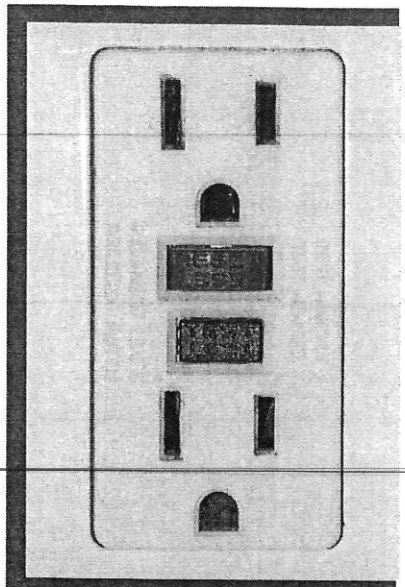
OSHA® QuickFacts

Laboratory Safety
Electrical Hazards

In the laboratory, workers may be exposed to electrical hazards including electric shock, arc blasts, electrocutions, fires and explosions. Potential exposures to electrical hazards can result from faulty electrical equipment/instrumentation or wiring, damaged receptacles and connectors, or unsafe work practices.

To avoid such hazards, follow these best practices:

- Always follow manufacturer's recommendations for using electrical equipment.
- Do not use electrical equipment to perform a task for which it is not designed.
- Most equipment includes either a 3-pronged plug or double insulation. Equipment with neither of these features is less safe but may meet electrical codes. You will not be protected from electric shock if a 3-pronged plug is not inserted into a 3-prong outlet.
- If you plug more than two pieces of low demand equipment into a standard outlet, use a fused power strip that will shut off if too much power is used.
- Make sure that any outlet near a sink or other water source is Ground-Fault Circuit Interrupter (GFCI) protected. If you have a GFCI, periodically test it by plugging something into it and pushing the "test" button. Once the equipment shuts off just turn it back on.
- Above all, do not disable any electrical safety feature.
- Before turning equipment on, check that all power cords are in good condition.
- Do not use extension cords as a substitute for permanent wiring.
- If you see a person being electrocuted, DO NOT TOUCH THEM! The electricity can go through you, too. If possible, turn off the power (pull the plug or trip the circuit breaker), or use an item made of non-conductive material (e.g., wooden broom handle) to pry him or her away from the contact. Call 911 immediately.



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For assistance, contact us. We can help. It's confidential.

OSHA® **Occupational Safety and Health Administration**
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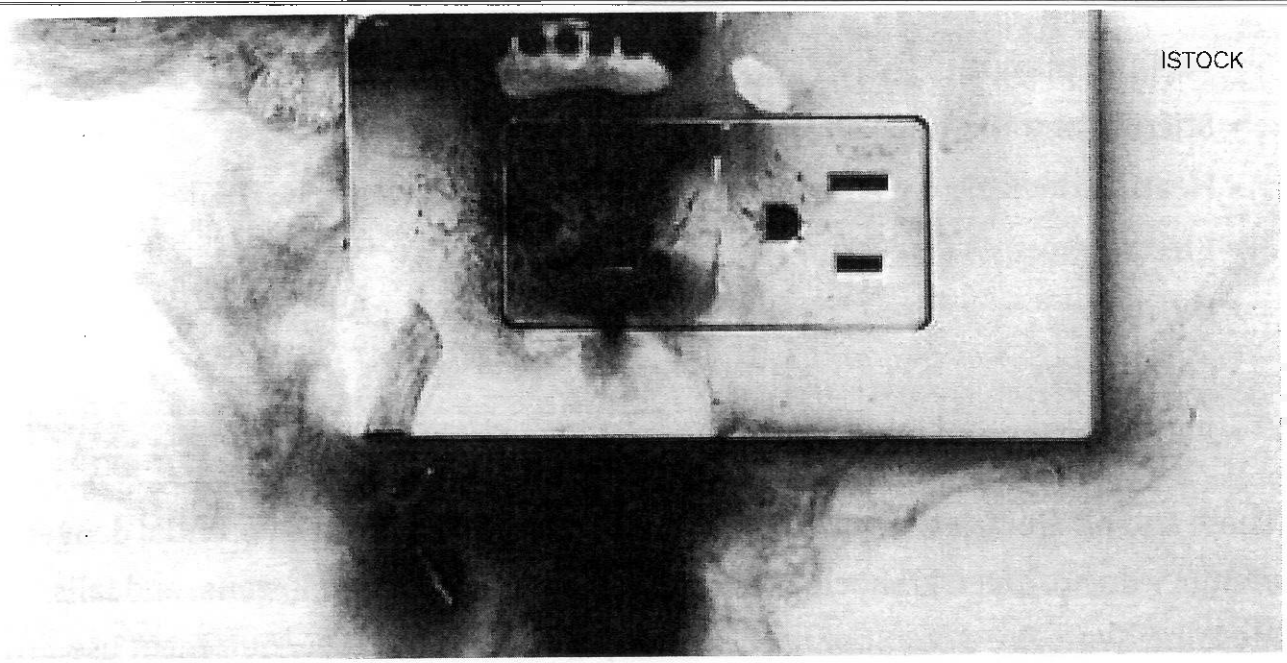
Lab Health and Safety



