Department of Electrical and Computer Engineering
Howard University

LABORATORY SAFETY MANUAL

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In case of accident or any emergency call 911

If there is fire in the building, walk downstairs do not use the elevators

I. Laboratory Safety

Modern times require the services of electricity in several forms. All electrical and computer engineering labs operate with electricity in the form of direct current (dc) or alternating current (ac) or sometimes with a combination of both. Note the labs ware wired with 120 volt, 60 Hz single phase and 208 volts, 60 Hz three phase. Electricity seems to be very friendly until when mishandle or a fault occurred. Not also some labs contain photovoltaic (PV) panels that generate electricity with sunlight. You cannot turn it off so far as there is the sun. Thus avoid touching exposed terminals of any electric source.

The National Electrical code (NEC) is an organization in the US that sets up standards for safe installation of electrical wiring and equipment. These standards are reviewed and revised on periodical basis. New standards may also be added. The NEC establishes standard codes for safe installation of electrical systems. It is a part of the National Fire Codes series that is published by the National Fire Protection Association (NFPA)

The Occupational Safety and Health administration (OSHA) warns that working with electricity can be very dangerous and it has been recognized as a serious workplace (lab in this case).hazard. There are national standards related to electric hazards.

Many workers (students, staff and faculty) are unaware of the potential hazards present in the work place especially with hands on labs equipment that has exposed wires or terminals that can lead to a possible danger of electrocution. Thus all personnel should be aware b of safety ad hazard in the electrical work environment. Safety is a major part of laboratory procedures. Thus before starting any experiment in the lab you should be fully aware of all necessary rules and precautions/

II. More on Lab Safety

Think First

This rule applies to all workers

Some basic rules are:

- Develop good habits of workmanship
- Learn to use tools correctly and safely
- Always study the job at hand and think through the procedures and application of tools
- Never permit yourself to be distracted from your work and never distract another worker engaged in hazardous work
- Do not be a clown. Joke are fun but not near machinery or electricity

Electric Shock

Physiological effects of electric currents can be generally predicted as shown in the table 1 below.

Table 1. Effects of Current

Current Level (milliamps), mA	Physiological Effect
2.6	Sensation threshold
9.0	Mild sensation
16.0	Painful
26.0	Cannot let go
36.0	Sever shock
66.0	Labored briefing
86.0	Extreme breathing difficulties
150.0	Death

Note: 1 mA = 0.001 Amp
Do not place yourself in a position to get any kind of electric shock..

Safety Rules

a. **Be sure of conditions of the equipment and dangers present before working.** Many sportsmen have been killed by supposedly unloaded guns and many technicians are killed supposedly by dead circuits
b. Never rely on safety devices such as fuses, relays, circuit breakers and interlock systems to protect you. They may not be working and they mail fail to protect you when needed.
c. **Never remove ground prongs of a three wire input plug.** This eliminates the grounding feature of the equipment making it a potential shock hazard.
d. **Do no work on cluttered bench.** A disorganize mess of connecting leads components and tools only leads to a careless thinking, short circuits. Shacks and accidents. Develop habits of systemized and organized procedures of work
e. **Do not work alone.** It is just good sense to have some one around in case of emergency to shut off the power to give you artificial respiration and to call a doctor and 911 DC Metro emergency number. Notify the assistant and or faculty present.
f. **Do not work on wet floors.** Your body contact resistance to ground is substantially reduced. It is advisable to work on insulated floor or wear rubber in sole footwear.
g. **If possible work with one hand.** A current between two hands crosses your heart and can be more lethal than a current from one hand to the foot.
h. **Never talk to any one while working** Do not let yourself be distracted. Also do not talk to anyone if the person is working on dangerous equipment. Avoid being the cause of an accident

i. **Always move slowly when work ring around electric circuits.** Violent and rapid movements may lead to accidental shocks and short circuits.

j. **Always connect the power source last**

III. VOLTAGE RULES: All ECE Instructional Laboratories lab kit voltages are **below 50 volts peak.** (OSHA permits "unqualified persons" to work on such circuits with "awareness-type" training.)

If you intend to work on a project using power sources **over 50 volts peak 120/208 volts in the energy conversion area,** you must **secure permission** and receive **specific training** from your Instructor, TA, or Lab Technical Personnel **before** any work on the project begins.

