

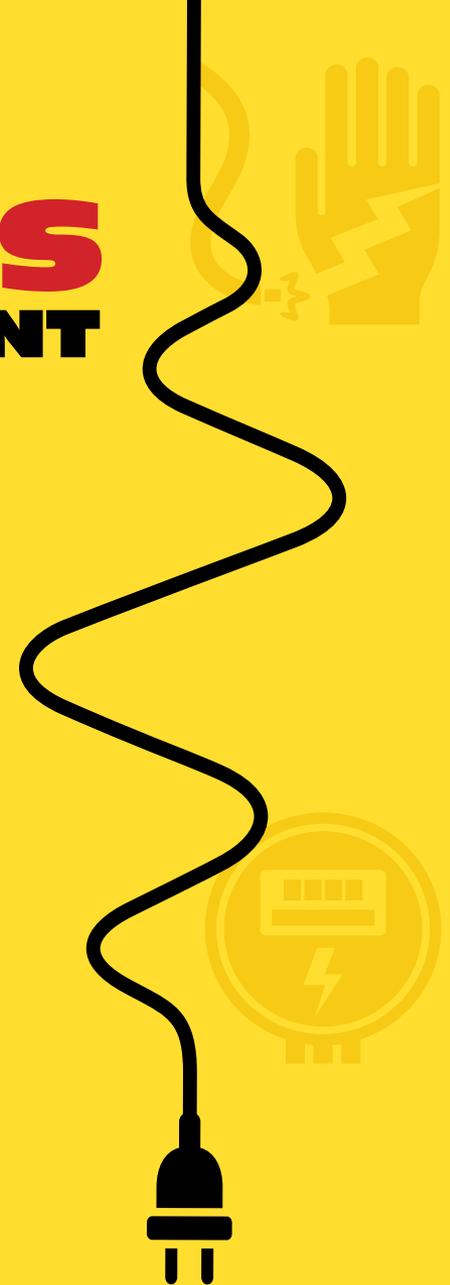
RISKY BUSINESS

YOUR ELECTRICAL EQUIPMENT

ES101



Self-Study September 2014



ELECTRICITY KILLS

- **Each year in the US, electrical incidents result in nearly 300 deaths and more than 3,500 injuries in the workplace.**
- **According to the National Fire Protection Association, 47,700 home fires in the U.S. are caused by electrical failures or malfunctions each year.**

