# Standards of Laboratory Safety – Quick Tips

OSHA adapted a general standard for occupational exposure to hazardous chemicals in laboratories. This standard recognizes the unique characteristics of working in a laboratory. The goals of the OSHA Laboratory Standard are to reduce the risk of injury or illness to laboratory workers by ensuring that they have the information, equipment, training and support required to work safely. Failure to comply could result in heavy fines, especially EPA infringements regarding hazardous waste regulations. Even fines for minor violations can be financially crippling, so pay close attention to compliance requirements.

Lab safety programs should be tailored to the work and experiments done there. Chemical experiment planning decisions are affected by a company's personnel knowledge and skill level, the experiment size and scale, the chemical hazards or the operations being considered, company policies and environmental regulations that might apply.

The following outline provides an overview of information that can be included in a company's or institution's lab safety program.

1. **OSHA Standard, Policies and Responsibilities**

- OSHA Laboratory Standard
- Company Policies
- Employee Roles and Responsibilities

1. **Chemical Hygiene Plan**

- Standard Operating Procedures or SOPs
- Employee Exposure/Controlling Chemical Exposure
    - Exposure Monitoring
    - Engineering Controls
    - Fume hoods and Laboratory Ventilation
    - Personal Protective Equipment or PPE
    - Administrative Controls
- Chemical and Hazard Identification
- Information and Training
- Record Keeping, Lab Inspections and Audits
- Emergency Procedures and Response

- Fire or Explosion
- Medical Injury or Poisoning
- Chemical Personal Exposure/Response
- Spill Control Response
- Accident Reporting

**III. Laboratory Equipment**

1. **Laboratory Waste Disposal**
2. **OSHA Lab Standard, Policies and Responsibilities**
   The OSHA Lab Standard helps ensure that laboratory workers understand the hazards of chemicals in their workplace and are protected from chemical exposure exceeding allowable levels, OSHA Permissible Exposure Limits. While on the job, lab workers have a “right-to-know” the types of hazards they may encounter. One key component of The Laboratory Standard is the Chemical Hygiene Plan. The OSHA Laboratory Standard requires that Chemical Hygiene Plans include specific elements and measures to promote employee safety in the laboratory. All individuals who work with hazardous chemicals in science and engineering laboratories should comply with the Lab Standard.

**Company policies**
Companies should have a written health, safety and environmental affairs (HS&E) policy statement. Companies can organize an HS&E committee consisting of employees, management, faculty, staff and students who can meet regularly to discuss HS&E issues. Companies should develop an HS&E orientation for all new employees and/or students.

**Roles and Responsibilities**
There are four typical roles involved in laboratory safety; the Chemical Hygiene Officer, a Supervisor or Principal Investigator, Environmental Health and Safety Personnel, and the Laboratory Worker.

The **Chemical Hygiene Officer** is responsible for developing and implementing the Chemical Hygiene Plan.

The responsibilities of a **Supervisor or Principal Investigator** may include sending laboratory workers to additional lab safety training. This might include: chemical awareness; procedural safety; understanding engineering controls; personal protective equipment needed to work safely with hazardous materials; and how to use equipment safely. They may also have laboratory workers complete hazardous substance approval forms and submit them for approval before using any particularly hazardous substance.

**Environmental Health and Safety Personnel** responsibilities typically include providing training, resources and consultation for a variety of laboratory safety issues. This might include chemical safety, biological safety, electrical safety, laser safety, radiation safety or other related topics. They may review the Chemical Hygiene Plan, develop and maintain laboratory safety manuals, conduct exposure monitoring, inspect fume hoods annually and perform safety audits.

**Laboratory workers** prepare and conduct experiments and actively monitor conditions. They participate in and contribute to the planning process.

The highest level of leadership must introduce and support effective implementation of lab review programs. Individuals who supervise laboratory activities should be responsible for supporting functions and individuals. While laboratory workers prepare and conduct experiments, the laboratory supervisor determines what level of planning is required. They are accountable for required training, documentation and compliance with regulations. Each worker should be responsible for safety and for a specific role in the experiment.