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Electrical Safety in the Laboratory

Electricity powers nearly everything used in the lab, but the associated hazards should never be overlooked

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52

Electricity has long been recognized as a serious workplace hazard. However, because electricity has become such a familiar part of our daily lives, we tend to overlook the hazards electricity poses, and fail to treat it with the respect it deserves.

Today's laboratories rely on a vast array of electrically powered equipment. Examples of equipment that are routinely used in day-to-day operations include:

- Vacuum pumps
- Stirring and mixing devices
- Heating devices (e.g., hot plates, heating mantles, ovens, etc.)
- Electrophoresis devices
- UV lamps
- Centrifuges
- Refrigerators and freezers

These and all electrical devices used in the lab setting present a potential danger of injury due to electric shock, electrocution, burns, fires, explosions, and falls. Most incidents are a result of unsafe work practices, improper equipment use, and faulty equipment.

Effects of electric shock

The significant hazards associated with electricity are electrical shock and fire. Electrical shock occurs when the body becomes part of the electric circuit. The effect of an electric shock may range from a slight tingling sensation, to severe burns, to immediate cardiac arrest. The severity and effects of an electrical shock depend on four main factors:

- The current's path through the body
- The amount of current flowing through the body

- The length of time the current passes through the body
- Whether the skin is wet or dry

Even if the electrical current is too small to cause injury, a person's reaction to the shock may cause them to fall, resulting in bruises, lacerations, broken bones, or even death. In addition to the electrical shock hazards, sparks from electrical equipment can serve as an ignition source for flammable or explosive vapors or combustible dust.

Electrical safety 101

Laboratory personnel can significantly minimize electrical hazards by following basic safety guidelines. Workers should always maintain awareness of the condition of laboratory equipment and ensure that it is in operable condition. Equipment with frayed or damaged cords, missing ground prongs, cracked tool casings, etc., should be removed from service immediately. Defective equipment should then be tagged and repaired by a qualified electrician or discarded and replaced. Ensure that all electrical outlets are properly grounded and can accept three-prong plugs. All electrical equipment should have a three-pronged, grounded plug or be double-insulated. Do not use 3-to-2 prong adapters.

Minimize the potential for water or chemical spills near electrical equipment. Ensure that any outlets near sinks and potentially other wet locations have ground-fault circuit protection. Ground-fault circuit interrupters (GFCIs) disconnect current if a ground-fault is detected and protect the user from electric shock.

Electrical outlets, wiring, and other electrical equipment—whether integral to the building or used in the laboratory—should only be serviced and repaired by qualified trades personnel or other qualified electricians. Repair work on hardwired equipment must only be carried out by qualified individuals who have received Lockout/Tagout training.

Circuit protection

Fuses, circuit breakers, and ground-fault circuit interrupters (GFCIs) are three well-known devices designed to automatically cut power when certain dangerous situations occur. Fuses and circuit breakers are designed to protect the laboratories' electrical systems from overheating and fire, and control the electrical current for a specific outlet or room. If too much current flows (based upon the wire's diameter and resistance rating), the wire may get hot and start a fire. To prevent this, fuses or circuit breakers detect when too much electricity is flowing and will blow fuses or trip circuit breakers.

All of a laboratory's fuses or breakers are located in a main breaker or panel box. Every breaker box also includes a master switch, which cuts power to the entire laboratory at once. This overload protection is beneficial for equipment left on for extended periods or when too many devices are plugged into the same outlet. Overloading not only can cause overheated wires and arcing, but can cause electrical shock and fire.

In contrast to fuses and circuit breakers, a GFCI is a specialized outlet with a built-in breaker. These devices are designed to prevent shock in the event an electrical device comes in contact with water. If the equipment were to contact with water, the breaker inside the GFCI would trip, automatically switching off the current. All power outlets that could be exposed to wet conditions, such as near a sink or where a leak or spillage could occur, should be equipped with GFCIs.