**YOU CAN PREVENT ELECTRICAL
INJURY TO YOURSELF, YOUR
FAMILY, AND YOUR COWORKERS**

TYPES OF INJURY FROM ELECTRICITY

1. Shock

- Nervous system
- brain, heart, breathing

2. Shock

- Muscles- reflex action
- no-let-go

3. Short Circuit

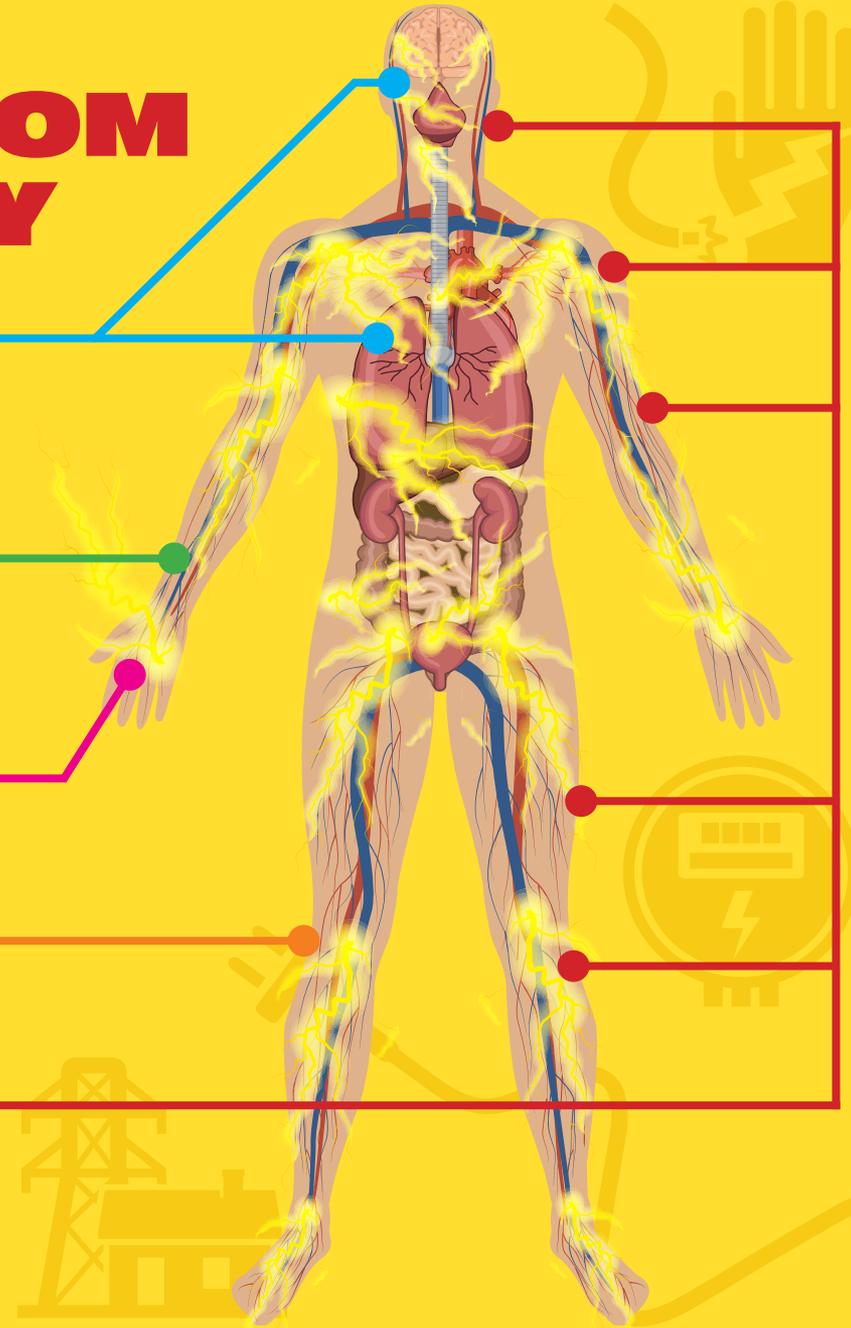
- Contact burns

4. Shock

- Internal burns

5. Arc Flash

- External burns, shrapnel, blast



WHO REQUIRES SAFE ELECTRICAL EQUIPMENT?

- **Public facilities, homes, industry, and utilities**
- **Workplace**
 - Equipment must be NRTL listed or approved by the local Authority Having Jurisdiction (AHJ)
 - Army requirement that all equipment is NRTL listed
 - Must be used in the environment and manner in which it was intended
- **Home**
 - Equipment should be NRTL listed per consumer product safety organizations

WHAT IS A NATIONALLY RECOGNIZED TESTING LABORATORY (NRTL)?

NRTLs are third-party organizations *Recognized* by OSHA as having the capability to provide *Product Safety Testing* and *Certification* services to manufacturers of a wide range of products for use in the American workplace.

Such as Underwriters Laboratories.



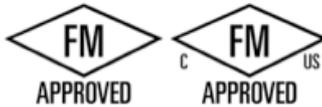
SAFE ELECTRICAL DESIGN ASSURED BY NRTL LISTING

The following are the NRTLs for electrical equipment recognized by OSHA

Most Common



UL marks on components to be used as a part of a system



Less Common



MOST COMMON LISTED EQUIPMENT NRTL SYMBOLS

Electrical Equipment approved by a Nationally Recognized Testing Lab (NRTL).

www.osha-slc.gov/dts/otpca/nrtl/nrtlmrk.html



NOTE:

"CE" IS NOT AN NRTL.



ACCIDENTS IN THE HOME ON UNLISTED ELECTRICAL EQUIPMENT

- **1960s - 3000 deaths per year**
 - Metal enclosure, insulation failure
 - Equipment grounds implemented
- **1970s - 1000 deaths per year**
 - In the bathroom or kitchen
 - GFCIs implemented
- **Today - 500 electrocutions (work and home) per year**
 - Unlisted electrical equipment
 - Modification or damage of equipment
 - Misuse of equipment

**IT IS UP TO YOU TO USE ELECTRICAL
EQUIPMENT SAFELY TO PROTECT
YOURSELF AND YOUR FAMILY**

SOURCES OF UNLISTED ELECTRICAL EQUIPMENT IN THE HOME

- **Discount stores**
- **Garage sales, antique shops, flea markets**
- **Mail order (especially deep discount)**
- **Foreign made**
- **Any equipment older than 30 to 40 years, the listing may no longer be adequate because it has not been updated to address grounding, polarization, and/or double insulation.**

**GROUNDING!, POLARIZATION!,
DOUBLE INSULATION!**

SOURCES OF UNLISTED ELECTRICAL EQUIPMENT IN THE LAB

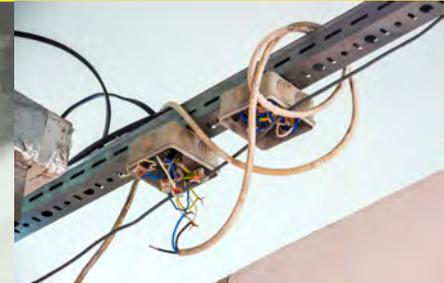
- **In-house built**
- **Brought in from another site/lab**
- **Commercial**
 - Custom built
 - High expense, low production quantity
 - Small company
 - Unique market
 - R&D application

SOMETIMES NRTL MARKINGS ON EQUIPMENT ARE COUNTERFEIT. BE SUSPECT IF A PRODUCT IS UNREASONABLY LOW COST, SEASONAL, OR IMPORTED.

WARNINGS FOR ELECTRICAL HAZARDS

- **Warnings labels on the outside of electrical equipment contain:**
 - **Danger, Warning, Caution - to get your attention**
 - **An international symbol of the hazard**
 - **A description of the hazard (shock, arc flash, laser)**
 - **An instruction for what to do, how to use.**
- **Instructions for the public often say**
 - **Do NOT open, no user serviceable parts**
 - **Take to qualified repair only**
- **Examples - laser pointer, DVD player, microwave oven, batteries, etc.**

HOW TO RECOGNIZE AND AVOID ELECTRICAL HAZARDS



GROUNDS

CURRENT TRAVELS IN A COMPLETE CIRCUIT WHICH RETURNS TO ITS SOURCE

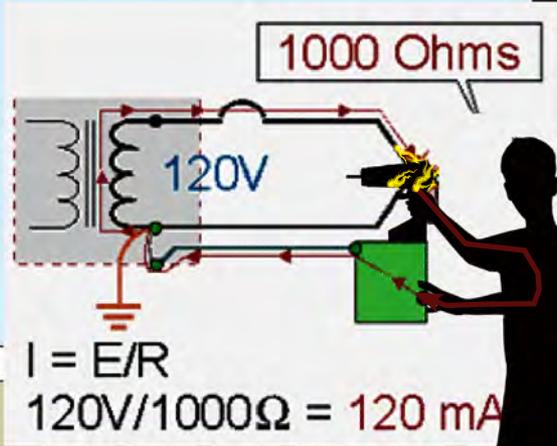
Electrical Shock

The body becomes part of an electrical path.

