

University of Massachusetts Dartmouth

College of Engineering – Mechanical Engineering Department

Best Laboratory Safety Practices

This handbook intends to provide you with essential safety information about our laboratories and give you important and necessary guidance to preserve your well-being and that of your classmates and our facility. Safety is YOUR responsibility. Your safety, your classmates' safety, and the safety of our equipment and the facility depend on you. For that reason, your grade in your various labs may depend in part on your instructor's perception of your safety behavior.

Before discussing safety specifics, a few words on accidents.

For an accident to occur, two conditions are necessary: (1) an unsafe condition, and (2) an unsafe act.

Here is an example: A student rushing through the lab slips on a wet spot on the floor and falls, injuring himself.

- The unsafe condition is the wet spot, which should have been cleaned up or marked with a warning sign the moment the spill occurred.
- The unsafe act is rushing in a lab, where care and caution around equipment and others working with equipment should always be observed.

No doubt, the student will blame the wet spot while the professor will blame the student's behavior. Each blames the other.

In reality, BOTH people are responsible for BOTH sides of the accident equation.

- The professor is responsible for training, monitoring, and controlling behavior AND assuring that the spilled water is cleaned or properly marked with a warning sign.
- The student is responsible for walking carefully, safely, and slowly through the lab AND for stopping to clean the spilled water or being proactive by alerting the professor.

You must be sure you know what constitutes unsafe conditions and what constitutes unsafe acts. Here is another example: A power tool that is missing a required safety guard or chip shield is an unsafe condition. Using that equipment is an unsafe act. (Indeed, just the presence of power equipment may constitute an unsafe condition.)

YOU are responsible for minimizing the likelihood of both of these situations. When you see an unsafe condition, take steps to correct it – often, this means alerting the right people and cautioning classmates to cease using the equipment. In the example of the spilled water, you can proactively wipe it up or arrange a warning sign; at a minimum, you should alert the responsible person in the lab. And, you can control your own behavior by avoiding an unsafe act, such as rushing. Instead, walk slowly and carefully.

We all need to realize that we are sometimes forced to work in situations that are inherently unsafe, requiring extra caution with safety procedures and behaviors. For example, working with power tools and rotary tools, hot ovens, open flames, dangerous chemicals, powerful lasers, loud sounds, electric circuits and high voltages, or toxic fumes are but a few of the circumstances that you may encounter in your undergraduate labs, graduate labs, and professional experiences – and all are unsafe to a greater or lesser degree.

In these situations, you must pay particular attention to your behaviors. Only you can take the necessary steps to insure your own safety and the safety of those around you and of the facility.

General Laboratory Safety

Many lab safety precautions are universal, such as these:

- 1) Know the primary and secondary exits for each room and lab that you use.
- 2) Know the location of the nearest fire extinguisher.
- 3) Know the location of the nearest fire alarm pull switch.
- 4) Know how to immediately call for help in an emergency (x 9191 or 508-999-9191 if on a cell phone).
- 5) Do not “horse around” in any lab. Our labs are small and many people are near you. You might inadvertently bump someone into an open flame or a running machine. You might harm yourself if acting irresponsibly. And, you might damage expensive and necessary equipment by reckless, thoughtless, or immature behavior.

- 6) ALWAYS wear proper personal protective equipment (PPE) as dictated by the needs of the specific lab, situation, and equipment.
- 7) Turn off any music devices and earphones and store away while in the lab.
- 8) Turn off and DO NOT USE cell phones – they distract from dangerous work. (It is acceptable to use a smart phone as a stopwatch or camera for your lab exercises.)
- 9) In general, wear long pants and solid, closed-toe shoes. Shorts, skirts, and sandals are unacceptable in any laboratory environment (so, plan accordingly).
- 10) In general, secure long hair, dangling clothes (sleeves, etc.), drawstrings, neckties, loose jewelry (or remove it), and the like.
- 11) Do NOT wear sunglasses in a lab. DO wear proper eye protection, as needed.
- 12) Be sure your lab work area is properly lighted, clean, dry, and has adequate bench space for your equipment and your notebooks.
- 13) Know how to operate and be trained to use all equipment in the lab and know how to immediately shut it off in an emergency.
- 14) Do NOT operate equipment while under the influence of alcohol or drugs. If you take a medication that might slow your reactions or dull your senses, then inform your professor and make alternate arrangements for completing the lab exercises.
- 15) Store personal possessions, such as backpacks, jackets, etc. away from general work areas and lab equipment. (Space is provided for this.)
- 16) When finished with your lab work, secure the area. Clean up any mess you've made, return tools, bits, instruments, equipment, parts, and other lab paraphernalia to the proper storage area. Leave the lab area clean and safe for the next person.
- 17) Collaborate with your classmates to clean general areas. The excuse "I didn't make that mess so I don't have to clean it" is a sure way to earn a failing grade.
- 18) Return safety goggles, ear protectors, thermal gloves, aprons, and other safety equipment to the proper storage area so the next students can find them.

Our laboratories have varying levels of safety requirements. The labs and their safety issues are discussed on the following pages.

