Electrical Safety, Grounding, and GFCIs

"It is the employer's responsibility to provide *either:*

(a) **GFCIs on construction sites for receptacle outlets in use and not part of the permanent wiring of the building or structure**; *or*

(b) a scheduled and recorded assured equipment grounding conductor program on construction sites, covering all cord sets, receptacles which are not part of the permanent wiring of the building or structure, and equipment connected by cord and plug which are available for use or used by employees."

(OSHA's Safety and Health Regulations for Construction)

Habitat for Humanity of Metro Denver provides GFCI-protected *temporary* power sources and GFCI-protected power in the *permanent* structure on every construction site.

Also outlined within the *Safety Policies* are safe inspection and operating practices for all permanent, temporary, and portable sources and conductors of electricity on site.

Overview: Electricity and Conductivity

Electricity always follows the quickest path to the ground.

- It will travel through *any* conductive material (such as water, metal, some chemical solutions… and the human body).

- It will NOT travel through insulators: glass, wood, rubber or plastic.

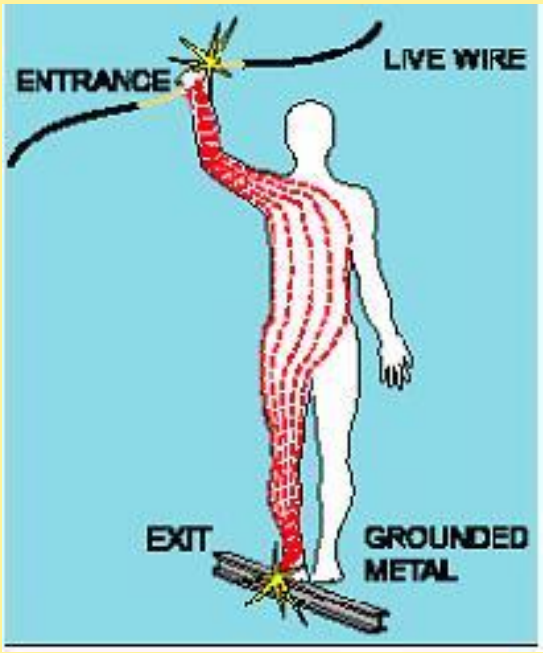
*nerd fact: **Water** is a terrible **conductor** of electricity. Pure **water** is actually a good insulator. However, **water** is a great ionic solvent: liquid in which ionic compounds can dissolve easily. It's those dissolved ions that can conduct well - and when **water** contains many dissolved ions, those ions make a good **conductor**.

- If you come into contact with live electrical parts or wires, electric current will pass *through your body* on the quickest path to the ground, delivering a shock and possibly severe burns or death.

Electrical Grounding

When there is **current leakage** from a tool or piece of equipment, the current will flow through any available conductor until it reaches the ground.

- Since your body is in contact with the tool, *you* are the nearest conductor unless the tool is grounded.



To prevent **ground-fault hazards**, it is HFHMD's policy that:

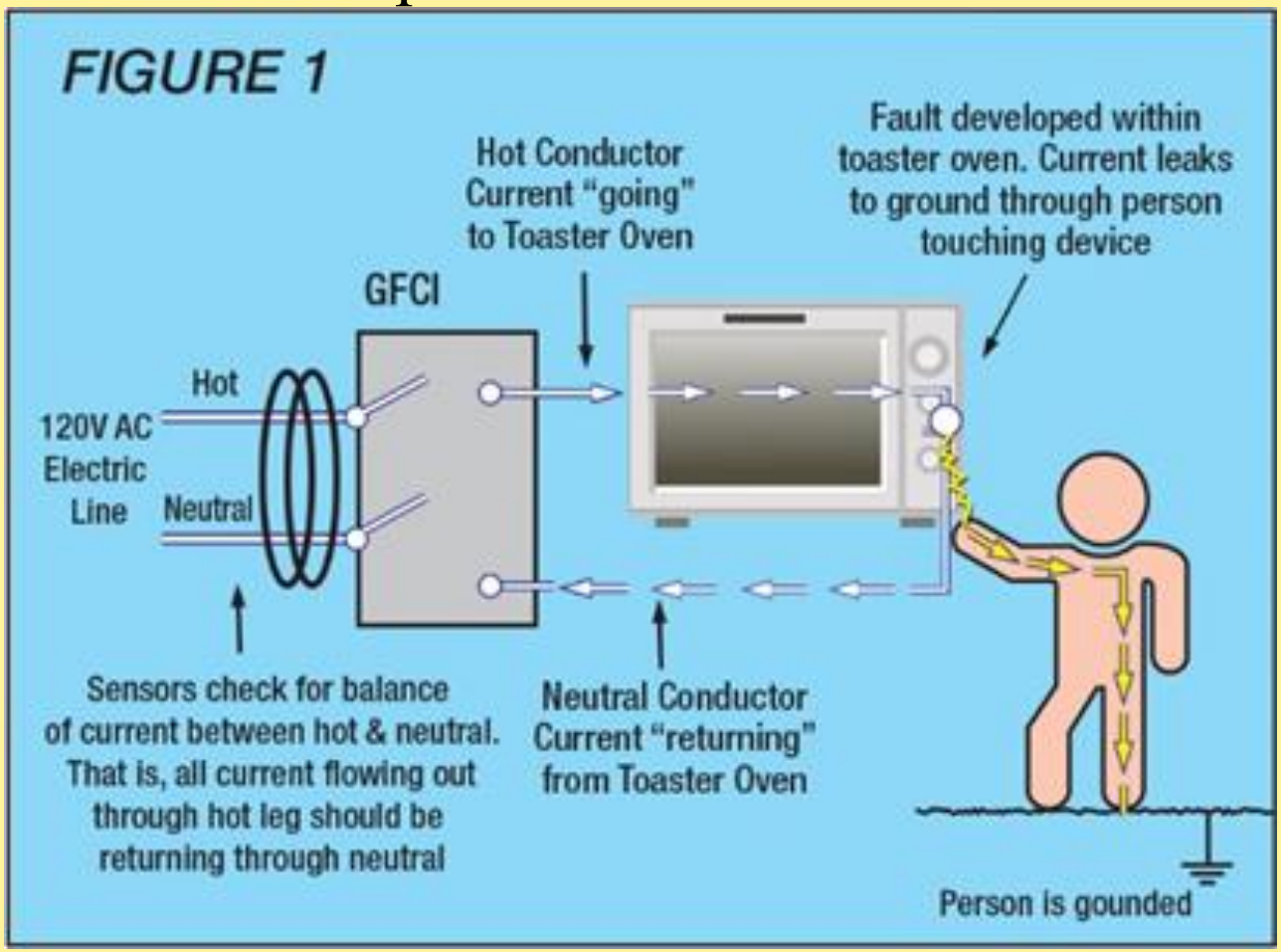
All electrical tools should be connected by a double-insulated, three-pronged, grounded plug *and* should be plugged into a Ground Fault Circuit Interrupter (GFCI).

Ground Fault Circuit Interrupters

(GFCIs)

A GFCI is a fast-acting circuit breaker.

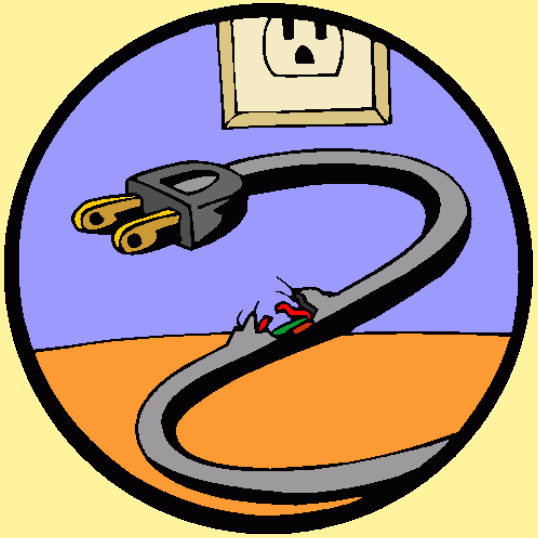
- It senses imbalances in a circuit caused by current leakage (which could lead to a ground fault and injury).
- In a fraction of a second, it shuts off the electricity.
- This is what "trips" the circuit.