Line-to-ground fault energizes metal parts.



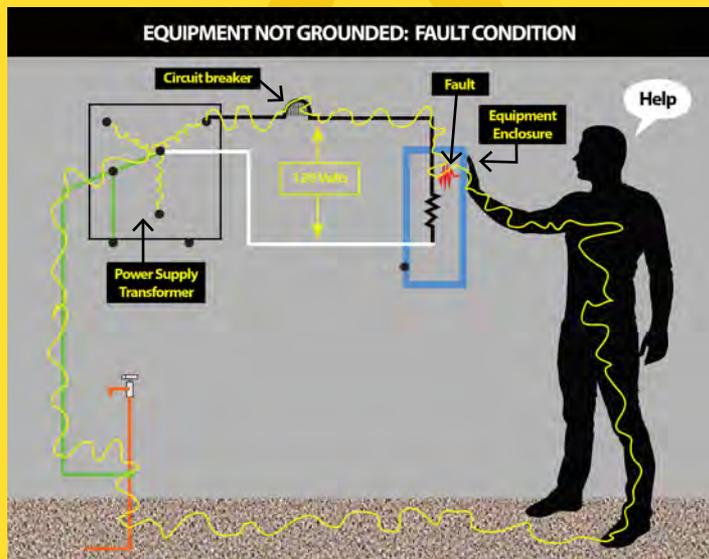
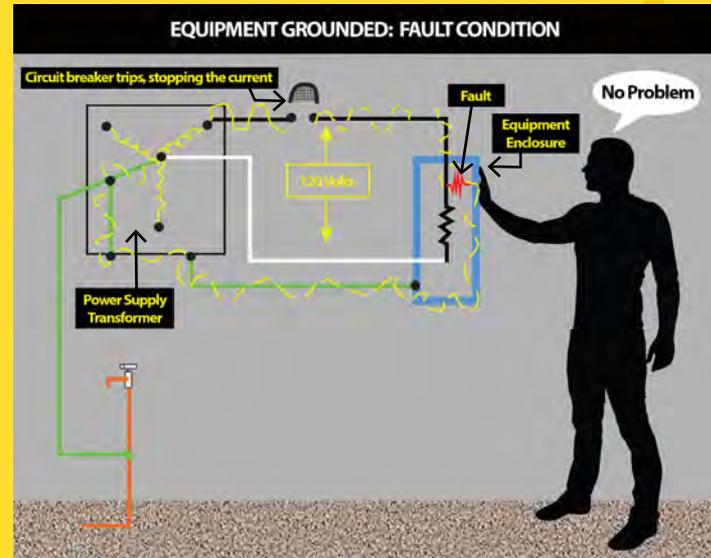
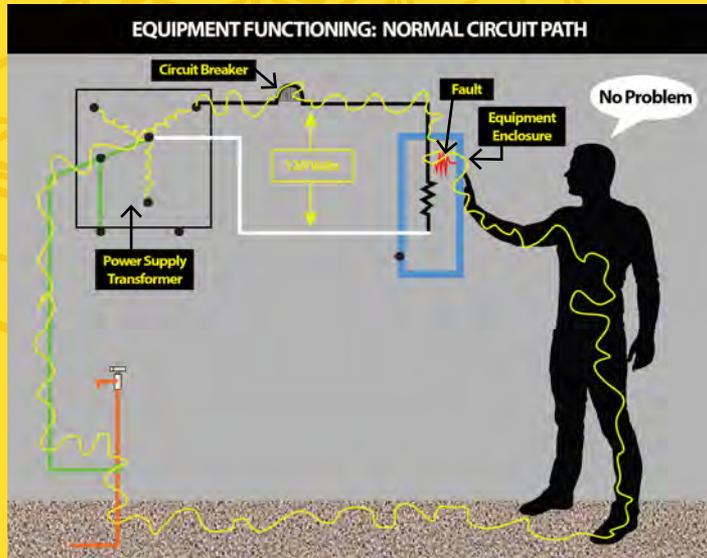
Grounded Object or Surface



The current passing through the body is the key factor in any shock accident.

REPORT ALL DEFECTIVE EQUIPMENT TO AN SME IMMEDIATELY.

GROUNDING BASICS



- **Most electrical tools and equipment are required to be grounded.**
- **Grounding makes equipment safe by:**
 - ~ Providing a low-impedance path for any unintended voltage that is present on a metal parts of the equipment.
 - ~ Facilitating operation of an over-current device (fuse or circuit breaker), when internal wiring contacts the equipment case. This is called a Ground Fault.

INSPECT CORDS BEFORE EACH USE

Always inspect extension cords and cords on tools and appliances for damage before plugging them in. Remove from service damaged or frayed cords.



**STAY CLEAR OF BARE
OR EXPOSED WIRING!**

PLUGS



- Never remove the ground pin (the third prong) this could lead to an electrical shock.
- Violation shown here is a power strip with a missing grounding prong.

**IF THE GROUNDING PIN IS MISSING,
DO NOT USE THE EQUIPMENT AND
REPORT IT TO YOUR SUPERVISOR
OR SAFETY OFFICER.**

INCORRECT USE

NOT PERMITTED AND SHOULD BE TAKEN OUT OF SERVICE!

Electrical boxes with knockouts are designed to be installed in or on walls. Use one-piece metal or plastic design.



