

## **Advanced manufacturing lab safety and operation policies**

This document outlines general safety and operation policies that apply to all laboratory work in the IMSE advanced manufacturing labs. Given the diversity of laboratory operations, this document does not include specific information about all potential laboratory hazards. Students dealing with lasers, chemicals and machinery in their lab work should also follow the specific safety policies established for these areas as given in the Appendices.

In order to implement this safety and operation policy, all student users are required to read this document and sign a form acknowledging that they are aware of the policies for working in the manufacturing labs, and stating they will follow those policies.

### **1. Controlling sources of exposure**

All experiments must be designed and carried out to minimize hazardous chemical and laser radiation exposure. Source reduction, engineering controls, and protective equipment are the three primary means of controlling exposure. The following are examples of source reduction measures, engineering control techniques, and protective equipment uses.

- Source reduction
  - Use the least hazardous chemical that will serve the intended purpose.
  - Design experiments to use the minimum amount of hazardous chemical required.
  - Always close containers when not in use.
  - Use the least amount of laser power that will serve the intended purpose.
  - Block laser beam or disable laser emission when not in use.
- Engineering controls
  - Use fume hoods whenever possible.
  - Do not use fume hoods for long term storage of equipment or chemicals.
  - Avoid the release of hazardous chemicals in rooms with no ventilation system or with re-circulating air systems.
  - Avoid delivering laser beam at eye level.
  - Use beam dump to contain stray laser beam.
  - Use optics designated for the laser wavelength.
- Protective equipment
  - Use safety glasses or splash goggles as designated for operations involving liquid or fine particulate chemicals.
  - Wear safety glasses for machining operations.
  - Use UV and/or IR protective safety glasses when working with lasers.
  - Wear appropriate gloves when dealing with chemicals and metal chips.
  - Use lab coat when handling strong acids and bases.
  - Shoes must be worn at all times. Closed-toe shoes must be worn when working with hazardous chemical materials, machinery, or moving heavy objects.

## **2. Personal hygiene**

Good personal hygiene practices are essential to minimize hazardous material exposure and potential injury from other hazardous conditions, such as broken glass and metal chips, in the laboratory.

- The storage or consumption of food or beverages is prohibited in all laboratory areas and hazardous chemical storage areas.
- Avoid "routine" exposures. Do not taste and avoid smelling any hazardous chemicals.
- Wash hands immediately upon contamination and after handling hazardous chemicals.
- Long hair and loose clothing must be confined when working in the laboratory.

## **3. Housekeeping**

Keeping the laboratory work area organized and clean is important to safe handling of hazardous materials and machine operations. Only the equipment and chemicals necessary for the particular procedure being performed should be in the work area. If several people are working in the same laboratory, requirements for space and hood access should be discussed and work areas agreed upon.

- Organize bench tops and leave sufficient space to perform your work safely.
- Properly label all containers of chemicals.
- Put away any clean glassware that is not being used.
- Return tools to tool box or designated area after use.
- Keep draws and cabinets closed when not in use.
- Floors and surfaces should be kept clean and spills cleaned up immediately.
- Always keep tables, chemical hoods, floors, and desks clear of all material not being used.
- The entire work area should be cleaned at the end of each day.
- Remove any equipment or clutter that interferes with access to emergency equipment.

## **4. Unattended operations**

Avoid leaving operations unattended. When it is necessary to leave an experiment unattended, provide for containment of hazardous chemicals in the event of equipment failure. Additionally, leave the lights on and place a warning sign on the door if, in the event of an emergency, there exists a hazard to persons entering the room.

## **5. Electrical safety**

The voltage and current used in laboratories are potentially lethal. The Lab Manager should be notified if unsafe electrical situations exist (e.g., wires are strung across pathways, frayed wires are found, grounding plugs have been removed), or if equipment malfunctions.

## **6. Use of lab equipment**

Faculty members are responsible for assuring that their students are receiving appropriate training and using safe laboratory practices while working in their laboratory or conducting projects or work for them.

## **7. What to do in the event of an accident or emergency**

The highest priority in an emergency response is the protection of life and health. The following basic steps apply to ALL emergency situations:

- Make sure everyone in the immediate vicinity is aware of the problem and stays a safe distance away from the incident.
- Contain the emergency if it can be done safely without causing harm to you.
- Call K-State Police Dispatch at 785-532-6412 or 911 for all emergency assistance.