Materials Science Laboratory

In the Materials Science Lab, you will investigate properties and characteristics of a variety of materials, often metals. The following are likely conditions that will require a focus on safety.

- Open flame (Bunsen burner)
- Melted, liquid metals
- Very hot metals (glowing red)

In these situations, you will need to protect yourself. The following are important:

- 1) Know the exits.
- 2) Know the fire extinguisher.
- 3) Know the fire alarm pull switch.
- 4) Know how to contact emergency services (x9191 or 508-999-9191).
- 5) Know to find the First Aid Kit (in the machine shop).
- 6) Wear long pants – no skirts, no shorts.
- 7) Wear long sleeves to protect your forearms from the possibility of burns caused by hot, melted splashing metal.
- 8) Wear solid shoes – no sandals.
- 9) Wear proper eye protection – regular eyeglasses may not provide enough protection from hot, liquid, melted metal splashing toward your eyes. In particular, you may need goggles that have side shields. If you wear eyeglasses for corrective vision, choose full-surround goggles that fit over your glasses.
- 10) Use the heavy thermal gloves when handling red-hot metal samples.
- 11) Use the powered ventilation system to remove fumes from melting metal.

Fluids Laboratory

Few hazards exist in the Fluids Lab. However, water occasionally splashes or drips into the floor from the experiments on the flow benches. If you see a leak or a puddle, you should immediately notify the professor or TA in the lab and then clean up the spill, eliminating the slip hazard.

Thermal Systems Laboratory

Few hazards are expected in the Thermal Lab; however, several of the experiments do present situations that deserve attention.

- 1) The Bomb Calorimeter experiment requires that the bomb be charged with oxygen to a high pressure. The oxygen tank, regulator, and pressure coupler are to be handled by the professor or TA only.
- 2) The Hilton Air Impulse Turbine makes a loud siren-like sound when running. Foam earplugs are available for anyone who finds the sound irritating.
- 3) The Transient Open System, the Refrigeration, and the Bomb Calorimeter experiments all require open water. In the event that water spills on the floor, take appropriate steps to notify the professor or TA and proactively clean up the spilled water.

Mechanics of Materials Laboratory

Few hazards exist in the Mechanics of Materials Lab. Students are urged to watch for the possibility of a sharp edge or sharp point occurring with a sample that has been broken (and almost all samples are intentionally tested to failure).

Students are asked to treat the bending beam experiment (with the attached strain gauges) with care. The strain gauges are delicate and are difficult and expensive to replace.

Design of Mechanical Systems Laboratory

Few hazards exist in the Mechanical Systems Lab. Students will explore, among other things, gear trains and transmissions and are cautioned to avoid pinch points between meshing gears.

Design for Manufacturing Laboratory (Machine Shop)

The Machine Shop presents many inherently unsafe conditions that could lead to serious accidents and serious injury. For this reason, the following safety rules must be observed.

- 1) To use tools in the shop, you must have been trained in shop practices and proper use of the machine tools (completed MNE345) and/or be currently enrolled in MNE345.
- 2) Never work alone. You MUST be working with at least one other person, with you in the same room, who has likewise received appropriate training in MNE345 and knows how to immediately shut down the equipment in the event of an emergency.
- 3) You must confirm that there is an appropriate shop supervisor (professor, TA, lab manager) in the near vicinity, and you must have proper acknowledgement from that supervisor that you are using the equipment. (That is, you must “check in” first.)
- 4) You must wear long pants – no shorts or skirts. (Therefore, plan ahead.)
- 5) You must wear appropriate full covered shoes – no open-toed sandals. (Therefore, plan ahead.)
- 6) You must wear eye protection. In many cases, ordinary eyeglasses are unacceptable, because they may not offer shatter resistance and may not provide full protection (particularly true with “designer glasses”).
- 7) For very loud machining operation, you and those near you should use hearing protection. Ear muffs or foam plugs are available.
- 8) You must know the secondary exits from the shop, the location of the fire extinguishers, the location of the fire alarm pull switch, and the location of the E-stop buttons.
- 9) You must know the location of the first aid kit.
- 10) You must know the emergency phone number (x9191 or 508-999-9191).
- 11) You must secure long hair, loose clothing, and loose, hanging items such as necklaces, neckties, drawstrings, loose bracelets, and the like.
- 12) You must turn off music players and remove headphones.
- 13) You must turn off cell phones and smart phones.
- 14) You must clean up your mess and assist others in class cleaning the general area. Saying “I didn’t make the mess, so I won’t clean up the mess” is unacceptable.

- 15) You must put away tools, bits, parts, and other shop paraphernalia in order to leave the shop in a clean, orderly fashion and ready for the next students.
- 16) If/when you see an unsafe condition and/or equipment that results in a potential safety risk, notify the professor, TA, or lab manager immediately and cease using that equipment. Put a sign on the equipment announcing that it is “out of service.”
- 17) Do not use welding equipment unless you have received proper training (which is not part of our curriculum) and have received a proper flame permit. Welding in the MNE shop should be done only in special circumstances by trained operators under proper supervision.