NEVER DAISY CHAIN EXTENSION CORDS (PLUGGING INTO EACH OTHER)



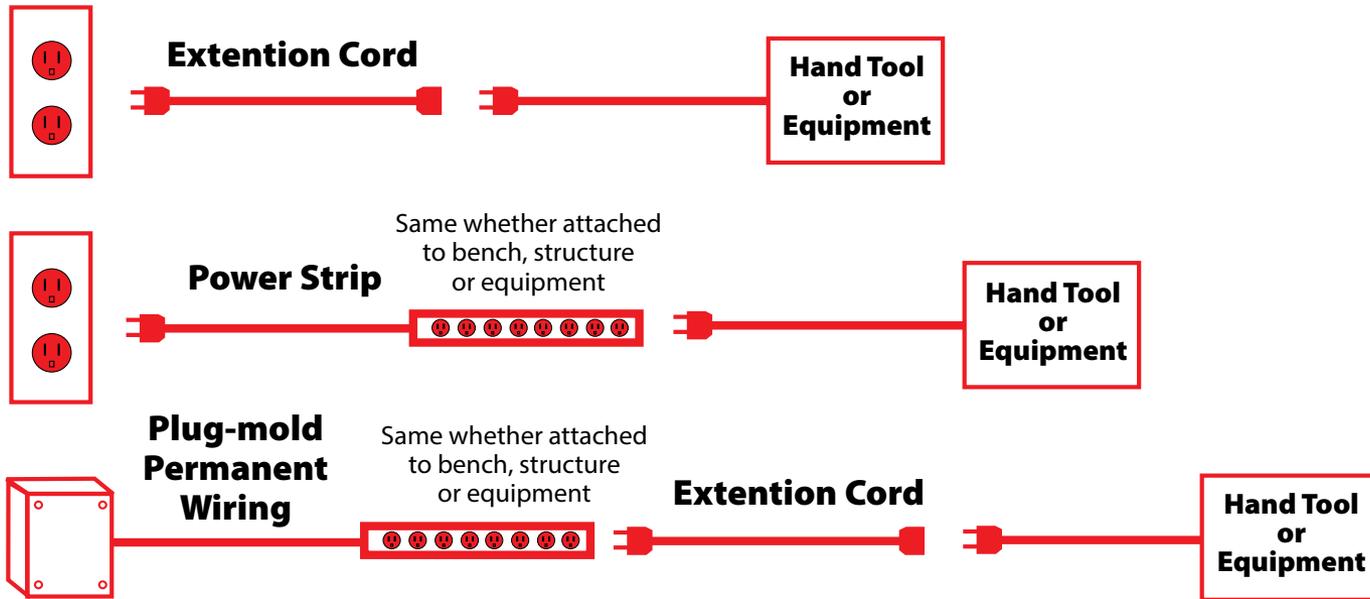
**Daisy chaining
can cause cords to
become overheated
and result in a fire
and/or damaged
equipment.**

NEVER DAISY CHAIN MULTIOUTLET STRIPS (PLUGGING INTO EACH OTHER)



ACCEPTABLE COMBINATIONS OF EXTENSION CORDS & POWER STRIPS

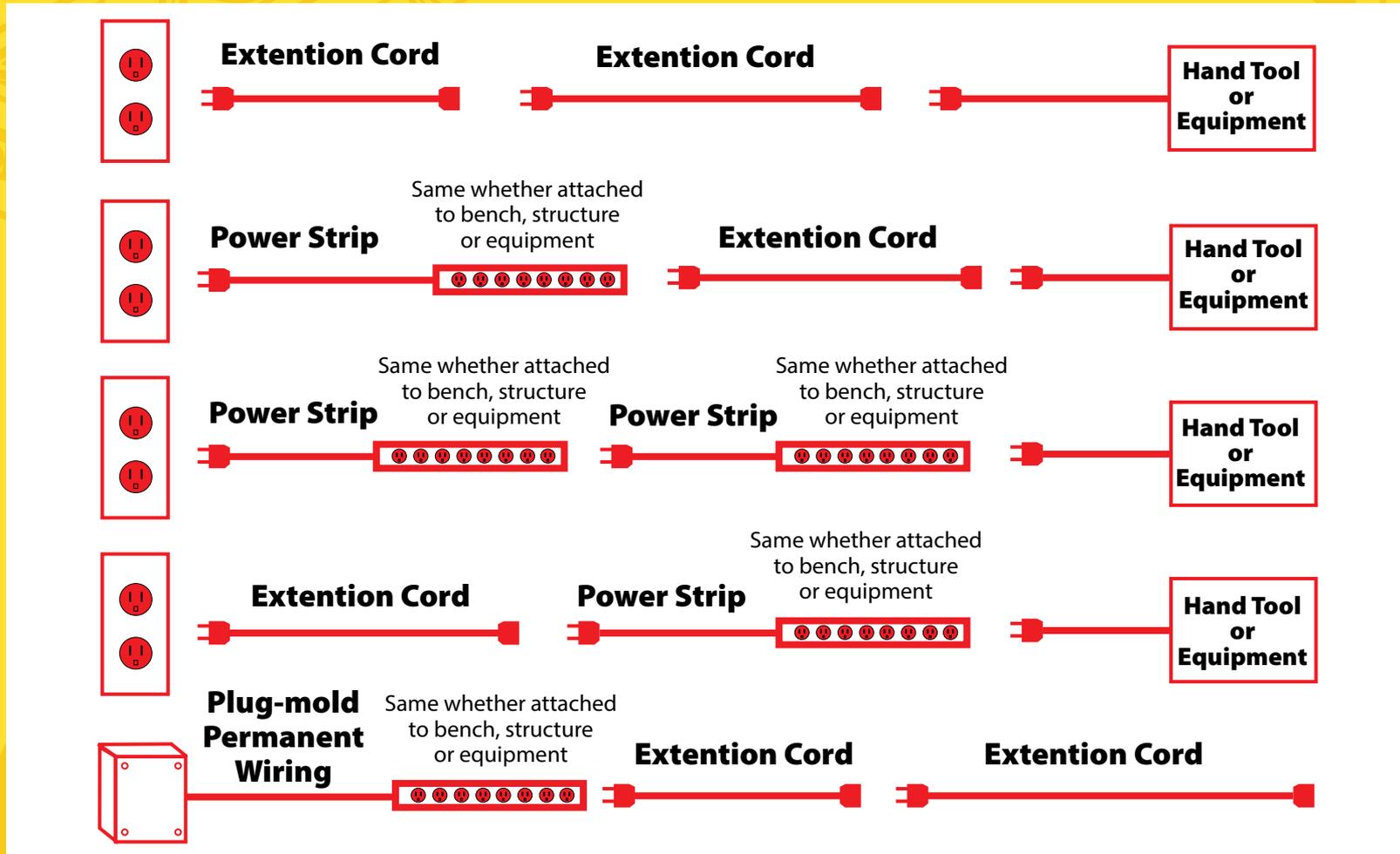
Pictured are some typical examples of proper use of extension cords/power strips.



