

Electrical Safety in the Laboratory

The purpose of this section is to advise laboratory occupants to develop and utilize appropriate work procedures for electrical safety and to remediate electrical hazards when possible. Electrical hazards for laboratory employees and students usually include shock, burn, or fire hazards. Electrical shocks occur when a part of the body becomes part of the electrical circuit. One way this can occur is by contacting a metallic part of a piece of equipment that has become energized by contact with an electrical conductor. The severity of the electrical shock depends on the following:

- The amount of the current (measured in Amperes or Amps);
- The pathway through the body;
- The duration of the exposure; and
- Whether the skin is wet or dry.

Roles and Responsibilities

Facilities Design and Construction (FD&C) specifies electrical design standards for FSU. FD&C oversees the design of electrical systems in new buildings as well as renovations and changes to existing buildings. Facilities Operations and Maintenance in each of the FSU work “zones” is responsible for responding to maintenance requests made by laboratory personnel and fulfilling those requests in a manner that meets the design guidelines set forth by FD&C. Contact the Service Center by calling 644-2424.

Laboratory personnel are responsible for their electrical equipment. Facilities Operations and Maintenance personnel must perform design changes to the building’s electrical infrastructure. Specific changes may be required when converting a dry laboratory to a wet lab environment or when a change in the electrical load exceeds the capacity in a given area (such as after a new laboratory is established in an existing space). Laboratory personnel are responsible for ensuring that electrical equipment connected to the building power system is in good condition.

The Department of Environmental Health and Safety (EH&S) provides electrical safety guidance for the University community. EH&S will respond to technical questions and provide individual assistance on electrical safety issues. EH&S inspects laboratories for electrical safety compliance and investigates all accidents resulting from electrical exposure.

General Requirements

Laboratory personnel typically encounter electricity in the form of hard-wired equipment (e.g. specialty microscopes, generators), plug-and-cord equipment (e.g. refrigeration, centrifuges, heating baths, electrophoresis devices), extension cords, and outlets. The following requirements must be followed to ensure electrical safety:

- All electrical equipment used by laboratories must be listed by a nationally recognized testing laboratory (NRTL), with a label showing its approval. It must be used in accordance with the instructions on the listing or labeling. Two examples of NRTLs include Underwriter’s Laboratory (UL) and Factory Mutual (FM). A full listing of approved NRTLs can be found on the [OSHA website](#) or [here](#)
- Work on electrical systems may only be done by an electrician that is properly licensed in the State of Florida. Under no circumstances may laboratory personnel undertake changes to the building electrical service.

- Laboratory personnel must always disconnect the power source to any electrical equipment before attempting service or repair.
- Live parts of electrical equipment operating at 50 volts or more must be guarded against accidental contact.
- A minimum 36-inch clearance must be maintained around electrical controls, panels and disconnects at all times. Greater clearance distances may be required when the equipment voltage is greater than 150V in conjunction with certain workplace conditions. Contact [EH&S](#) for more information.
- When unplugging a device, be sure to pull from the plug to prevent wiring damage.
- Never override electrical safety equipment such as guards or electrical interlocks.

Use of Extension Cords

In general, extension cords are not appropriate where a permanent wiring solution is available, regardless of convenience. Extension cords should be used only for temporary purposes and replaced with surge protectors if needed for longer periods of time. When extension cords are used, the following restrictions apply:

- Use only extension cords that are listed and labeled by a Nationally Recognized Testing Laboratory.
- Use only extension cords that are adequately rated for the intended use and environment. The rating must be denoted not only on the original package but printed on the extension cord insulating jacket. Review the capacity of the extension cord to ensure that you are staying within the cord's power rating.
- Use only extension cords with a minimum conductor size of 16 AWG (American Wire Gauge). If the device to be powered has a third prong or grounding pin, then only use extension cords with a grounding pin. Never remove the grounding pin to make a three prong cord fit in a two-prong outlet or use an adapter to make this connection.
- Extension cords may not be run through doors, windows, walls, or ceilings and may not be attached to building surfaces (i.e. walls, ceilings) by staples or other means.
- Extension cords must be protected from damage and may not be placed in such a way that they create a tripping hazard. Do not run extension cords under carpets or any other flooring for protection that was not designed for this purpose.
- Extension cords may not be plugged end-to-end or "daisy-chained."
- Extension cords must be inspected regularly for wear, as it is especially likely around the plug. Worn or frayed cords must be removed from service and replaced. Cracks in extension cords may not be repaired with electrical tape.