1. **Chemical Hygiene Plan**
   Under the Laboratory Standard, employers that use hazardous chemicals in the laboratory must develop and carry out the provisions of a written chemical hygiene plan (CHP). The CHP must include the necessary work practices, procedures, and policies to ensure that employees are protected from all potentially hazardous chemicals in their laboratory. Complete hazard assessments should be made for all chemicals, materials and any other products associated with experiments or procedures. Employers are required to develop and carry out a written CHP that addresses all aspects of the Laboratory Standard. The laboratory is regulated under the general industry standards if a company does not have a fully implemented written plan.

**Standard Operating Procedures**
A requirement of the CHP is to develop Standard Operating Procedures (SOP) relevant to safety and health considerations to be followed when laboratory work involves the use of hazardous chemicals. This is especially the case when select carcinogens, reproductive toxins and substances that have a high degree of acute toxicity are present. SOP can be stand-alone documents or supplemental information included as part of research notebooks, experiment documentation, or research proposals. Operating procedures should help ensure a process is in place so that an experiment is well-planned and includes and addresses relevant health and safety issues.

**Employee Exposure/Controlling Chemical Exposure**
CHP also requires monitoring, measuring and controlling employee exposure to chemicals in the lab.

1. **Exposure Monitoring** can be conducted by Environmental Health and Safety personnel if there is reason to believe that exposure levels for a particular substance may routinely exceed either the action level or the permissible exposure limit set forth by OSHA. Based on the results, periodic monitoring may be scheduled at the discretion of health, safety and environmental affairs personnel in accordance with applicable federal, state and local regulations. Air can be monitored in several different ways. To determine a workers chemical exposure, diffusion detector tubes, vapor monitoring badges or personal air sampling pumps can be used. Detector tubes and pumps, hand-held electronic monitors or fixed, wall-mounted electronic monitors can be used to monitor specific areas. Employers must provide monitoring results to employees within a specific time frame and keep records of exposure monitoring, medical consultations and exams.
2. **Engineering Controls** are the primary means of control for exposure to hazardous chemicals. They include local ventilation, including fume hoods, ducted safety cabinets, glove boxes, vented storage cabinets, and vented canopies. A member of the safety committee or EHS can provide help

determine the appropriate type of engineering controls for specific operations. Some engineering controls include providing secure, adequately spaced, well ventilated storage of chemicals, providing fireproof cabinets for storage of flammable chemicals, allowing only minimum amounts of flammable liquids in each laboratory, storing acids and bases separately and storing fuels and oxidizers separately.

3. **Fume Hoods and Laboratory Ventilation** A chemical fume hood is critical in a lab. A well-designed hood, when properly installed and maintained, offers a large degree of protection to the user, provided that it is used appropriately and its limitations are understood. A fume hood is a ventilated enclosure in which gases, vapors and fumes are contained. It is used to control chemical exposure to the user and lab occupants and helps prevent chemical release into the laboratory. A fume hood can also limit the effects of a spill by partially enclosing the work area and drawing air into the enclosure through an exhaust fan. An exhaust fan installed on top of the laboratory building pulls air and airborne contaminants through ductwork out of the building. In a well-designed, properly functioning fume hood, only about 0.0001% to 0.001% of the material released within the hood actually escapes from the hood into the laboratory.

   A hazard analysis can help determine if a fume hood is necessary for an experiment. Such an analysis should include: a review of the physical characteristics; the quantity and toxicity of the materials to be used; the experimental procedure; the volatility of the materials present during the experiment and the probability of their release; the number and sophistication of manipulations; and the skill level of the person performing the work.

   Many laboratories use equipment and apparatuses that can generate airborne contaminants, but cannot be used within a fume hood. Examples include gas chromatographs, ovens, and vacuum pumps.

