2nd Version (2023)

Laboratory Safety Manual

Mutah University

College of Engineering

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Foreword

Welcome to this manual, which focuses on ensuring your safety during laboratory and engineering workshop activities within the College of Engineering.

As engineering students and professionals, you will undoubtedly engage in experiments and projects that involve various materials, equipment, and processes. While these experiences are essential for your academic and professional growth, they also come with inherent risks. Understanding and mitigating these risks is paramount to ensuring a safe and productive learning environment.

This manual aims to equip you with a solid foundation in laboratory safety practices. It will familiarize you with potential hazards, safe handling of chemicals, appropriate conduct in labs, emergency protocols, and preventive measures to minimize accidents and injuries. To achieve this, we need your full cooperation. Please take the time to carefully read this manual and direct any safety-related inquiries to your laboratory's supervisor in charge or the Faculty Safety Officer.

We wish you a fulfilling and safe learning experience as you embark on your engineering journey. Together, let us make safety an integral part of our pursuit of knowledge and innovation.

ALL laboratory users need to fill up the following form before commencing the lab works. Handle the signed form to your lab supervisor:

Laboratory Safety Acknowledgment Form

Course number (for undergraduate student):

Laboratory name:

I,

declare that:

1. I have read the Laboratory Safety Manual ☐
2. I have read the relevant SDS / MSDS for each chemical to be used ☐
3. I have understood the importance of being safe in the laboratory ☐
4. I will abide by all guidelines and rules listed in this manual ☐

Signature of student or research personnel Date

Signature of Lab Supervisor Date

By signing this form, individuals acknowledge their responsibility for practicing safe behaviors and adhering to safety protocols while working in the laboratory. The form serves as evidence of their commitment to safety and is often required before they are allowed to work in the laboratory.

1. GENERAL LABORATORY SAFETY RULES

- ✓ **Follow Instructions**: Always adhere to the instructions provided by your professors, instructors, or supervisors. Never deviate from approved procedures or protocols.

- ✓ **Protective Clothing**: Wear appropriate personal protective equipment (PPE) such as lab coats, safety goggles, gloves, and closed-toe shoes to minimize the risk of chemical contact or injury.

- ✓ **No Food/Drinks and No Smoking**: Never consume food or drinks inside the laboratory to prevent accidental ingestion of chemicals or contamination.

  In addition, smoking, is prohibited.

- ✓ **Chemical Handling**: Handle chemicals with caution, and be aware of their potential hazards. Always use proper labeling and storage techniques.

- ✓ **Emergency Equipment**: Familiarize yourself with the location and operation of emergency equipment, including fire extinguishers, and safety showers.

- ✓ **No Unauthorized Experiments**: Perform only authorized experiments and procedures. Do not conduct any experiments without proper approval and supervision.

- ✓ **Keep Workspaces Clean**: Maintain a tidy work area, free of clutter and unnecessary items. A clean environment helps prevent accidents and allows for easy access to emergency equipment.

- ✓ **No Horseplay**: Refrain from engaging in horseplay or practical jokes inside the laboratory. Such behavior can be dangerous and lead to accidents.

- ✓ **Proper Waste Disposal**: Dispose of hazardous waste according to established guidelines and protocols. Do not dispose of chemicals or other hazardous materials in regular trash bins.

- ✓ **Report Incidents**: Immediately report any accidents, spills, or injuries to your instructor or supervisor. Prompt reporting is essential for timely assistance and mitigation.

- ✓ **No Unauthorized Personnel**: Restrict laboratory access to only authorized personnel. Visitors or untrained individuals should not be allowed in the lab.

- ✓ **Know Emergency Procedures**: Familiarize yourself with emergency procedures, including evacuation routes and assembly points in case of fire or other emergencies.

- ✓ **No Mouth Pipetting**: Never use your mouth to pipette chemicals. Always use proper pipetting devices and follow safe pipetting practices.

- ✓ **Electrical Safety**: Be cautious with electrical equipment and cords. Inspect them for damage before use, and never use equipment with frayed or exposed wires.

- ✓ **No Loose Clothing or Jewelry**: Avoid wearing loose clothing, jewelry, or anything that could get entangled in equipment.

- ✓ **Monitor Experiments**: Keep a close eye on ongoing experiments and never leave them unattended.

2. WORKING TIME IN LABORATORIES

Undergraduate students should note that:

- their laboratory working times are allocated in their academic timetable

- they are allowed to work in laboratories only under the supervision of the professor in charge or Lab supervisor.

- they are not permitted to work in laboratories outside their allocated schedules, except after obtaining permission from the professor in charge, and the Chair of the Department.

