Norfoil	Extended Contact	- Good for most hazardous chemicals.	-Poor fit.
Viton	Extended Contact	- Good for chlorinated and aromatic solvents.	-Poor for ketones -Expensive
Polyvinyl Chloride (PVC)	Specific Use	- Good for acids, bases, oils, fats, peroxides and amines - Good resistance to abrasions	-Poor for most organic solvents.
Polyvinyl Alcohol (PVA)	Specific Use	- Good for aromatic and chlorinated solvents.	-Poor for water-based solutions
Stainless steel/ Kevlar/ Leather	Cut resistance		
Cryogenic	Cryogenic materials	- Designed to prevent frostbite	
Nomex	Pyrophoric Materials		

It is essential that gloves be properly removed when contaminated or at the end of a procedure to ensure that contamination with the workers skin does not occur. The following pictures demonstrate the proper method to doff (remove) single-use gloves. This method ensures that only gloved hands touch glove and bare hands touch only the inside of the glove and skin.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Eye and Face Protection

The eyes are delicate organs that are very sensitive to irritants. Most substances when in contact with the eye are painful and irritating, and some can cause considerable damage and loss of vision. It is important to protect the eyes at all times with the appropriate level of eye protection for the hazards associated with the laboratory. Eye protection required for each work space should be available for all workers and visitors at the entrance to the space. There are several different types of eye and face protection:

- Safety glasses with side shields provide the minimum protection and are acceptable for regular use. Safety glasses should meet the ANSI Z87.1-2003 Standard for Occupational and Educational Eye and Face Protection.
- Chemical splash goggles are more appropriate protection against projectiles, pressurized equipment or parts, potentially explosive compounds, and glassware at high temperatures.
- Face shields only provide splash and projectile protection to the skin of the face and neck. Face shields do not provide any eye protection.
- When there is a risk of splashing of hazardous material or flying particles, both chemical splash goggles and a face shield should be utilized. Both should also be utilized when working with particularly hazardous operations.
- Special glasses or goggles are required for work with lasers and ultraviolet light sources.

Note that prescription glasses do NOT provide adequate protection in the laboratory or against chemical hazards. Safety glasses or goggles must still be worn. Safety goggles or glasses can be purchased with the users' prescription to lessen the discomfort of wearing two sets of glasses.

The use of contact lenses when working with chemicals are not recommended where chemical vapors are present or if chemical splash or dust is possible. If they are to be worn, chemical splash goggles must be worn as well.

Laboratory Coats, Gowns, and Aprons

Laboratory coats should be worn during most, if not all laboratory procedures and come in a variety of styles and fabrics. Despite the style or fabric, all lab coats should be worn fully buttoned or fastened and the sleeves down to the wrist. Laboratory coats should not be taken home for laundering.

Laboratory coats made of cotton will protect the wearer against general laboratory hazards. If working with flammable materials, cotton laboratory coats with a flame retardant treatment are recommended. Laboratory coats made of synthetic fibers will also protect the wearer against general hazards but they may be degraded by certain solvents and will melt upon contact with flames. A detailed risk assessment will assist laboratory workers in determining the type of fabric desired in a laboratory coat.

Laboratory coats with snaps are preferred over buttons for the snaps allow for a quicker removal of the coat in the event of an emergency. Coats with elastic wrist cuffs provide better protection than coats with a standard seam by allowing the hand and forearm to be continuously covered by the gloves and coat.

Laboratory coats can serve four main protective functions:

1. Protect your clothing from being damaged.
2. Provide an additional layer of material to protect you from spills, splashes and burns.
3. Reduce the chance of taking home hazardous materials on your clothes.
4. Protect your samples and reactions from contaminants on your clothes.

An apron is typically made of non-permeable materials such as plastic or rubber. Aprons provide protection to the torso and legs of the wearer. They can be worn in conjunction with a laboratory coat to provide a non-permeable covering to protect against corrosive or irritating chemicals.