PREVENT ACCIDENTS: FOLLOW THIS ADVICE

- Connect to the power source **LAST.**
- **However, first switch off power source before disconnecting your project.**
- If you are working with a lab kit that has internal power supplies, **turn the main power switch OFF** before you begin work on the circuits. Wait a few seconds for power supply capacitors to discharge. These steps will also help prevent damage to circuits.
- If you are working with a circuit that will be connected to an external power supply, **turn the power switch of the external supply OFF** before you begin work on the circuit.
- Check circuit power supply voltages for proper value and for type (DC, AC, frequency) before energizing the circuit.
- Do not run wires over moving or rotating equipment, or on the floor, or string them across walkways from bench-to-bench. Do not wear loose clothes or long chains. If you have a long, tie it short to prevent danger of being caught by a rotating machine or avoiding electric shock with jewelry. Remove all metal conductive materials form your exposed body before working on energized projects.
- When breaking an electric machinery (inductive) circuit open the switch with one hand and turn your face away to avoid danger arc due to ionization formed that may develop across the switch terminals.
- If you are working large electrolytic capacitors be sure to wait long enough (approximately five time constants) for the capacitors to discharge before working on the circuit.
- All conducting surfaces intended to be at ground potential should be connected together.

IV. MORE CAUTIONS

- The EECS Instructional Laboratories (34-501, 38-500, 38-600) are equipped with Ground Fault Current Interrupt (GFCI) circuit breakers. Check for leakage paths to ground when breakers trip repeatedly and the problem is not due to an overload.
- Any equipment used in the laboratories must be equipped with a standard three-prong AC plug or a two-pronged polarized plug.
- All exposed non-current-carrying metal parts of fixed and portable equipment that may accidentally become energized should be grounded.
- All electrical equipment or apparatus that may require frequent maintenance must be capable of being completely disconnected from the power source.
- Do not bring into the lab or use in the lab equipment that does not conform to these rules without specific permission from your instructor, TA, or lab technician.

V. QUESTIONS ABOUT LAB SAFETY

- Any questions about lab safety should be directed to your immediate supervisor or instructor. If problems arise that cannot be solved at this level, you should contact Howard University Safety Officer:

VI. BASIC ELECTRICAL SAFETY PRACTICES

Howard University requires everyone who uses electrical equipment to understand these safety precautions to comply with the OSHA or NEC Electrical Safety-Related Work Practices standard. The following safe work practices can prevent electrical shock. Contact your supervisor for additional safety training.

A. Safe Work Practices

1. Turn off and unplug equipment (instead of relying on interlocks that can fail) before removing the protective cover to clear a jam, replace a part, adjust or troubleshoot. Ask a qualified person to do the work if it involves opening equipment and creating an exposure to energized parts operating at 50 volts or more.
2. Don't use an electrical outlet or switch if the protective cover is ajar, cracked or missing. Call FIXIT (x3-4948) and report this.
3. Only use DRY hands and tools and stand on a DRY surface when using electrical equipment, plugging in an electric cord, etc.
4. Never put conductive metal objects into energized equipment.

5. Always pick up and carry portable equipment by the handle and/or base. Carrying equipment by the cord damages the cord's insulation.
6. Unplug cords from electrical outlets by pulling on the plug instead of pulling on the cord.
7. Use extension cords temporarily. The cord should be appropriately rated for the job.
8. Use extension cords with 3 prong plugs to ensure that equipment is grounded.
9. Never remove the grounding post from a 3 prong plug so you can plug it into a 2 prong, wall outlet or extension cord.
10. Re-route electrical cords or extension cords so they aren't run across the floor, under rugs or through doorways, etc. Stepping on, pinching or rolling over a cord will break down the insulation and will create shock and fire hazards.
11. Don't overload extension cords, multi-outlet strips and wall outlets.
12. Heed the warning signs, barricades and/or guards that are posted when equipment or wiring is being repaired or installed or if electrical components are exposed.

B. *Check for Unsafe Conditions* (either before or while you're using equipment:)
1. Is the cord's insulation frayed, cracked or damaged, exposing the internal wiring?
2. Are the plug's prongs bent, broken or missing, especially the third prong?
3. Is the plug or outlet blackened by arcing?
4. Was liquid spilled on or around the equipment?
5. Are any protective parts (or covers) broken, cracked or missing?
6. Do you feel a slight shock when you use the equipment?
7. Does the equipment or the cord overheat when it is running?
8. Does the equipment spark when it is plugged in or when switches or controls are used?

C. **If you observe any of these unsafe conditions:**
1. Don't use (or stop using) the equipment.
2. Tag/label the equipment UNSAFE--DO NOT USE and describe the problem.
3. Notify your supervisor, FIXIT or the service company, as appropriate.