Use of a GFCI device, sometimes called a "GFCI pig-tail," with an extension cord does not violate this policy and may be required for your application.

UNACCEPTABLE COMBINATIONS OF EXTENSION CORDS & POWER STRIPS

Pictured are some commonly seen violations of no daisy-chain policy.



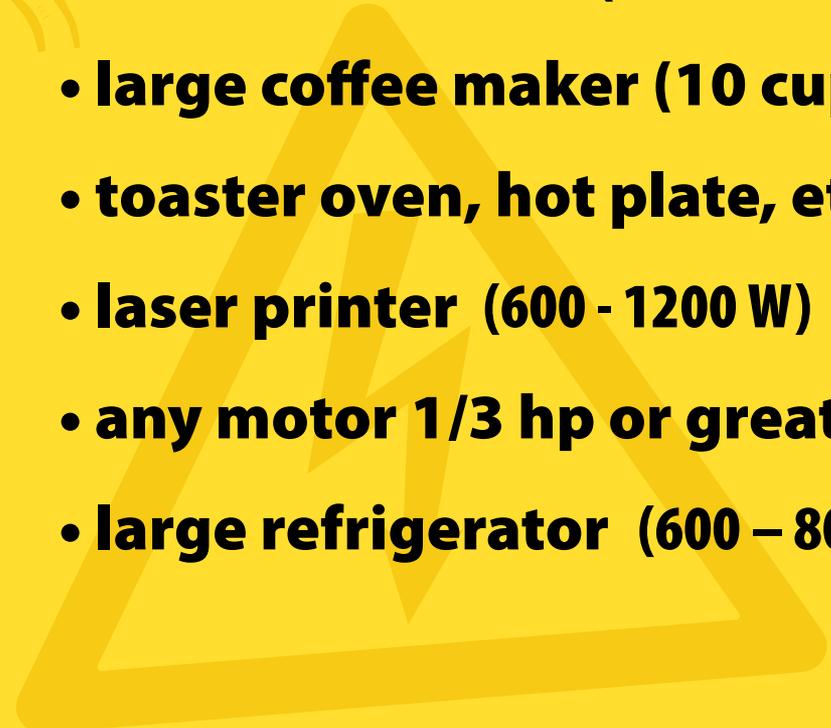
Note that acceptable and unacceptable combinations of extension cord use are not limited to the examples above, these examples have been chosen as representative of usual applications found.

RELOCATABLE POWER TAPS MAY CONTAIN SURGE SUPPRESSION



NEVER PLUG THESE INTO A POWER TAP



- **window air conditioner (1200 – 3000 W)**
 - **space heater (1000 – 1800 W)**
 - **microwave oven (1100 – 2000 W)**
 - **large coffee maker (10 cup) (1200 W)**
 - **toaster oven, hot plate, etc. (1200 - 1500 W)**
 - **laser printer (600 - 1200 W)**
 - **any motor 1/3 hp or greater (> 750 W running, > 1,500 W startup)**
 - **large refrigerator (600 – 800 W running, > 1,500 W startup)**
- 
- 
- 

ALLOWED IN A POWER TAP, ADD INDIVIDUAL POWERS TO GET TOTAL POWER

- **small coffee pot (4 cup) (650 W)**
- **computer with monitor (200 – 500 W)**
- **inkjet or dot matrix printer (100 – 200 W)**
- **small refrigerator (300 W)**
- **clock radio, small radios, VCR (50 – 100 W)**
- **small portable fan (200 – 300 W)**
- **slow cooker (200 W)**
- **charger (cell, PDA, etc.) (< 5 W)**
- **laptop power supply (60 – 80 W)**

SOMETIMES USERS MISUSE ELECTRICAL EQUIPMENT

**A motor was plugged
into a power strip.**

**Use electrical equipment
as it was intended per
the manufacturer's
instructions.**



IF IN DOUBT, ASK YOUR SME.

PROTECT FLEXIBLE CORDS & CABLES FROM PHYSICAL DAMAGE



EXTENSION CORD FIRE FROM IMPROPER USE

Improper use of extension cords can result in electrical fires. Electric appliances must be installed and powered as required by the manufacturer's instructions and code requirements.



REQUIREMENTS FOR THE USE OF ELECTRIC SPACE HEATERS

- **Read the labels!**
- **Do NOT plug into extension cord or multi-outlet tap**
- **Should detect tilt or knock over**
- **Do not plug two into same branch circuit**
- **Keep away from combustibles**



CHECK WITH YOU LOCAL AHJ TO SEE IF ELECTRIC SPACE HEATERS ARE PERMITTED AT YOUR LOCATION. IF YOU HAVE ANY QUESTIONS, CONTACT YOUR SME.