4. **Personal Protective Equipment** Personal protective equipment (PPE) is  gear used to protect the wearer from a hazardous chemical. It is a protection system used as a last resort, when substitution or engineering controls are not an option. PPE does not reduce or eliminate the hazard; it helps protect the wearer. PPE includes eye protection, respiratory protection, protective clothing and shoes and gloves. The need for PPE is dependent upon the type of operations and the nature and quantity of the materials in use, and must be determined on an individual basis. Personal protective equipment must be carefully selected to ensure that it is compatible with the chemicals used. Workers who rely on PPE must understand the functioning, proper use, and limitations of the PPE used.
5. **Administrative Controls** It may be necessary to supplement engineering controls and PPE with administrative controls, like restricting access to an area, restricting the use of particular chemicals to a specific group of people, or limiting the time workers are exposed to chemicals.

**Chemical and Hazard Identification**

Chemical manufacturers or distributors perform an assessment of the physical and health hazards of each chemical they produce. This information is included in a material safety data sheet (MSDS) and partial information contained on the MSDS is also listed on container labels. The information found on the original container label and the MSDS may provide a great deal of information about the

identity of the chemical constituents and their health and physical hazards. The manufacturer or distributor is required to provide an MSDS with the initial shipment of their products. Any MSDSs received by a laboratory must be maintained in a central location in the laboratory or department and be readily available to laboratory workers. The Chemical Hygiene Plan should outline what to do with MSDSs received by a laboratory. The manufacturer's label should always be kept intact. When a chemical is transferred to another container for storage, the new containers should be labeled with the name of the product, the chemical constituents, any hazard warnings and the appropriate precautions.

**Information and Training**

Employers must provide information and training regarding safe work practices for employees on such issues as: hazard awareness; handling of chemicals; procedures and permissible exposure limits; health and hygiene; physical hazards; electrical safety; emergency procedures; personal protective equipment; working alone in the laboratory; laboratory security;, and handling visitors to the lab. Laboratory workers may need very specific training on safe work practices when working in areas such as controlled environments and cleanrooms. Employees should learn and be aware of the location of the Chemical Hygiene Plan, the Laboratory Standard and all pertinent MSDS information and be familiar with the details and contents.

Employers should schedule regular departmental safety meetings for all students and/or employees to discuss the results of inspections and aspects of laboratory safety. Employers should also forbid employees from working alone in any laboratory or if this is impossible, employees should always alert a staff member when working alone. Experiments should not be allowed to run unattended unless they are failsafe. Good housekeeping practices should be performed in all work areas.

**Recordkeeping**

It is essential for any lab where chemicals are used to keep accurate records such as MSDS, Certificates of Analysis, lab analysis documentation, logs of chemical usage, cleaning logs and maintenance logs. This information can be used in inspections and audits.

Laboratory supervisors are responsible for the health and safety conditions in the laboratories under their management. An important tool in managing this responsibility is the laboratory self-inspection. Properly conducted, self-inspections help ensure healthful working conditions and improve regulatory compliance. The laboratory supervisor is responsible for correcting all problems found during these audits, and for maintaining copies of self-inspection checklists and forms. These forms should be available for review by lab workers, other company personnel and external auditors.

If your company requires laboratory auditing as part of its qualification or quality policy, the lab supervisor or manager should develop a well-defined laboratory Audit Plan. Some aspects that this laboratory Audit Plan should address include: the audit purpose; identification of laboratory auditors and responsibilities; scope; objectives; requirements; and criteria for the laboratory audit. Once the laboratory Audit Plan is approved, communication of plan, an audit schedule and checklist help set expectations.

