

GENERAL LABORATORY RULES AND PRECAUTIONS FOR ELECTRICAL SAFETY

Department of Electrical Engineering

The following general rules and precautions are to be observed at all times in the laboratory. These rules are for the benefit of the experimenter as well as those around him/her. Additional rules and precautions may apply to a particular laboratory.

1. There must be at least two (2) people in the laboratory while working on live circuits or chemical processing.
2. Shoes must be worn at all times.
3. Remove all loose conductive jewelry and trinkets, including rings, which may come in contact with exposed circuits. (Do not wear long loose ties, scarves, or other loose clothing around machines.)
4. Consider all circuits to be "hot" unless proven otherwise.
5. When making measurements, form the habit of using only one hand at a time. No part of a live circuit should be touched by the bare hand.
6. Keep the body, or any part of it, out of the circuit. Where interconnecting wires and cables are involved, they should be arranged so people will not trip over them.
7. Be as neat as possible. Keep the work area and workbench clear of items not used in the experiment.
8. Always check to see that the power switch is OFF before plugging into the outlet. Also, turn instrument or equipment OFF before unplugging from the outlet.
9. When unplugging a power cord, pull on the plug, not on the cable.
10. When disassembling a circuit, first remove the source of power.
11. "Cheater" cords and 3-to-2 prong adapters are prohibited unless an adequate separate ground lead is provided, the equipment or device is double insulated, or the laboratory ground return is known to be floating.
12. No ungrounded electrical or electronic apparatus is to be used in the laboratory unless it is double insulated or battery operated.
13. Keep fluids, chemicals, and heat away from instruments and circuits.
14. Report any damages to equipment, hazards, and potential hazards to the laboratory instructor.
15. If in doubt about electrical safety, see the laboratory instructor. Regarding specific equipment, consult the instruction manual provided by the manufacturer of the equipment. Information regarding safe use and possible hazards should be studied carefully.

Electrical safety

Kent Barnett
Technical Writer
Portable Instruments Division
Tektronix, Inc.

Wally House
Product Safety Manager
Instruments Group
Tektronix, Inc.

Safety is important whenever you use electrical equipment — whether in the classroom, in the laboratory, or in the home. In this article we look at some basic safety considerations, particularly as they relate to the safe use of measurement equipment. The accompanying sidebar on Third-party safety certification explains why safety certification should be an important consideration when choosing electrical equipment.

Safety is everyone's responsibility. Nowhere is this truer than when using electricity.

Using electricity is like swimming, in that novices and experts can both enjoy its benefits provided they follow the rules at all times. None of us can fully depend on others to provide a safe working or playing environment. You have more control than anyone else over your activities and the caution you use when participating in those activities.

Practice safety

Tektronix encourages you to learn and follow these general precautions, and to read and follow instructions specific to circuits or equipment you work with.

- Never work alone.
- Learn first aid, especially cardiopulmonary resuscitation (CPR), for electrical accident victims.
- Except when absolutely necessary, turn off power or disconnect power source before working on electrical or electronic circuits. Consider all wires and terminals to be live until proven otherwise by a safe test method.
- Be sure your test equipment is operating properly before using it.
- Do not work on electronic circuits or equipment while standing on a wet floor, or when touching plumbing or metal objects that may provide a hazardous earth-ground path.
- Remove metal jewelry, watches, rings, chains, etc., before working on electrical circuits or equipment.
- Whenever possible, make current and voltage measurements with one hand in your pocket or behind you.
- Resist the temptation to throw a switch "to see what happens."

- Turn off power and unplug equipment before checking or replacing fuses. Locate and correct the cause of a blown fuse or tripped circuit breaker before replacing the fuse or resetting the breaker.
- Replace defective cords and plugs. Form a habit of inspecting for defects such as frayed wires, loose connections, and cracked insulation.
- Always check the electrical ratings of equipment you use, and be sure you use that equipment within its ratings.
- In general, treat all circuits as if high voltage or high current is present.

Safety measures

A primary safety measure is grounding the equipment chassis through a wire in the power cord. This practice is variously referred to as "green-wire ground" (because of the color of the insulation on the chassis ground wire) or "third-wire ground" (because a ground wire is a third wire).

If an internal electrical fault should somehow apply a dangerous voltage to the chassis of an instrument with a grounded chassis, the chassis ground wire would safely conduct the fault current to ground. In the process, the current might trip a circuit breaker or blow a fuse, which would alert the user that the instrument has a problem. But the main reason for the ground wire is to provide a path for any fault current. No fault current will then flow through the user if he/she touches the chassis.

For the reasons just explained, do not cut off the ground terminals of power cords in order to make "floating measurements" — doing so defeats ground protection. (Floating measurements are referenced to a voltage other than ground potential.) Use safety-approved equipment or procedures for such measurements.



The market offers various products, such as the Tektronix A6901 Ground Isolation Monitor and the A6902B Voltage Isolator, that permit floating measurements.

One technique of making floating measurements is to use a buffer to isolate the device being tested from the measurement portion of the test instrument. The Tektronix A6902B Voltage Isolator uses this buffer technique, which extends the range of the test instrument to 3000 volts (DC + peak AC) or 500 volts (DC + peak AC), depending upon the type of probe used.

Another way of making floating measurements is to isolate the power supply of the test instrument from the AC power-line ground reference. The Tektronix A6901 Ground Isolation Monitor uses this method, which allows an instrument's chassis to float up to ± 40 volts (28 volts rms) from ground.

Safety symbols as marked on equipment

- ⚡ DANGER — high voltage.
- ⊕ Protective ground (earth) terminal.
- ⚠ ATTENTION — see operator's manual.

Safety symbols in manuals

- ⚠ ATTENTION — This symbol indicates the location of applicable cautionary or other information in Tektronix operator's and service manuals.

What is electric shock?

According to Stedman's Medical Dictionary, electric shock is "a sudden violent impression caused by the passage of a current of electricity through any part of the body." This says nothing about the magnitude of that current.

PLEASE SIGN IN INK

ASSUMPTION OF RISK AND RELEASE

Department of Electrical Engineering

SEMESTER: _____

Course (Lab): _____

Section: _____

Name of TA: _____

I have read and fully understand the written safety and other rules and precautions that are a part of the requirements for my participation in the above reference course, as well as those explained to me by my instructor(s), and I agree strictly to observe them; and

I do for myself, my heirs, executors, and administrators hereby accept full responsibility for and indemnify, release, and discharge the University of Hawaii, its officers, agents and employees from property damage, and/or personal injury which may result from my failure to abide by these safety rules and precautions, or from any inherent risks inside the course.

Name of Student (PRINT Last, First)

Signature

Date _____

Co-Signature of parent or guardian if student is under 18 years of age

Date _____