POOR ELECTRICAL HOUSEKEEPING EXAMPLES



DO NOT BLOCK BREAKER PANELS AND OTHER FACILITY ELECTRICAL EQUIPMENT

**LEAVE AT LEAST 36 INCHES CLEARANCE
IN FRONT OF ELECTRICAL PANELS**

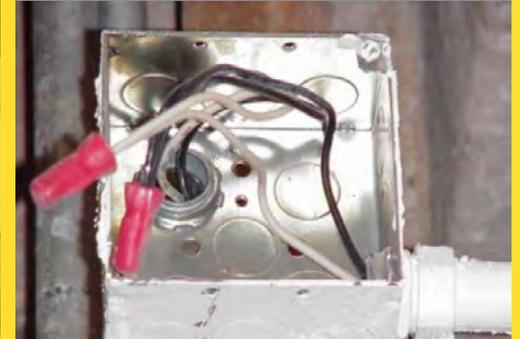
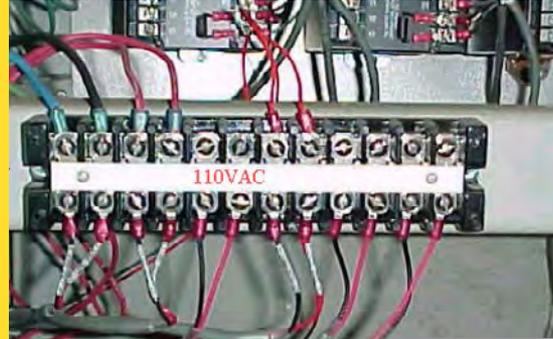
**In the event of an emergency, you must be able to reach the main power source
as quickly as possible, without tripping or climbing over obstructions.**



**IF YOU HAVE ANY QUESTIONS,
CONTACT YOUR SME.**

REPORT EXPOSED CONDUCTORS OR EQUIPMENT WITH COVERS REMOVED

**IF IN DOUBT,
ASK YOUR
SME OR
ELECTRICIAN.**



ENCOUNTERING ELECTRICITY UNEXPECTEDLY

UNKNOWN ELECTRICAL HAZARDS EXIST:

- behind walls
- inside many enclosures
- in the floor
- in the ceiling
- underground
- overhead outdoors