3. PERSONAL PROTECTION

These requirements typically include the use of various personal protective equipment (PPE) based on the specific hazards present in the laboratory.

- ✓ **Lab Coats or Protective Clothing**: Lab coats or other protective clothing should be worn to shield the body and regular clothing from chemical spills, splashes, and other potential contaminants.

- ✓ **Safety Goggles or Face Shields**: Safety goggles, Safety glasses or Face Shields are necessary to protect the eyes and face from chemical splashes, flying debris, or any other potential eye hazards.

- ✓ **Gloves**: Disposable or chemical-resistant gloves must be used when handling hazardous materials, chemicals, or biological agents to prevent skin exposure and contact.

- ✓ **Respirators**: In environments where airborne contaminants are present, appropriate respirators may be required to protect the respiratory system from inhalation hazards. The type of respirator required will depend on the specific airborne contaminants.

✓ **Footwear**: Closed-toe and non-slip footwear should be worn in the laboratory to protect the feet from spills, dropped objects, and potential chemical exposure.

Wearing open-toed shoes, sandals, high heeled shoes, thongs, or with bare feet will be prohibited entering the laboratories

✓ **Ear Protection**: In labs with loud equipment or noise, ear protection, such as earplugs or earmuffs, may be required to prevent hearing damage.

✓ **Hair Restraints**: Long hair should be tied back or covered to prevent it from getting caught in equipment or coming into contact with chemicals.

✓ **Appropriate Clothing**: Avoid wearing loose clothing, jewelry, or accessories that could become entangled in equipment or pose a safety risk.

✓ **Face Masks**: In some cases, face masks may be necessary, particularly in laboratories working with biological agents or when respiratory protection is required.

4. HOUSEKEEPING

Maintaining good housekeeping in laboratories is crucial for creating a safe and efficient working environment. Here are some general rules for housekeeping in laboratories:

- ✓ **Keep Workspaces Clean**: Regularly clean and organize work areas, benches, and equipment to minimize clutter and potential hazards.
- ✓ **Proper Storage**: Store chemicals, reagents, and equipment in designated areas with proper labeling and appropriate storage conditions.
- ✓ **Clean Spills Immediately**: Any spills, whether chemical or biological, should be cleaned up promptly and according to established protocols.
- ✓ **Waste Disposal**: Dispose of hazardous waste in accordance with safety guidelines and waste management procedures. Separate and label waste containers correctly.
- ✓ **Keep Emergency Exits Clear**: Ensure that emergency exits, aisles, and pathways are unobstructed and easy to access at all times.
- ✓ **Personal Items**: Store personal items such as bags, jackets, and belongings in designated areas outside the laboratory.
- ✓ **Equipment Maintenance**: Regularly inspect and maintain laboratory equipment to ensure proper functioning and safety.
- ✓ **No Unauthorized Equipment**: Do not bring or use personal equipment without proper authorization or approval.
- ✓ **Report Hazards**: Immediately report any damaged equipment, potential hazards, or unsafe conditions to supervisors or the safety officer.
- ✓ **Scheduled Cleaning**: Establish a regular cleaning schedule for the entire laboratory, including work surfaces, floors, and storage areas.
- ✓ **Regular Inspections**: Conduct regular inspections of the laboratory to identify and address potential safety and housekeeping issues.
- ✓ **Chemical Compatibility**: Store chemicals in a way that ensures compatibility to prevent accidental reactions.

5. PREVENTION OF FIRE

Preventing fires in the laboratory is of utmost importance to ensure the safety of personnel, protect valuable equipiment, and maintain a secure working environment. Here are some general rules for fire prevention in laboratories:

- ✓ **No Open Flames or Smoking**: Avoid open flames and smoking in the laboratory. Use non-sparking equipment for procedures that may generate sparks.
- ✓ **Use Electrical Equipment Safely**: Inspect electrical equipment regularly for any damage, and avoid overloading electrical outlets. Unplug equipment when not in use.
- ✓ **Proper Storage of Flammable Materials**: Store flammable chemicals in designated flammable storage cabinets or areas, away from heat sources and incompatible materials.
- ✓ **Control Ignition Sources**: Keep ignition sources such as Bunsen burners, hot plates, and electrical devices away from flammable materials.
- ✓ **Ensure Proper Ventilation**: Adequate ventilation helps disperse flammable vapors and reduces the risk of ignition.
- ✓ **Regular Inspections**: Conduct regular inspections of electrical systems, gas lines, and safety equipment to ensure their proper functioning.
- ✓ **Know How to Use Fire Extinguishers**: Train laboratory personnel on the proper use of fire extinguishers and the different types of extinguishers available.
- ✓ **Appropriate Fume Hood Use**: When working with volatile chemicals, use a fume hood to contain and exhaust harmful vapors.