## **Appendix A: Lab safety policy – chemical hazards**

Students who need to work with chemical hazards in the IMSE labs must study the general safety rules listed below and take a quiz. The quiz will be given by the student's supervisor/advisor. After passing the quiz, the student will be given permission to work in the lab and must follow the instructions when operating specific machines.

### **General safety rules**

- Safety glasses are to be worn whenever working with acids, bases, or any corrosive and irritant materials. Be familiar with the use of the eye-wash and the first-aid kit if they are needed at any time. Use plastic gloves when handling any hazardous materials to prevent skin contact.
- Let the instructor/lab manager know immediately about any glassware breakage or chemical spills that may occur so that proper cleanup procedures can be instituted. Dispose of all used solutions in an approved manner as directed.
- Whenever working with acids or bases, have the chemicals available at your work station, do not carry pipets with fluid across the room.
- When diluting acids, pour the acid into the water, NOT water into acid as this may cause spattering of the acid. When acid is mixed with another reagent, an exothermic reaction may occur which heats up the container. This is natural, so do not panic and spill contents.
- Use heat-resistant gloves and/or tongs when handling hot glassware, crucible, reactor vessel, etc.
- All volatile materials must be handled in a hood with the exhaust fan on.
- Label and date all chemical mixtures that are made up and kept for future use. Do not store solutions in glass containers with glass stoppers, use plastic or rubber stoppers.
- Empty all used microorganism media from test containers into a designated container so that it may be sterilized before disposal.
- Clean all spatulas, glassware, and dishes after use and before storage to prevent contamination. Before leaving, turn off all power and heat to the apparatus you have used, or place in the standby mode. Return all chemicals you are using to their proper storage space.
- In case of chemical spill, alert people in immediate area of spill; confine spill to small area; avoid breathing vapors from spill, use appropriate kit to neutralize and absorb inorganic acids and bases. Collect residue, place in container, and dispose as chemical waste. The Division of Environmental Health and Safety must be notified of any size spill immediately by calling 911 to report the spill.

## **Appendix B: Lab safety policy - laser**

### **General:**

- Only trained, authorized personnel may operate lasers. Authorization is received from the laser lab managers.
- NEVER put yourself into any position where your eyes approach the axis of a laser beam (even with eye protection on).
- Keep beam paths below or above standing or sitting eye level. Do not direct them towards other people.
- Do not damage laser protective housings, or defeat the interlocks on these housings.
- Eliminate all reflective material from the vicinity of the beam paths.
- Never use viewing instruments to look directly into a laser beam or its specular reflection. If this is necessary, install an appropriate filter into the optical element assembly.
- Keep ambient light levels as high as operations will permit.
- Do not work alone when performing high power laser operations.
- Visitors should not be permitted to observe a laser experiment without first receiving a laser safety briefing and being issued laser eye protection. They will be escorted by knowledgeable personnel at all times.
- Eyewear must be of the correct optical density and offer protection at the wavelength(s) of the laser(s) being used.
- Eyewear will only protect your eyes for short time periods, depending on the laser power. Therefore, do not look directly into any laser beam, even with laser eye protection on.
- Periodically inspect and replace damaged or defective eyewear.
- Exposure to direct or diffuse reflections from ultraviolet lasers (particularly excimers) can result in short and long term skin hazards. Cover your exposed skin areas when working near these lasers (use long sleeve shirts or lab coats, cloth gloves, etc. as necessary).
- Follow any pertinent safety precautions listed in the laser manufacturer's published owner's manual.
- Prior to lasing, perform a "countdown" or make an announcement to warn others that you are about to lase.

### **Use of Laser Eye and Skin Protection:**

- Eyewear must be of the correct optical density and offer protection at the wavelength(s) of the laser(s) being used.
- Eyewear will only protect your eyes for short time periods, depending on the laser power. Therefore, do not look directly into any laser beam, even with laser eye protection on.
- Periodically inspect and replace damaged or defective eyewear.
- Exposure to direct or diffuse reflections from ultraviolet lasers (particularly excimers) can result in short and long term skin hazards. Cover your exposed skin areas when working near these lasers (use long sleeve shirts or lab coats, cloth gloves, etc. as necessary).