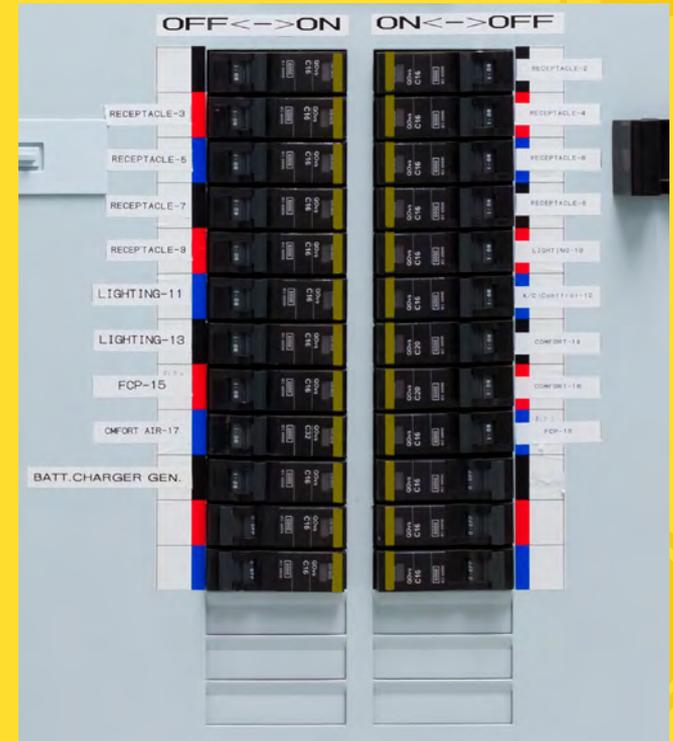


ELECTRICAL PROTECTION

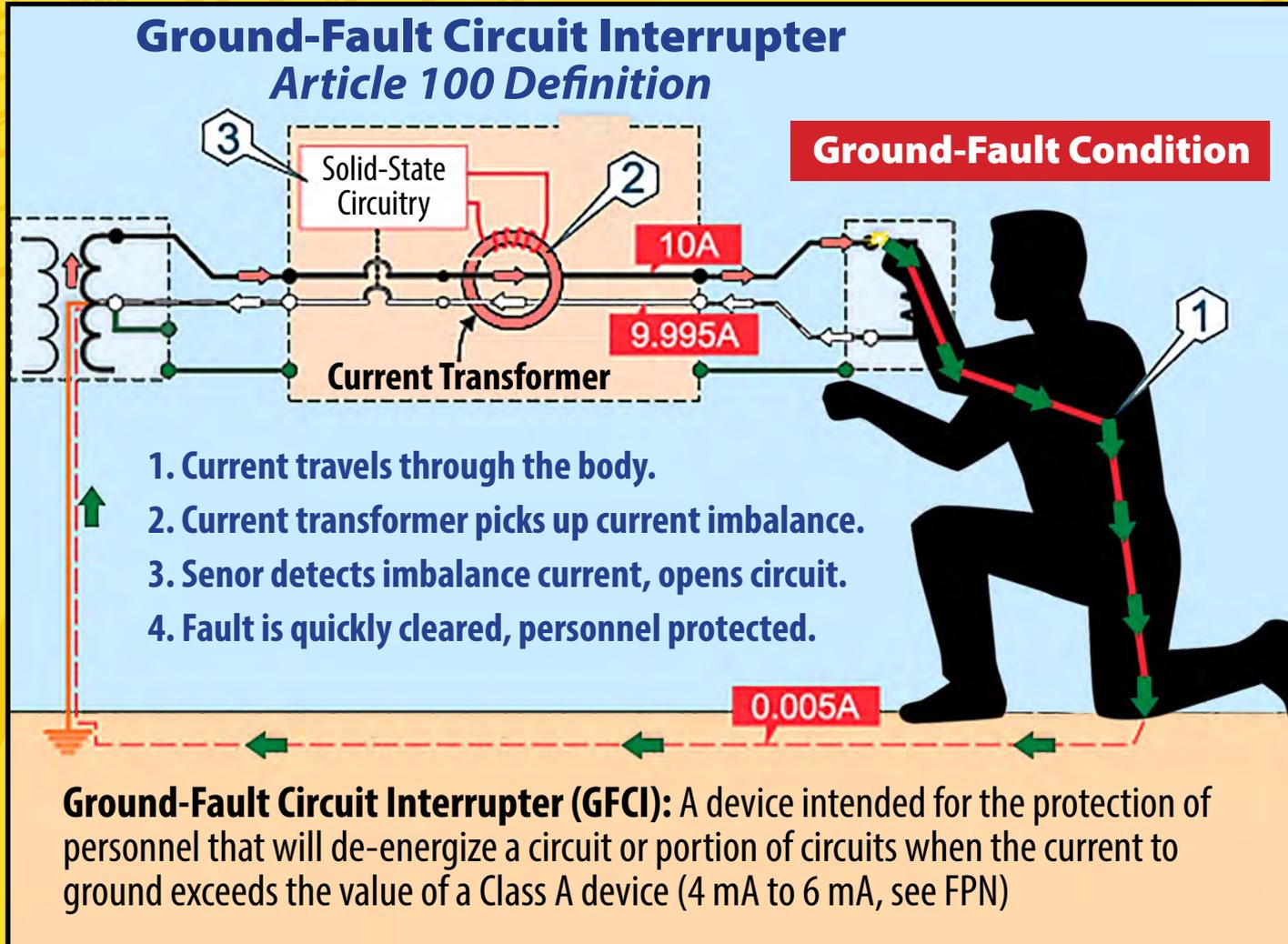
Circuit Breaker (overcurrent protection)

- Protects EQUIPMENT.
- Load trip range in Amps.
- With a ground protects people.
- Must be able to open a fault current.
- They can fail, sometimes explode.

There are requirements for operating large breakers, including PPE. You are not authorized because it can hurt you!

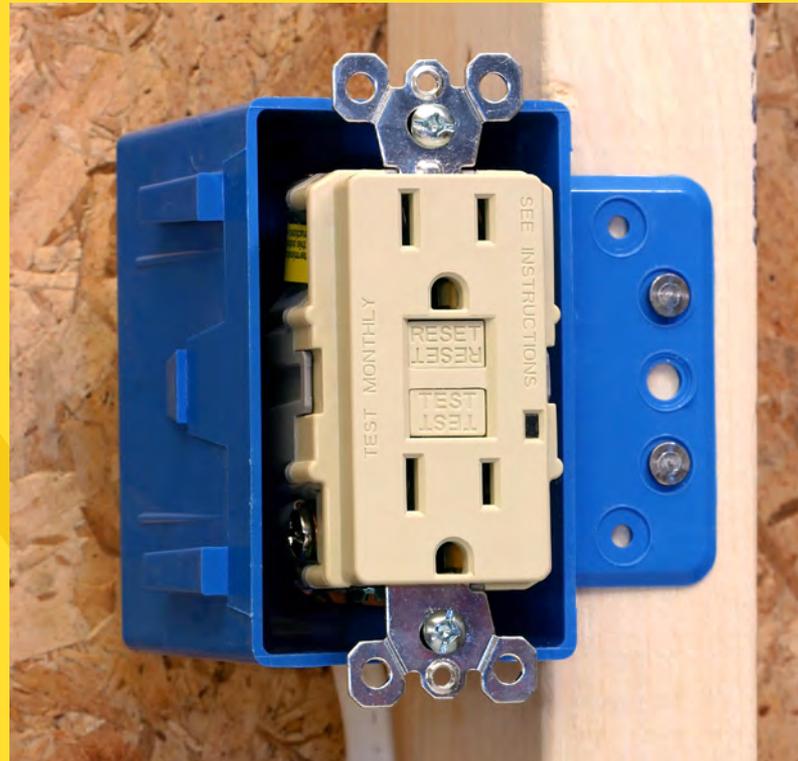


HOW A GFCI WORKS



USE GFCIs, THEY SAVE LIVES!

(Ground-Fault Circuit Interrupter)



**GFCIs should be tested regularly.
Report malfunction to your supervisor or safety officer.**

ELECTRICAL EQUIPMENT

Shall be suitable for the environment in which to be used and installed.