- ✓ **Emergency Contact Information**: Keep emergency contact information, including local fire department numbers, easily accessible in the laboratory.

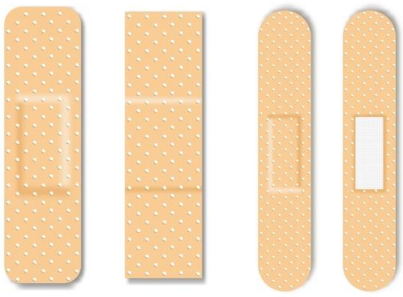
Call 911

6. FIRST AID KIT

The role of a first aid kit in a laboratory is to provide immediate medical assistance for minor injuries or illnesses that may occur during laboratory work. First aid kits are essential for promptly addressing injuries and preventing them from escalating into more severe conditions. They serve as a first line of defense until professional medical help is available. The location of the first aid kit should be easily accessible and well-known to all laboratory personnel.

Typical contents of a laboratory first aid kit may include:

Adhesive Bandages: for treating small cuts, scrapes, or blisters.



Sterile Gauze Pads and Dressings: to cover larger wounds and control bleeding.

Antiseptic Wipes or Solution: for cleaning and disinfecting minor wounds to prevent infection.

Medical Tape: Used to secure dressings and bandages in place.

Scissors: For cutting bandages or clothing if necessary.

Instant Cold Packs: For treating minor burns, strains, or sprains.

Burn Gel or Dressing: For minor burn injuries.

7. CHEMICALS HANDLING

Proper Handling of chemicals are critical aspects of laboratory safety. Adhering to general rules for chemicals handling helps prevent accidents, minimize exposure to hazardous substances, and protect the environment. Here are some essential guidelines:

- ✓ Everyone must read all Material Safety Data Sheets (SDS / MSDS) relevant to their lab work. Elaborate lists of MSDS are accessible through the following websites:

  https://www.msds.com/ (SDS / MSDS website online)

  https://chemicalsafety.com/sds-search/ (Chemical Safety)

  https://pubchem.ncbi.nlm.nih.gov/ (National Library of Medicine online)

- ✓ Always wear the appropriate personal protective equipment (PPE) when handling chemicals, including lab coats, safety goggles, gloves, and any additional equipment as needed.
- ✓ Ensure all containers are properly labeled with the correct chemical name, concentration, and any hazard warnings.
- ✓ Be aware of chemical incompatibilities and avoid mixing incompatible substances.
- ✓ Store chemicals in designated areas, according to their compatibility and hazard class. Flammable, corrosive, and toxic chemicals should have separate storage spaces.
- ✓ Work in well-ventilated areas or use fume hoods when handling volatile or noxious chemicals.
- ✓ Never use mouth suction for pipetting chemicals; always use the appropriate pipettes and equipment.
- ✓ Thoroughly wash hands after handling chemicals, especially before eating, drinking, or touching the face.

8. WASTE DISPOSAL

Proper disposal of waste is a critical aspect of laboratory safety. Adhering to general rules for waste disposal helps prevent accidents, and protect the environment. Here are some essential guidelines:

- ✓ **Segregation**: Separate different types of waste, such as hazardous, non-hazardous, organic, and inorganic, into clearly labeled and appropriately marked containers.
- ✓ **Chemical Waste Labels**: Properly label chemical waste containers with the contents and any relevant hazard information.
- ✓ **Neutralization**: When necessary and allowed, neutralize or stabilize chemical waste before disposal.
- ✓ **No Mixing**: Never mix different types of waste unless explicitly permitted.
- ✓ **Chemical Spills and Cleanup**: Follow proper procedures for cleaning up chemical spills and dispose of spill cleanup materials as hazardous waste.
- ✓ **Consult Safety Data Sheets (SDS)**: Refer to SDS for each chemical to determine appropriate waste disposal methods.
- ✓ **Waste Collection**: Store chemical waste in designated areas until it can be collected and disposed of by authorized personnel.

Proper disposal of the wastes from an experiment should be determined before the experiment is started.

1. Volatile compounds should be properly labeled and stored in a fume hood until disposal.
2. Waste chemicals should never be disposed of in sinks or drains.
3. Store waste chemicals in waste-containers.
4. Organic liquid wastes must never be mixed with aqueous wastes like acids.
5. Keep waste containers capped between uses, and do not overfill them.

