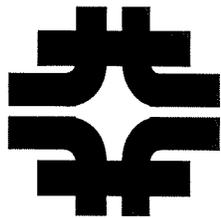
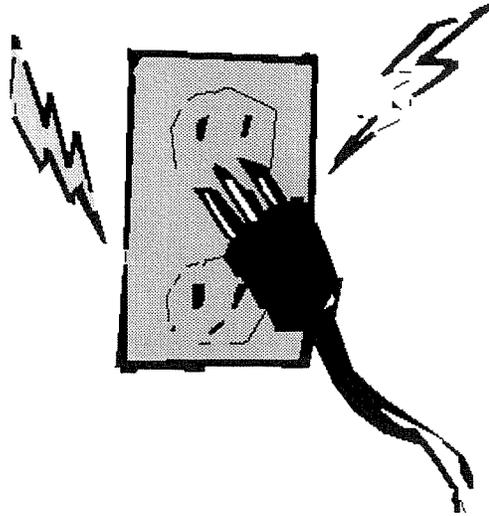


Deliver to

Name _____

Div/Sec _____

Mail Stop _____



Basic Electrical Safety

The material included in this handout must be studied before the training session. This booklet is for you to keep as a reference.

Course FN000235

Basic Electrical Safety

- ✓ Sign attendance sheet
- ✓ Take one of each of the 5 handouts.
- ✓ Turn cell phones and pagers to vibrate.
- ✓ Turn laptop computers to OFF.



Basic Electrical Safety

**Rafael Coll,
Environment Safety and Health Section**

Health & Safety Group

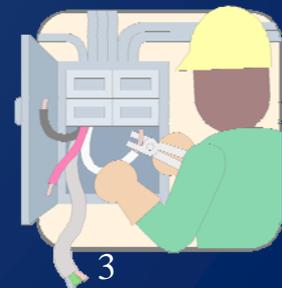
Ext. 8518





Basic Electrical Safety

- ✓ Course not designed to teach you to work on electrical equipment.
- ✓ You will not be qualified to work on electrical equipment.
- ✓ If you spot problems with electrical equipment you should report it to your supervisor.





Objectives

- Be familiar with the fundamental concepts of electricity.
- Be familiar with the effects of electricity on the human body.
- Be able to recognize common electrical hazards.





Objectives

- Be familiar with electrical protective devices.
- Be familiar with PPE used by qualified electrical workers.



Electrical Terminology

- Voltage
 - electrical pressure (water pressure)
- Amperage
 - electrical flow rate (gallons/min)
- Impedance
 - restriction to electrical flow (pipe friction)



Electrical Terminology

- **Circuit**
 - path of flow of electricity
- **Circuit Element**
 - objects which are part of a circuit and through which current flows.
- **Fault**
 - current flow through an unintended path.

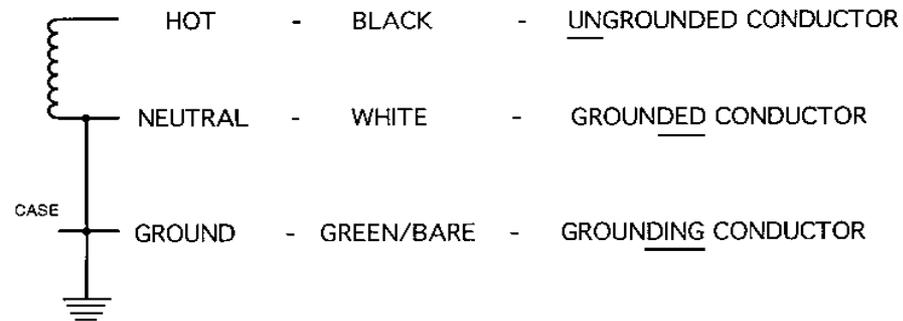


Electrical Terminology

- What is Grounding?
 - Protection from electric shock
 - normally a secondary protection measure
- A ground is a conductive connection
 - between electrical circuit or equipment and earth or ground plane
 - creates a low resistance to the earth.



Electrical Terminology





Basic Rules of Electrical Action

- Electricity isn't live until current flows
- Electrical current won't flow until there is a complete loop, out from and back to the power source.



Fundamentals of Electrical Hazards

- To flow electricity must have a complete path.
- Electricity flows through *conductors*
 - water, metal, the human body
- Insulators are non-conductors
- The human body is a conductor.