### **Accident/Emergency Procedures:**

- In case of an emergency, dial 911 for assistance.
- Emergency response personnel will be directed to you as necessary.
- An Emergency Power Off button is located in the lab to shut down power to the lab.
- Notify the lab managers.

## **Appendix C: Lab safety policy - manufacturing machinery**

Students who need to work with machines in the IMSE labs must study the general safety rules listed below and take a quiz. The quiz will be given by the student's supervisor/advisor. After passing the quiz, the student will be given permission to work in the lab and must follow the instructions when operating specific machines.

### **General safety rules**

- Wear safety glasses.
- Wear shoes covering the entire foot and no sandals.
- Do not wear ties, loose clothing, jewelry, gloves, etc. around moving or rotating machinery. Long hair must be tied back or covered to keep it away from moving machinery. Hand protection in the form of suitable gloves should be used for handling hot objects, glass or sharp-edged items.
- Wear appropriate clothing for the job (i.e. do not wear short sleeve shirts or short pants when welding).
- Do not run the extension cord across walkways where people might trip over it or where the cord may be run over and damaged.
- Do not operate any equipment unless you are familiar with its operation and have been authorized to operate it. Ask your supervisor when in doubt.
- Before starting a machine, always check it for correct setup and always check to see if machine is clear by operating it manually, if possible.
- Make sure the workpiece and tool are secured on the machine before operation.
- Use correct size tools (e.g. screwdriver, wrench) for tightening and loosening parts.
- Machines must be shut off when cleaning, repairing, or oiling.
- Know where the emergency stop button is on a machine and use it when needed.
- Stop machine when noticing unusual noise, vibration, etc. and take corrective action.
- Use care and appropriate tools (e.g. brush) when removing chips, shavings, etc. from the work area.
- Keep the area around machines clean, dry and free from trip hazards.
- Store metal chips in an approved container.

## Appendix D: Lab safety policy – gas cylinder

Students who need to work with gas cylinders in the IMSE labs must study the general safety rules listed below and take a quiz. The quiz will be given by the student's supervisor/advisor. To move gas cylinders, the student will need to get permission from Timothy Deines.

### General safety rules

- Only those gas cylinders in immediate use shall be located in a laboratory. Replacement cylinders and empty cylinders shall be stored in a designated area, preferably outside the building. Do not store cylinders in hallways.
- When not in use or while in transit, regulators shall be removed and valve protection caps put in place.
- All compressed gas cylinders must be secured with a chain, clamp, or strap at all times when in use, storage, or transport. Three points of contact should be made with the cylinder at all times whether in transit, storage, or use.
- Each tank must be properly and permanently identified when received. Never accept a cylinder on which the name of the contents is illegible. Do not rely on color codes for tank identification.
- Use appropriate regulators and do not attempt to modify or change cylinder valves or regulators.
- Always use recommended handling procedures for compressed gas cylinders even though they may seem empty.
- Return empty cylinders to the manufacturer, if possible.
- Use all of the contents of the cylinder.
- Cylinders that cannot be returned and are empty or are no longer wanted are handled through the hazardous waste program. Contact EHS

1. Fire safety:

document: [https://www.k-state.edu/safety/training/firesafety/revise-firesafety@ksu\\_KP30Jun2015.pdf](https://www.k-state.edu/safety/training/firesafety/revise-firesafety@ksu_KP30Jun2015.pdf)

quiz: [https://kstate.qualtrics.com/SE/?SID=SV\\_aY1lqtAHGCMkthP](https://kstate.qualtrics.com/SE/?SID=SV_aY1lqtAHGCMkthP)

2. Hazardous waste:

<https://www.k-state.edu/safety/training/hazardous-waste/index.html>

3. Laser safety & Laboratory Safety:

<https://passthrough.signin.k-state.edu/passthrough/vivid>

4. Gas cylinder:

[https://kstate.qualtrics.com/jfe/form/SV\\_cBy008ZK9wq90iV](https://kstate.qualtrics.com/jfe/form/SV_cBy008ZK9wq90iV)