Respiratory Protection

When engineering controls (chemical fume hoods, biological safety cabinets, shielding) and work practices cannot reduce the airborne contaminants below an acceptable concentration, then respiratory protection is required. Respirators should be used as a last resort because of the stress they can place on the respiratory tract of the user and they can be cumbersome to wear.

Please note that surgical masks are not considered to be true respiratory protection because they do not protect the wearer from hazards. Dust masks are not considered to be respirators and do not require fit testing or medical evaluations.

Use of any type of respirators must be based upon a risk assessment conducted by the area supervisor and MSU Respiratory Protection Program Manager. Training and fit testing of respirators must be in accordance with the Mississippi State University Respiratory Protection Program through EH&S.

EH&S LABORATORY SAFETY REVIEWS

EH&S conducts annual Lab Safety Reviews of all University research, academic, and diagnostic laboratories. The Lab Safety Review aims to ensure a safe working environment through the evaluation of facility design features, workplace practices, and other safety considerations. Furthermore, these reviews assist with monitoring compliance with applicable federal, state, or local regulations. For more information regarding the Lab Safety Review process, including a comprehensive checklist, please visit the EH&S Lab Safety Reviews webpage.

EMERGENCY RESPONSE

Accidents can happen at any time and to anyone when working with or around hazardous materials. It is important that all personnel be aware of the proper emergency response procedures. All personnel should know how to report an incident, the location and proper use of safety equipment (safety showers, eye washes, fire extinguishers, and first aid kits), the location of spill kits/control supplies, rally points during building evacuations, and all available exits for evacuation purposes. The following equipment should be present in or near all areas that work with or store hazardous chemicals and other pertinent hazards:

- **Emergency Safety Shower and Eyewash Station:** Safety showers and eyewash stations must be present in any location in which the eyes and/or body of any person may be exposed to injurious chemicals. Safety showers and eyewash stations must be present on the same level as the hazard and the path of travel must be free of obstructions and within 10 seconds (immediate access). If a door is between the hazard and the shower, the door must open in the same direction of travel or it is considered to be an obstruction. An area no less than 36 in^2 (3 $ft^{2)}$ must be clear of all obstructions around the safety shower and eyewash station. The area(s) must be well lit and labeled via a highly visible sign.
    - Emergency safety showers should be used for chemical contact or fire to the body. Affected clothing must be removed as soon as possible.
    - Emergency eyewash stations should be used for any foreign material (solid, liquid, vapor, or mist) in the eye. Eyelids must be lifted and kept open while the victim moves the eyeballs around to ensure adequate washing of the eye. This must occur for a minimum of 15 minutes. Portable eyewash bottles are only meant to provide extra time for the victim to reach a plumbed eyewash station.

- **First Aid Kit:** A first aid kit should be present in each work area to address minor cuts, scrapes and other injuries. A basic first aid kit should include: absorbent compress, adhesive bandages, adhesive tape, antiseptic, sterile pads, triangular bandages, and gloves. No expired materials or ingestible medications are permitted to be located in a first aid kit.

- **Small-Spill Containment/Clean-Up Kit**: Each area should have materials present to assist in containing and cleaning up small spills. Only trained personnel should clean up spills and EH&S must be notified of all chemical, biological, and radiological spills. Clean-up and containment materials must be disposed of according to hazardous waste procedures outlined in this manual. Items for the spill kit can include items such as paper towels, hand broom and dust pan, and tongs or forceps.

APPENDIX

Appendix A. The International Fire Code (IFC) Chemical Classifications

Classification	Definition
Combustible Liquids II	Liquids having a closed cup flash point at or above 100˚F and below 140˚F
Combustible Liquids IIIA	Liquids having a closed cup flash point at or above 140˚F and below 200˚F
Combustible Liquids IIIB	Liquids having a closed cup flash points at or above 200˚F
Corrosive	A chemical that causes visible destruction of, or irreversible alterations in, living tissue by chemical action at the point of contact. A chemical shall be considered corrosive if, when tested on the intact skin of albino rabbits by the method described in DOT 49CFR 173.137, such chemical destroys or changes irreversibly the structure of the tissue at the point of contact following an exposure period of 4 hours.
Explosive	A chemical compound, mixture or device, the primary or common purpose of which is to function by explosion. The term includes but is not limited to dynamite, black powder, pellet powder, initiating explosives, detonators, safety fuses, squibs, detonating cord, igniter cord, igniters, and display fireworks.
Explosive Division 1.1	Explosives that have a mass explosion hazard. A mass explosion is one which affects almost the entire load instantaneously.
Explosive Division 1.2	Explosives that have a projection hazard but not a mass explosion hazard.
Explosive Division 1.3	Explosives that have a fire hazard and either a minor blast hazard or a minor projection hazard or both, but not a mass explosion hazard.