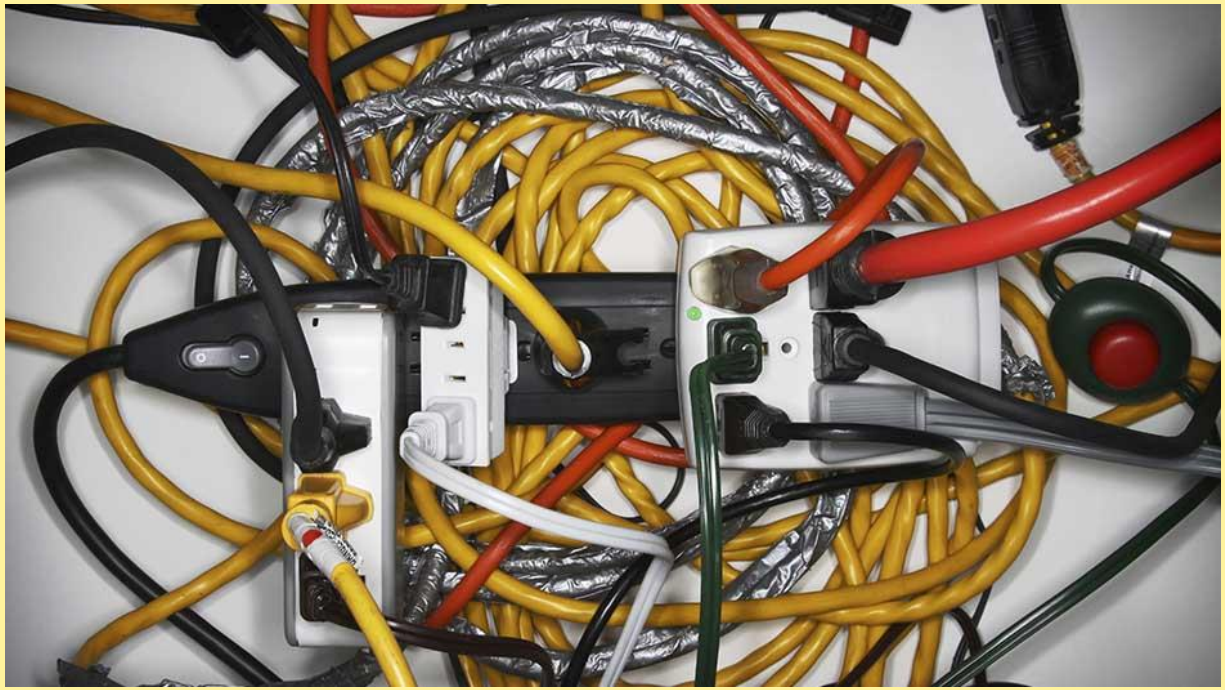
If GFCI trips, it's an indicator of a larger problem than temporarily lost power:

It means electrical leakage somewhere between the tool in use and the source of power.

- Do *not* reset a GFCI until verifying that all cords and tools are undamaged, under no stress, and that all connections are secure and free of moisture.



- GFCI's can trip as a result of "cumulative leakage," which can be the result of an extremely long circuit (too many end-to-end cords) or overloading one circuit with too many tools
  - The otherwise negligible loss of energy from each tool and connection add up to enough to trip the breaker.
  - Adjust these circuits to bring tools closer to the power source.



HFHMD Electrical Grounding and Safety Program

Temporary power sources

Our Policy:

- **All temporary power will be GFCI-protected.**
- **Each site under construction must have a sufficient amount of GFCI-protected power:**

Single family homes must be provided with a *minimum* of 3 circuits (60amps).

Duplexes must be provided with a *minimum* of 4 circuits (80amps).

Multiple-unit sites must *average* 3 circuits per unit under construction.

Staff and AmeriCorps are responsible for:

- **Testing temporary electrical service GFCIs weekly** by depressing the "Test" button and ensuring receptacle functionality.
- Ensuring weather-proof guards are in place over outlets.
- **Conducting a monthly visual inspection** of the entire temporary power system for damage, including:
  - Damaged or disconnected grounding wire, damaged or missing receptacle covers, damaged or missing panel cover, damaged or malfunctioning meter, any risk of interference to overhead temporary power connections (such as trees, structures, etc.).
- Immediately contacting a professional electrician to make repairs in the event of damage.