9. **GENERAL SAFETY RULES FOR ELECTRICAL HAZARDS**

General safety rules for electrical hazards are crucial to prevent accidents, injuries, and electrical fires. Here are some important guidelines to follow when dealing with electrical equipment and hazards:

Disconnect Power: Always disconnect the power supply before working on electrical circuits or equipment.

Inspect Equipment: Regularly inspect electrical cords, plugs, and equipment for damage or wear. Replace damaged or frayed cords immediately.

Use Ground Fault Circuit Interrupters (GFCIs): Install GFCIs in areas where water and electricity are present, such as laboratories or workshops.

Avoid Overloading: Do not overload electrical outlets or extension cords. Use multiple outlets if needed, and distribute the load evenly.

Proper Cord Usage: Extension cords should only be used temporarily and not as permanent wiring solutions.

Keep Flammable Materials Away: Avoid placing flammable materials near electrical equipment to prevent fire hazards.

No Wet Hands: Never touch electrical equipment with wet hands or when standing in water.

Lockout/Tagout Procedures: Use lockout/tagout procedures when servicing electrical equipment to prevent accidental energization.

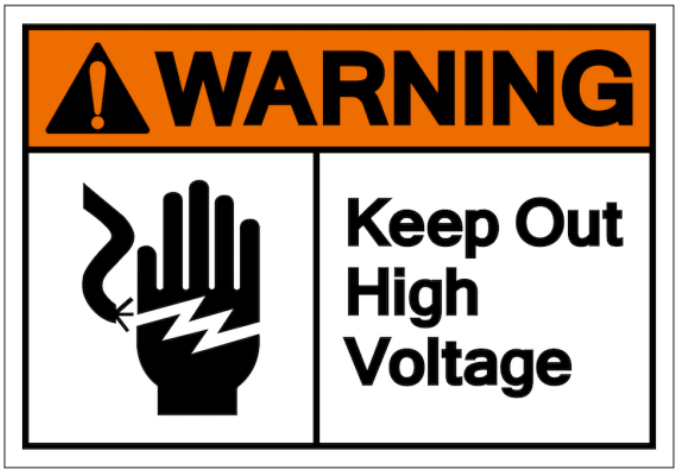
No Tugging on Cords: When disconnecting a plug, pull from the plug itself, not the cord.

Use Insulated Tools: When working with live circuits, use insulated tools to minimize the risk of electric shock.

Keep Electrical Panels Accessible: Ensure that electrical panels are accessible and not blocked by objects.

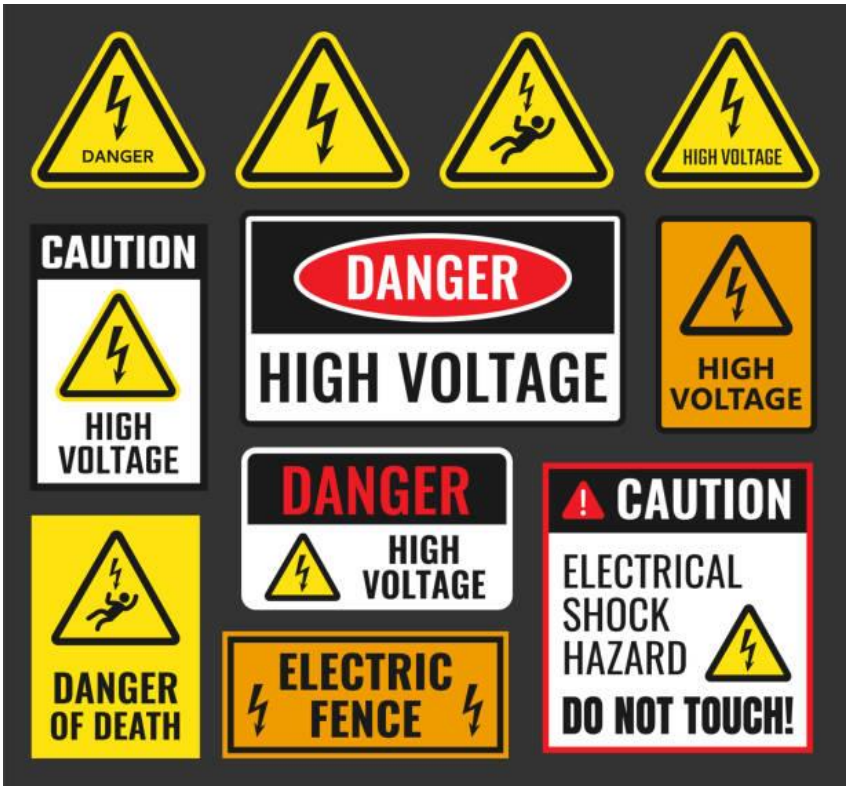
Emergency Shut-Offs: Know the location of emergency shut-off switches and how to use them.