Classification	Definition
Explosives Division 1.4	Explosive that pose a minor explosion hazard. The explosive effects are largely confined to the package and no projection of fragments of appreciable size or range is to be expected. An external fire must not cause virtually instantaneous explosion of almost the entire contents of the package
Explosives Division 1.5	Very insensitive explosives. This division is comprised of substances that have a mass explosion hazard but which are so insensitive that there is little probability of initiation or of transition from burning to detonation under normal conditions of transport.
Explosives Division 1.6	Extremely insensitive articles which do not have a mass explosion hazard. This division is comprised of articles that contain only extremely insensitive detonating substances and which demonstrate a negligible probability of accidental initiation or propagation.
Flammable Liquids IA	Liquids having a closed cup flash point below 73˚F and having a boiling point below 100˚F
Flammable Liquids 1B	Liquids having a closed cup flash point below 73˚F and having a boiling point at or above 100˚F
Flammable Liquids 1C	Liquids having a closed cup flash point at or above 73˚F but below 100˚F
Flammable Solids	A solid, other than a blasting agent or explosive, that is capable of causing fire through friction, absorption of moisture, spontaneous chemical change or retained heat from manufacturing or processing, or which has an ignition temperature below 212˚F or which burns so vigorously and persistently when ignited as to create a serious hazard.
Flammable Gas	A material which is a gas at 68˚F or less at 14.7 psig of pressure which 1. Is ignitable at 14.7 psig when in a mixture of 13% or less by volume with air; or 2. Has a flammable range at 14.7 psig with air of at least 12% regardless of the lower limit.

Classification	Definition
Highly Toxic	A material which produces a lethal dose (LD50) or lethal concentration (LC50) which falls within any of the following categories: 1. A chemical that has a median lethal dose (LD50) of 50 mg or less per kg of body weight when administered orally to albino rats weighing between 200 and 300 g each. 2. A chemical that has a median lethal dose (LD50) of 200 mg or less per kg body weight when administered by continuous contact for 24 hours (or less if death occurs within 24 hrs.) with the bare skin of albino rats weighing between 2 and 3 kg each. 3. A chemical that has a median lethal concentration (LC50) in air of 200 ppm by volume or less of gas or vapor, or 2 mg/L or less of mist, fume or dust when administered by continuous inhalation for 1 hr. (or less if death occurs within 1 hr.) to albino rats weighing between 200 and 300 g each. Mixtures of these materials with ordinary materials, such as water, might not warrant classification as highly toxic. While this system is basically simple in application, any hazard evaluation that is required for the precise categorization of this type of material shall be performed by experienced, technically competent persons.
Organic Peroxide	An organic compound that contains the bivalent -O-O- structure and which may be considered to be a structural derivative of hydrogen peroxide where one or both of the hydrogen atoms have been replaced by an organic radial. Organic peroxides can present an explosion hazard or they can be shock sensitive. They can also decompose into various unstable compounds over an extended period of time.
Organic Peroxides Class 1	Describes those formulations that are capable of deflagration but not detonation.
Organic Peroxides Class 2	Describes those formulations that burn very rapidly and that pose a moderate reactivity hazard.
Organic Peroxides Class 3	Describes those formulations that burn rapidly and that pose a moderate reactivity hazard.