Electrical safety is for everyone because even contact with the standard 117 volt electrical circuits, which we constantly use, can be lethal under certain conditions.

VII. More Safety

a. Know the location of electrical panels and disconnect switches in or near your laboratory so that power can be quickly shut down in the event of a fire or electrical accident.

b Never obstruct electrical panels and disconnect switches. These should be clearly labled to indicate what equipment or power source they control. A minimum 3-foot clearance must be maintained around electrical panels at all times to permit ready and safe operation and maintenance of such equipment

.c. Do not overload circuits or wiring. Overloading can lead to overheated wires and arcing, that can cause fires and electrical shock injuries.

d. Inspect all electrical equipment (hot plates, stirrers, ovens, extension cords, etc.) before use to ensure that cords and plugs are in good condition—not worn, twisted,

frayed, abraded, corroded, or with exposed wires or missing ground pins. Live parts must be effectively insulated or physically guarded. Equipment with damaged or defective cords or plugs should be taken out of service immediately and repaired by qualified personnel.

e. Ensure that all electrical outlets have a grounding connection requiring a three-pronged plug. All electrical equipment should have three-pronged, grounded plugs or be double-insulated.

f. Electrical outlets, wiring, and other electrical equipment integral to the building may only be serviced and repaired by Facilities Operations qualified trades personnel or other qualified electricians.

7. Work on electrical equipment must be done only after the power has been disconnected. On cord and plug connected equipment, the power cord must be unplugged and under the exclusive control of the person performing the work so that the equipment cannot be accidentally turned on by someone else. On hard-wired equipment, the main disconnect device or circuit breaker must be shut off and locked and tagged with a special padlock and tag. Service and/or repair work on hard-wired equipment may only be carried out by authorized individuals (faculty and technician).

h. Limit the use of extension cords—they are for temporary, short-term use only. In all other cases, request the installation of a new electrical outlet. Do not use extension cords as substitution for fixed receptacle outlets. Long-term use of extension cords is a violation of OSHA-NEC regulations. The long-term use of multi-outlet power strips is also illegal, except for use with computer equipment.

i. Ensure that all extension cords used are carefully placed, visible, and not subject to damage.

Cords must not run across aisles or corridors where they might be damaged or create a tripping hazard. Cords must not run through doors, walls or partitions, under rugs, or above dropped ceilings. They must not be tied in knots, draped overhead, or attached to walls.

j. Ensure that the wire size of an extension cord is adequate for the current to be carried. Failure to do so can lead to electrical fires. Cords used for 110-120 volt service should be Underwriters Laboratories (UL) listed with a polarized three prong plug. Extension cords must never be linked together—use the proper length extension cord needed for the application.

k. Keep corrosive chemicals and organic solvents away from electrical cord—these can easily erode the insulation on wires.

l. Keep flammable materials away from electrical equipment.

m. Keep electrical equipment away from wet or damp locations or potential water spillage, unless specifically rated for use under such conditions.

n. Never handle electrical equipment when hands, feet, or body are wet or perspiring or when standing on a wet floor.

15. In the event of an electrical fire, leave the area, call 911, and pull the nearest fire alarm.

Do not use water on an electrical fire. The appropriate fire extinguisher is ladled "C" or "ABC." If safe and possible, shut down the main power source.

o. . In an electrical emergency, if a person received an electrical shock, do not touch the equipment, cord or person. Call 911 so that the Fire Department can treat the injured person and evaluate the situation. If safe and possible, shut down the main power source

VI. Extracted from Howard University Department of Public Safety

The Department of Public Safety is concerned about the safety of you, your friends and family. We are offering these tips.

- Know your environment and become aware of your surroundings
- Travel in a group with trusted friends and designate a specific meeting place and time to meet back up should the group split up
- Always locate your nearest exits
- Wear comfortable shoes and clothing
- Pay attention to directions on street/parking signs when parking your car and always secure your car keys
- Keep personal identification and credit cards on your person to a minimum
- Secure cell phones and other electronic devices when not in use
- Don't leave anything visible in the passenger area of vehicles. Secure all items in the trunk, discreetly, out of the view of others.
- Use disposable cameras in crowded environments
- Know the warning signs for alcohol poisoning (vomiting, blue lips or nail beds, irregular or slow breathing, passed out and hard to awaken) and call an ambulance if you see these signs in someone

BE RESPECTFUL OF OTHERS AND THEIR PROPERTY

All of the above rules and regulations are necessary precautions in all the Department of Electrical and Computer Engineering Laboratories to safeguard the students, lab staff, faculty, equipment and other laboratory users.