Use of Power Strips

Power strips permit more products to be plugged into the same outlet. While power strips may be convenient they may create safety hazards when used incorrectly. Power strips do not increase the amount of power available to a location, but rather more access to the same electrical source. A heavy reliance on power strips generally indicates that additional wall outlets are needed. Follow these procedures when using power strips:

- Use only NRTL (Nationally Recognized Testing Laboratory) tested power strips, and be sure they are used only as intended by their NRTL listing.
- Select power strips that are properly rated for the application. For example, in a wet chemistry laboratory the power strip must be rated for corrosive and indoor wet locations.
- Read and understand the manufacturer's instructions and limitations on the power strip. For example, the on/off switch on the power strip may not be designed to interrupt the power of the devices plugged into the strip during normal applications.
- Do not overload the circuit. Review the capacity of the circuit and the power requirements of all of the items plugged into it. This includes not only the items plugged into the power strip but other devices plugged into wall outlets along the same circuit.

Use of Clamp Lighting

Clamp lighting refers to lamps that can be attached to objects (such as desks, benchtops, or equipment) using a clamp connected to the lamp assembly. These devices are commonly available at many home and commercial product retailers. Clamp lighting poses special hazards in the laboratory due to the generation of heat and the potential for the equipment to accidentally fall. Follow these procedures when using clamp lighting:

- Use only NRTL (Nationally Recognized Testing Laboratory) tested clamp lights, and ensure they are used only as intended by their NRTL listing.
- Use clamp lights that are properly rated for the application. Many clamp lights cannot be used in a wet environment.
- Clamp lights may not be attached to any surface within 6 feet of a water source (e.g. sinks, emergency showers, water tanks). Clamp lights shall not be attached or used directly above any open water container or conveyance that they could fall into.
- Prevent lights from contacting combustible materials (such as paper goods). Move combustible materials at least three feet away from the lamp reflector surface. Move any combustible materials that could potentially fall onto the reflector surface to another location.
- Do not wrap excess cord around the lamp. The reflector surface gets very hot and may damage the cord jacket.
- Inspect cords daily prior to use for cracks, wear, or exposed conductor wires. Discard lamps with damaged cords.

Ground Fault Circuit Interrupters

Ground Fault Circuit Interrupters, or GFCIs, are designed to protect the end user from electrical shock. GFCIs are not required on all circuits in laboratories. Best management practices in laboratory safety call for all outlets within 6-feet of a water source (such as a sink) or in a wet environment to have GFCI protection. All maintenance requests and renovation designs must include a provision for GFCI protection under these circumstances.

If a laboratory currently has outlets with GFCI protection, they should be tested at least once per month. Laboratory personnel are responsible for testing the GFCI. To test the receptacle GFCI, first plug a lamp into the outlet and turn it on. Next, press the "TEST" button on the GFCI. Under properly functioning conditions, the GFCI's "RESET" button should pop out and the light will turn off. Press the "RESET" button to restore power to the outlet.

- If the “RESET” button pops out but the light does not go out, the GFCI has been improperly wired. Contact Maintenance to correct the wiring errors.
- If the “RESET” button does not pop out, the GFCI is defective and should be replaced.

Changes to Building Electrical Services

Changes to electrical services in the laboratory may only be performed by an electrician that is properly licensed in the State of Florida. Adding or modifying building circuitry or wiring is an example of a change to the electrical service. Changes are requested by contacting the Facilities Service Center at 644-2424.

Damaged or Defective Equipment

Any of the following circumstances requires that the user immediately take the equipment out of service:

- Experiencing shocks, even mild shocks, when the equipment is touched
- Abnormal heat generation
- Arcing, sparking, or smoking from the equipment.

Laboratory personnel must tag the equipment, “Do Not Use” and should arrange for equipment repair either through the equipment manufacturer or through their department support as appropriate.

Special Considerations

Please follow these guidelines when working with electrical equipment or devices:

- Laboratory personnel frequently construct equipment such as lighting fixtures or housings for use in specialty applications. All electrical equipment constructed by FSU employees or students must be inspected prior to use by a Florida licensed electrician or qualified electrical engineer. All electrical equipment must be constructed in accordance with the requirements of the current National Electric Code.
- If flammables are used, electrical equipment with motors must be rated for Class I Division 2 environments.
- Refrigerators used to store [flammable chemicals](#) must be certified by the manufacturer or be modified in accordance with NFPA 45, and require special posting. Contact the Laboratory Safety Office for information.
- Variac is a brand name for a type of variable transformer. These transformers are used to control the temperature of heating mantles and sometimes for the rate of a stirring motor, or heating a high vacuum line. Some older models of Variacs will keep whatever is plugged into them electrically live even though the Variac is switched off! Touching this device and ground at the same time could complete a circuit with your body and lead to electrocution.
- Install ground fault circuit interrupter (GFCI) devices for any outlets within 6 feet of a water source.

Electrophoresis

Electrophoresis, especially if performed with large gels, poses a risk of electric shock.

Please refer to the following guidance document for information about safely performing electrophoresis:

- Stanford University [Electrophoresis Safety](#)