Do Not Use Damaged Equipment: If you notice any electrical equipment is damaged or malfunctioning, report it and have it repaired by a qualified professional.



Unplug Unused Equipment: Unplug equipment when not in use to save energy and reduce the risk of electrical fires.

No Metal Objects Near Outlets: Never insert metal objects into electrical outlets or switches.



Avoiding electric shock is crucial for your safety. Here are some tips to help you prevent electric shock:

- Inspect power cords and plugs regularly for damage. Replace any frayed or damaged cords.
- Don't overload electrical outlets or power strips. Use them according to their rated capacity.
- Unplug appliances when not in use, especially if they have heating elements (e.g., irons, toasters).
- Keep electrical appliances away from water sources.
- Use rubber gloves and insulated tools when dealing with electrical equipment in wet environments.
- If you need to use extension cords, choose ones that are rated for the load you're connecting.
- Don't touch electrical appliances or outlets with wet hands or while standing on a wet surface.

✓ **If you notice any electrical problems, such as flickering lights, sparking outlets, or unusual odors, contact a qualified electrician to inspect and repair the issue.**

✓ **If someone is experiencing an electric shock, disconnect the power source if possible and call for medical assistance immediately. Do not touch the person while they are in contact with live electricity.**

10. GENERAL SAFETY RULES FOR MECHANICAL HAZARDS

General safety rules for mechanical hazards are essential to protect individuals from potential injuries while working with machinery and equipment. Mechanical hazards can arise from moving parts, rotating equipment, sharp edges, and other physical forces present in various machines. Here are some important guidelines to follow when dealing with mechanical hazards:

Machine Guarding: Ensure that all machines and equipment have appropriate guards in place to prevent contact with moving or rotating parts. Guards should not be removed or bypassed.

Lockout/Tagout Procedures: Implement lockout/tagout procedures when servicing or performing maintenance on machines to prevent accidental startup.

Avoid Loose Clothing and Jewelry: Avoid wearing loose clothing, jewelry, or accessories that could get caught in machinery.

No Horseplay: Avoid horseplay or any behavior that distracts from the safe operation of machinery.

Maintain Equipment: Regularly inspect and maintain machinery to ensure it operates safely and efficiently.

Emergency Stop Buttons: Know the location of emergency stop buttons and how to use them in case of emergencies.

Keep Work Area Clean: Maintain a tidy work area to prevent tripping hazards and ensure clear access to machinery.

Keep Hands Clear: Keep hands and body parts clear of moving or pinch points in machinery.

Avoid Reach-In Hazards: Do not reach into machinery while it is in operation or moving.

Avoid Overloading Equipment: Do not overload machinery beyond its intended capacity.

Appropriate PPE: Wear appropriate personal protective equipment (PPE), such as safety goggles, gloves, and steel-toed shoes, when working with machinery.

11. EMERGENCY PLAN DURING FIRE INCIDENTS

During a fire emergency in university laboratories, it's crucial to act swiftly and responsibly to ensure the safety of all individuals present. Remember, fire safety is a shared responsibility. Make sure everyone in the laboratory is aware of the emergency plan and practices fire safety measures at all times. Regular fire drills and safety training can also help ensure that everyone knows what to do in case of a fire.

Here's an emergency plan to follow during a fire in university laboratories:

Call for Help: While evacuating, call the local emergency services (Civil Defense - Fire department) to report the fire. Provide them with the exact location of the laboratory and any relevant details about the situation.

Evacuate the Area: Instruct everyone to leave the laboratory immediately and in an orderly manner. If possible, close the laboratory doors behind you to contain the fire and prevent its spread.

Assist People with Disabilities: Help anyone with mobility challenges or disabilities to evacuate safely.

Stay Low to the Ground: If there is smoke, stay close to the ground where the air is less toxic and easier to breathe.

Do Not Re-enter the Building: Once outside, do not re-enter the building until emergency personnel declare it safe to do so.

Assemble at a Safe Location: Designate an assembly point at a safe distance from the building. This location should be far enough away to ensure everyone's safety and to allow emergency responders easy access to the building.

Account for Everyone: Designate someone to take attendance at the assembly point to ensure that all individuals are accounted for. If someone is missing, inform emergency responders immediately.

Stay Informed: Listen to instructions from emergency personnel and university authorities. Follow any further evacuation procedures or safety measures they communicate.

Don't Attempt to Fight the Fire: Never attempt to fight a laboratory fire on your own, as it could be hazardous due to the presence of chemicals and other dangerous materials. Leave firefighting to trained professionals.