**Emergency Procedures/Response**

Spills and chemical exposure can occur if chemicals are transported incorrectly, even when moving chemicals only a short distance within the lab. Regulations require companies and institutions to develop plans and conduct drills for dealing with emergencies such as fire, explosion, accidental poisoning, chemical spill or vapor release, electric shock, bleeding and personal contamination. Individual departments should have a written emergency action plan, a designated emergency coordinator and a designated assembly point. The emergency coordinator is the first point of contact for questions about the emergency procedures and the emergency action plan. A designated assembly point is where building occupants should gather in the case of a building evacuation. Make sure you are accounted for before leaving the assembly point. Rescue personnel are required to enter a building and search for individuals who are thought to still be in the building. Be sure to familiarize yourself with the emergency action plan for your department.

Employers must provide appropriate safety equipment and first aid kits in case of emergency. Safety equipment may include fire extinguishers, fire blankets, AEDs, safety showers, eye wash fountains, spill control materials and fume hoods. These items should be tested or checked monthly. An appropriate supply of first aid equipment should be provided as well as instructions for their proper use.

**What To Do in the Event of:**

1. **Fire or Explosion**
   Dial 911. If fire or explosion occurs, public safety should be notified immediately.. Notify a supervisor or manager in charge immediately so that emergency procedures can be followed.
2. **Medical Injuries or Chemical Poisoning**
   Dial 911. If any injury or illness occurs and assistance is needed, contact public safety. If an ambulance is needed, public safety will arrange for one. Poison Control may also be contacted. Notify a supervisor or manager in charge immediately so that the appropriate emergency procedures can be followed.
3. **Personal Chemical Exposure/Response**
   How a chemical exposure affects a person depends on many factors. The dose is the amount of a chemical that actually enters the body. The actual dose that a person receives depends on the concentration of the chemical and the frequency and duration of the exposure. The sum of all routes of exposure must be considered when determining the dose. In addition to the dose, the outcome of the exposure is determined by (1) the way the chemical enters the body, (2) the physical properties of the chemical, and (3) the susceptibility of the individual receiving the dose. In all cases, the incident should be reported to your laboratory manager, supervisor or principal investigator, regardless of severity.
4. **Chemicals on Skin or Clothing**
    1. Immediately flush with water for no less than 15 minutes (except for Hydrofluoric Acid, Flammable Solids or >10% Phenol). For larger spills, the safety shower should be used.
    2. While rinsing, quickly remove all contaminated clothing or jewelry.
    3. Use caution when removing pullover shirts or sweaters to prevent contamination of the eyes.
    4. Check the Material Safety Data Sheet (MSDS) to determine if any delayed effects should be expected.

5. Discard contaminated clothing or launder them separately from other clothing. Leather garments or accessories cannot be decontaminated and should be discarded.

5. **Spill Control Response**
   The complexity and detail of the emergency plan will depend on the physical characteristics and volume of materials handled, their potential toxicity, and the potential for releases to the environment. An effective spill response procedure should consider all of the following:

   1. Review Material Safety Data Sheets (MSDSs) or other references for recommended spill cleanup methods and materials, and the need for personal protective equipment, respirators, gloves, protective clothing, etc.
   2. Acquire sufficient quantities and types of appropriate spill control materials to contain any spills that can be reasonably anticipated. The need for equipment to disperse, collect and contain spill control materials brushes, scoops, sealable containers should also be reviewed.
   3. Require proper use of recommended personal protective equipment and training. For example, if an air purifying respirator or self-contained breathing apparatus are needed, personnel must attend annual training and fit-testing.
   4. Position spill control materials and protective equipment in a readily accessible location within or immediately adjacent to the laboratory.
   5. Develop a spill response plan that includes:
      - Contact information for the individuals to be contacted in the event of a spill
      - Evacuation plans for the room or building, as appropriate
      - Instructions for containing the spilled material, including potential releases to the environment, protect floor drains
      - Inventory of spill control materials and personal protective equipment
      - Means for proper disposal of cleanup materials (in most cases, as hazardous waste) including contaminated tools and clothing
      - Decontamination of the area following the cleanup

Your laboratory or work area should have access to sufficient quantity of sorbents or other types of materials to control any spill that can be reasonably anticipated. Absorption and neutralizing materials may include acid neutralizer, caustic neutralizer and solvent neutralizer. For mercury spills, necessary clean up equipment may include a small mercury vacuum, Hg Absorb Sponges, Hg Absorb Powder, Hg Vapor Absorbent and Mercury Indicator.