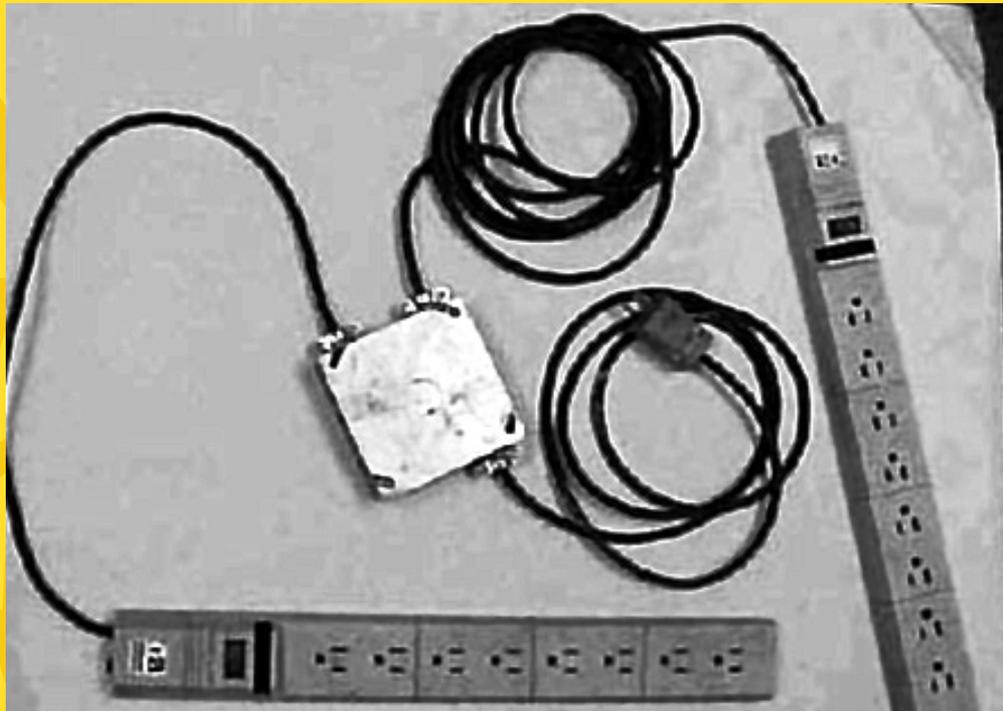
Before



After

ELECTRICAL SAFETY OF EQUIPMENT

Only UL (or other NRTL) approved device can be used. Be aware that electrical equipment not approved or listed by a Nationally Recognized Testing Laboratory (NRTL) is in use in many locations. ALWAYS inspect your equipment before use!



SOMETIMES LISTED EQUIPMENT IS RECALLED OR FOUND UNSAFE



IF IN DOUBT, ASK YOUR SME.

DO NOT USE METAL LADDERS FOR ELECTRICAL WORK



FALLS CAUSED BY ELECTRIC SHOCK



Electric shock can also cause indirect or secondary injuries or death.



BATTERIES AND BATTERY BANKS

Exposed battery terminals present a burn hazard, e.g., car battery.



BATTERY SAFETY

- **Do not wear jewelry, dangling badges, other loose metal when working on batteries**
- **Do not put batteries in your pocket with any metal**
- **Wear eye protection**
- **Wear chemical and/or electrical PPE as necessary**
- **Bulging batteries are unstable**
- **Have a maintenance plan for all UPSs**

POWER LINES CAN KILL!

STAY AWAY FROM

Overhead



Downed



Underground



ASSUME ALL LINES ARE ENERGIZED !

**STAY AT LEAST
10 FEET AWAY!**

RULE OF THUMB



**If the overhead power line is 50 kV or less,
stay at least 10 feet away. For everything else,
keep at least 35 feet away.**

STATIC ELECTRICITY

STATIC ELECTRICITY CAN IGNITE GASOLINE VAPORS.



Stay near your vehicle and do not re-enter it while fueling. If you do re-enter your vehicle during fueling, touch a metal part of your vehicle before touching the gasoline nozzle to discharge any potential static buildup.

LIGHTNING FACTS



- **More deaths occur per year from lightning than tornadoes and hurricanes combined.**
- **Avoid high places, open fields, water, trees, and other tall and/or metal structures.**
- **If you hear thunder over head, you may be struck by lightning.**
- **If outside, seek shelter immediately!**



IT IS UP TO YOU!

**You can make the
difference in protecting
yourself, your family,
your friends, and your
co-workers against the
hazards of electricity.**

ES 101 RISKY BUSINESS

- YOUR ELECTRICAL EQUIPMENT EXAM

Name: _____ Date: _____

- 1. What are the three primary injury mechanisms from electricity?**
 - (a) *shock, stomach ache, burn*
 - (b) *arc flash, shock, thermal burn*
 - (c) *burn, cancer, arc flash*
- 2. What best protects the user/operator from electrical hazards when using electrical equipment?**
 - (a) *Administrative Controls*
 - (b) *Engineering Controls*
 - (c) *Safe Design*
- 3. The following is NOT an example of an NRTL, and does not assure safe equipment.**
 - (a) *FM*
 - (b) *CE*
 - (c) *UL*
 - (d) *TUV*
- 4. It is an Army requirement that electrical equipment in the laboratory must be NRTL listed or approved by the Army AHJ.**
 - (a) *True*
 - (b) *False*
- 5. If you find the ground pin of a plug missing, what should you do, choose one.**
 - (a) *Use the equipment carefully, not near water.*
 - (b) *Report the damaged equipment, and use it carefully.*
 - (c) *Do not use the equipment, report it appropriately.*
 - (d) *Don't worry about it.*
- 6. A Ground Fault Circuit Interrupter (GFCI) protects you from: Choose one answer.**
 - (a) *lightning*
 - (b) *shock in a wet location*
 - (c) *fire*
 - (d) *dirt*
- 7. A daisy chain (one extension cord plugged into another) is hazardous because?**
 - (a) *cords may become overheated and result in a fire*
 - (b) *attached equipment may be damaged*
 - (c) *both of above*
- 8. All of the following can be safely plugged into a multi-outlet tap except one. Which one should never be plugged into a multi-outlet tap? Select one answer.**
 - (a) *clock radio*
 - (b) *cell phone charger*
 - (c) *small coffee pot*
 - (d) *space heater*
- 9. If you find a piece of electrical equipment in your workplace that is not listed by an NRTL what should you do?**
 - (a) *use it carefully*
 - (b) *report it to your electrical Authority for inspection and approval*
 - (c) *discard it*
 - (d) *approve it yourself*
- 10. Sometimes NRTL markings on equipment are counterfeit. Be suspect if a product is:**
 - (a) *Unreasonably low cost*
 - (b) *Seasonal*
 - (c) *Imported*
 - (d) *all of the above*