Classification	Definition
Organic Peroxides Class 4	Describes those formulations that burn in the same manner as ordinary combustibles and that pose a minimal reactivity hazard
Organic Peroxides Class 5	Describes those formulations that burn with less intensity that ordinary combustibles or do not sustain combustion and that pose no reactivity hazard.
Organic Peroxides Undetermined	Organic peroxides that are capable of detonation. These peroxides pose an extremely high-explosion hazard through rapid explosive decomposition
Oxidizer	A material that readily yields oxygen or other oxidizing gas, or that readily reacts to promote or initiate combustion of combustible materials and, if heated or contaminated, can result in vigorous self-sustained decomposition.
Oxidizers Class 1	An oxidizer that does not moderately increase the burning rate of combustible materials.
Oxidizers Class 2	An oxidizer that will cause a moderate increase in the burning rate of combustible materials with which it comes in contact.
Oxidizers Class 3	An oxidizer that causes a severe increase in the burning rate of combustible materials with which it comes in contact.
Oxidizers Class 4	An oxidizer that can undergo an explosive reaction due to contamination or exposure to thermal or physical shock and that causes a severe increase in the burning rate of combustible materials with which it comes into contact. Additionally, the oxidizer causes a severe increase in the burning rate and cause spontaneous ignition of combustibles.
Oxidizing Gas	A gas that can support and accelerate combustion of other materials more than air does.

Classification	Definition
Pyrophoric	A chemical with an autoignition temperature in air, at or below a temperature of 130˚F.
Toxic	A chemical falling within any of the following categories: 1. A chemical that has a median lethal dose (LD50) of more than 50mg/kg, but not more than 500mg/kg of body weight when administered orally to albino rats weighing between 200 and 300 g each. 2. A chemical that has a median lethal dose (lD50) of more than 200mg/kg but not more than 1000mg/kg of body weight when administered by continuous contact for 24 hr. (or less if death occurs within 24 hrs.) with the bare skin of albino rabbits weighing between 2 and 3 kg each. 3. A chemical that has a median lethal concentration (LC50) in air of more than 200ppm but not more than 2000ppm by volume of gas or vapor or more than 2 mg/L but not more than 20mg/L of mist, fume, or dust when administered by continuous inhalation for 1 hr. (or less if death occurs within 1hr) to albino rats weighing between 200 and 300 g each.
Unstable (Reactive) Materials	A material, other than an explosive, which in the pure state or as commercially produced, will vigorously polymerize, decompose, condense or become self-reactive and undergo other violent chemical changes, including explosion, when exposed to heat, friction or shock, or in the absence of an inhibitor, or in the presence of contaminants, or in the contact with incompatible materials. Unstable (reactive) materials are divided into 4 classes.
Unstable Class 1	Materials that in themselves are normally stable but which can become unstable at elevated temperatures and pressures.
Unstable Class 2	Materials that in themselves are normally unstable and readily undergo violent chemical change but do not detonate. This class includes materials that can undergo chemical change with rapid release of energy at normal temperatures and pressures, and that can undergo violent chemical change at elevated temperatures and pressures.

Classification	Definition
Unstable Class 3	Materials that in themselves are capable of detonation or of explosive decomposition or explosive reaction but which require a strong initiation source or which must be heated under confinement before initiation. This class includes materials that are sensitive to thermal or mechanical shock at elevated temperatures and pressures.
Unstable Class 4	Materials that in themselves are readily capable of detonation or explosive decomposition or explosive reaction at normal temperatures and pressures. This class includes materials that are sensitive to mechanical or localized thermal shock at normal temperatures and pressures.
Water Reactive Materials	A material that explodes; violently reacts, produces flammable, toxic, or other hazardous gases; or evolves enough heat to cause autoignition or ignition of combustibles upon exposure to water or moisture. Subdivided into 3 classes.
Water Reactive Class 1	Materials that react with water with some release of energy, but not violently.
Water Reactive Class 2	Materials that react violently with water or have the ability to boil water. Materials that produce flammable, toxic, or other hazardous gases, or evolve enough heat to cause autoignition or ignition of combustibles upon exposure to water or moisture.
Water Reactive Class 3	Materials that react explosively with water without requiring heat or confinement.