1. **Accident reporting**
   All accidents, injuries, or close calls should be reported to your supervisor or principal investigator. Companies may require that all incidents be reported, evaluated by the departmental safety committee, and discussed at departmental safety meetings.

**III. Laboratory Equipment**

Laboratory equipment may include refrigerators, centrifuges, microscopes, glassware, vacuum systems, stirring and mixing devices, heating devices and autoclaves. Laboratory workers should be trained in their use and know the possible hazards when working with this equipment. Laboratory workers should follow cleaning, maintenance and calibration schedules to ensure all lab

equipment is working properly.

Electrically powered equipment, such as hot plates, stirrers, vacuum pumps, electrophoresis apparatus, lasers, heating mantles, ultrasonicators, power supplies, and microwave ovens are essential elements of many laboratories. These devices can pose a significant hazard to laboratory workers, particularly when mishandled or not maintained. Many laboratory electrical devices have high voltage or high power requirements, carrying increased risk. All electrical connections should be removed from the inside of chemical refrigerators and magnetic closures should be required. Temperature monitoring may be required for incubators, refrigerators and freezers. Require grounded plugs on all electrical equipment and install ground fault interrupters (GFIs) where appropriate.

Compressed gases can be toxic, flammable, oxidizing, corrosive, inert or a combination of hazards. In addition to the chemical hazards, compressed gases may be under a great deal of pressure. The amount of energy in a compressed gas cylinder makes it particularly dangerous. Appropriate care, handling and storage of compressed gas cylinders is essential. Always secure all compressed gas cylinders.

Working with hazardous chemicals at high or low pressures requires planning and special precautions. Procedures should be implemented to protect against explosion or implosion through appropriate equipment selection and the use of safety shields. Care should be taken to select glass apparatus that can safely withstand designated pressure extremes. Always provide safe guards on all vacuum pumps. Vacuum work can result in an implosion and the hazards of flying glass, splattering chemicals and fire. All vacuum operations must be set up and operated with careful consideration of the potential risks. Equipment at reduced pressure is especially prone to rapid pressure. Such conditions can force liquids through an apparatus, which can also be dangerous.

1. **Laboratory Waste Disposal**
   Systems should be developed for the legal, safe and ecologically acceptable disposal of chemical wastes. In order to responsibly manage chemical waste, each employee should be familiar with the following: hazardous waste characteristics, properly packaging hazardous waste, effective labeling and following waste collection protocol. It is beneficial to maintain a chemical inventory to avoid purchasing unnecessary quantities of chemicals. Date stored chemicals and re-certify or discard them after predetermined maximum periods of storage. Other questions that may arise are: What are the procedures and company policy for drain disposal of chemical waste? What is the proper procedure for the disposal of empty chemical containers? Always follow federal, state and local guidelines for proper disposal of batteries, item mercury containing items, used oil and the recycling of silica gel as well as other chemicals.

Related EZ Facts Topics

208 First Aid Regulation, 29 CFR 1910.151 and Z308.1-2003 Summary
240 Personal Protective Equipment Standards
190 Selecting Chemical Protective Clothing
145 Fume Extraction: Engineering Controls for Reducing Employee Chemical Exposure
120 Emergency Eye/Face Wash/Shower Requirements

200 Hazard Communication Labeling
147 Spill Cleanup: Assessing Your Needs and Choosing the Right Sorbents

**Source**

OSHA Standard 1910.1450 Occupational Exposures to Hazardous Chemicals in Laboratories



Source: Grainger Know How – https://www.grainger.com/know-how