Power cords, grounding, and testing

Because power cords are exposed, flexible, and unsecured, they are in more risk of damage than permanently fixed wiring.

Staff and AmeriCorps are responsible for:

- **Visually inspecting everything for any damage.**
  - That's each cord set, attachment cap, plug, and receptacle of cord sets (as well as any equipment connected by cord and plug).
  - Damage includes: deformed or missing pins, insulation damage (cuts, abrasions, tears), indications of possible internal damage (crimps indicating crushing), missing/damaged grounding plug, etc.
- **Taking out of service any equipment found damaged.**
  - It should be labeled, removed from use and repaired and tested before being returned to service.
- **Taking out of service any equipment *suspected* to be damaged**
  - If it has been exposed to an incident, such as a cord run over by vehicle, pinched in a doorway, crushed in a window, strained from pulling, etc.

Staff and AmeriCorps are responsible for:

- **Testing for continuity each extension cord located in their respective tool trailers before the start of every new build.**
  - Tool trailers remaining on a single site for more than three months shall have all their extension cords tested at minimum every three months.

Basic continuity tester, similar model available at Warehouse for testing cords in tool trailers.

Staff and AmeriCorps are responsible for:

- **Ensuring all construction equipment is plugged into a GFCI inside a wired house.**
- **Ensuring that only GFCI-protected outlets are powered in a house while under construction.**
  - On each home, this will include: kitchen countertops, bathroom(s), outside receptacles, and garage receptacles (where applicable).
- **Never leaving an electrical panel door off or open.**

Electrical Injuries and Emergencies

ELECTRICAL SHOCK

Electricity follows the easiest path to the ground.

So if you touch a live electrical part while you are in contact with the ground, current passes through *you* to the ground, causing **shock**.

<u>Shock can cause:</u>

- Heartbeat and breathing to stop
- Muscle contractions that result in falls, broken bones, and/or bruises
- Severe internal and external burns.

<u>The effects of shock depend on:</u>

- The type of circuit
- Its voltage
- How it travels through the body
- How long it lasts.

Responding to Electrical Injuries

Check the scene and the victim.

- Can you approach safely?
- Is anyone else in danger?
- De-energize the power source IF POSSIBLE SAFELY
  - Turn off any breakers and circuits, but do not touch an electrical cord to remove it if it is the source of electrocution.
  - Do not touch any downed power lines.

Call 911.

- Follow instructions from emergency personnel.

Responding to Electrical Injuries

Move the victim away from power safely.

- Never touch a person who is in contact with a source of electricity.
- If you can't turn the power off, use a non-conducting tool (such as a rope or wooden stick) to move the person or move the source away from them.

Make sure you do not complete a circuit while moving victim.

- This could be between two wires or between one wire and the ground.
- If the victim is touching a power line, *stay clear*.

Responding to Electrical Injuries

If it safe to do so, CARE for the victim:

- Check breathing and pulse. Give rescue breathing and/or CPR is necessary.
- Treat minor burns at the point of contact with cool water, then cover with a clean, dry cloth.
- Cover serious burns with a sterile, dry cloth and get immediate medical attention.
- Treat victim for shock by keeping him/her lying down until professional help arrives.

Responding to Electrical Fires

Use a class C fire extinguisher on small electrical fires.

- A class C fire requires an agent that can break apart the elements that feed a fire: oxygen, heat, and fuel. Carbon dioxide (CO2) extinguishers smother a fire by eliminating the oxygen. They also suppress the fire's heat because their discharge is very cold. Similarly, dry chemical extinguishers work to separate the elements of a fire. The fire dies when the oxygen and fuel can no longer interact due to the chemicals introduced by a dry chemical extinguisher. These Class C fire extinguishers may contain monoammonium phosphate, potassium bicarbonate, or potassium chloride, all of which are suitable for putting out class C fires.

***Never* use water on an electrical fire.**

If the fire is large or growing rapidly, evacuate.

Responding to Downed Power Lines

- If you see a downed line, assume it is live.
- Stay away from it and call for help.
- If the wire hits your vehicle, stay in side.
- If the vehicle catches fire, jump out, being careful not to touch the vehicle and the ground *at the same time*.