Grounding and bonding

Electrical grounding and bonding are essential safety practices for preventing static discharge and reducing the possibility of a fire. The bonding and grounding process can be defined as providing an electrically conductive pathway between a dispensing container, a receiving container, and an earth ground. This pathway

helps eliminate the buildup of static electricity by allowing it to dissipate into the ground safely.

All flammable liquids [defined by the fire code as having a flashpoint of less than 100°F (38°C)] need to be bonded and grounded during dispensing. Transferring a liquid from one metal container to another may result in static electrical sparks. It is important to bond metal dispensing and receiving containers together before pouring to prevent the buildup of static electricity and prevent sparks from causing a fire.

Bonding is accomplished by making an electrical connection from one metal container to the other. This ensures that there will be no difference in electrical potential between the two containers, and, therefore, no sparks will be formed. Grounding is done by connecting the container to an already grounded object that will conduct electricity. This could be a buried metal plate, a metallic underground gas piping system, metal water pipes, or a grounded, metal building framework.

Lab refrigerators electrical safety

Whenever a refrigerator or freezer is needed to store flammable liquids, a UL-listed flammable materials storage refrigerator or freezer is required. Flammable material refrigerators and freezers are designed to prevent the ignition of flammable vapors inside the storage compartment, as these units do not have any internal ignition sources.

When refrigeration or freezing of flammable materials is needed, and the air outside the refrigerator might be explosive, explosion-proof refrigerators are required. Explosion-proof refrigerators are designed to prevent the ignition of flammable vapors or gases that may be present inside or outside the storage compartment. It is generally used in a work area where flammable liquids will evaporate, and vapors can build up inside or outside the unit. A good example

would be a location such as a solvent dispensing room where an explosive atmosphere may develop at some time in the room.

All ordinary domestic refrigerators and freezers should be labeled with the phrase, "No materials with a flashpoint below 100° F (38°C) may be stored in this refrigerator/ freezer," or "Not for flammable storage."

Explosion-proof models require special hazardous-location hardwiring rather than simple cord and plug connections. This refrigerator type is not plugged into a wall receptacle but hardwired directly into the building's electrical system. Standard use refrigerators cannot be used to store flammable materials.

Be prepared

Know the location and how to operate shut-off switches and circuit breaker panels so that power can be promptly shut down in the event of a fire or electrical accident. Be sure to always leave at least a three-foot clearance around electrical panels for ready access.

Plan for what steps will be taken in the event of a power loss. Loss of electrical power can create hazardous situations. If fume hoods cease to operate, the hoods may release flammable or toxic vapors into the laboratory. If a refrigerator or freezer fails to work, harmful vapors may be emitted as stored chemicals warm. If magnetic or mechanical stirrers fail to operate, safe mixing of reagents may be compromised.

Emergency procedures

All laboratory workers must be trained in, and be familiar with, applicable emergency procedures [29 CFR 1910.1450(f)(4)(i)(C)]. They should be able to safely respond to a laboratory fire and electrical shock incidents, and be able to evacuate personnel and call for emergency assistance. Employees should know

the location of the fire alarm pull station, fire extinguishers, main panel box, exits, shower/eye wash, first aid kit, and emergency telephone numbers.

OSHA standard 1910.151(b) requires the employer to ensure prompt first aid treatment for injured employees. Emergency medical services can be provided either onsite by a person trained in first aid, or by ensuring that emergency treatment services, such as an infirmary, clinic, or hospital, are in near proximity to the workplace.

OSHA standards address electrical safety

Employers are responsible for complying with the Occupational Safety and Health Administration's (OSHA) general industry electrical safety standards as published in 29 Code of Federal Regulations (CFR), 1910 Subpart S -Electrical. Subpart S addresses electrical safety requirements for the practical safeguarding of workers in their workplaces.

OSHA's electrical standards are based on the National Fire Protection Association standards (NFPA), NFPA 70, National Electrical Code (NEC), and NFPA 70E, Standard for Electrical Safety in the Workplace.

References:

1. Code of Federal Regulations, 29 CFR 1910 Subpart S - Electrical. Gov't. Printing Office. Washington, DC 20402 [latest edition].
2. Occupational Safety and Health Administration (OSHA). US Department of Labor. Laboratory Safety Guidance. OSHA 3404-11R, 2011.
3. National Research Council. 2011. Prudent Practices in the Laboratory: Handling and Management of Chemical Hazards, Updated Version. The National Academy Press, Washington, DC.
4. UAW (United Auto Workers). 2012. Electrical Safety in the Workplace. This material was produced under Grant #SH-16600-07-60-F-26 from the