Circuits Explained

Electrical Grounding

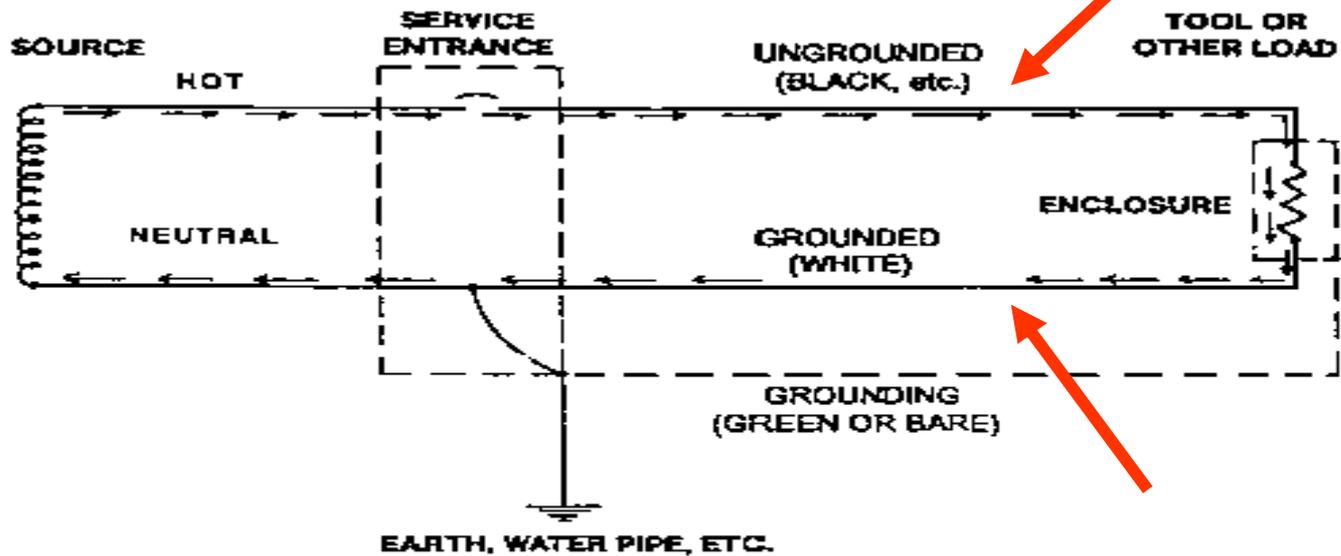
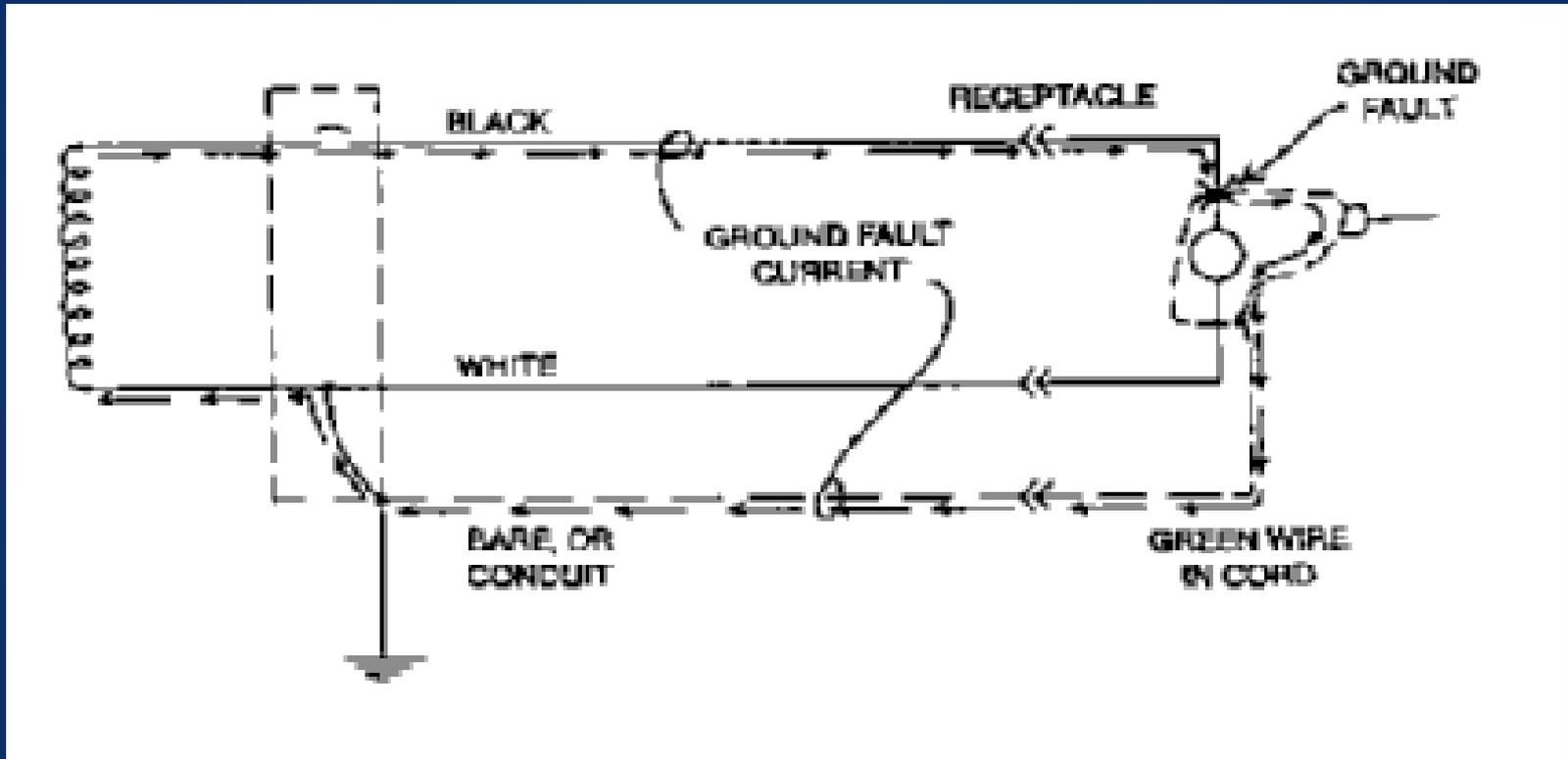


Figure 12: CURRENT FLOW IN A PROPERLY GROUNDED CIRCUIT



Circuit with a ground fault

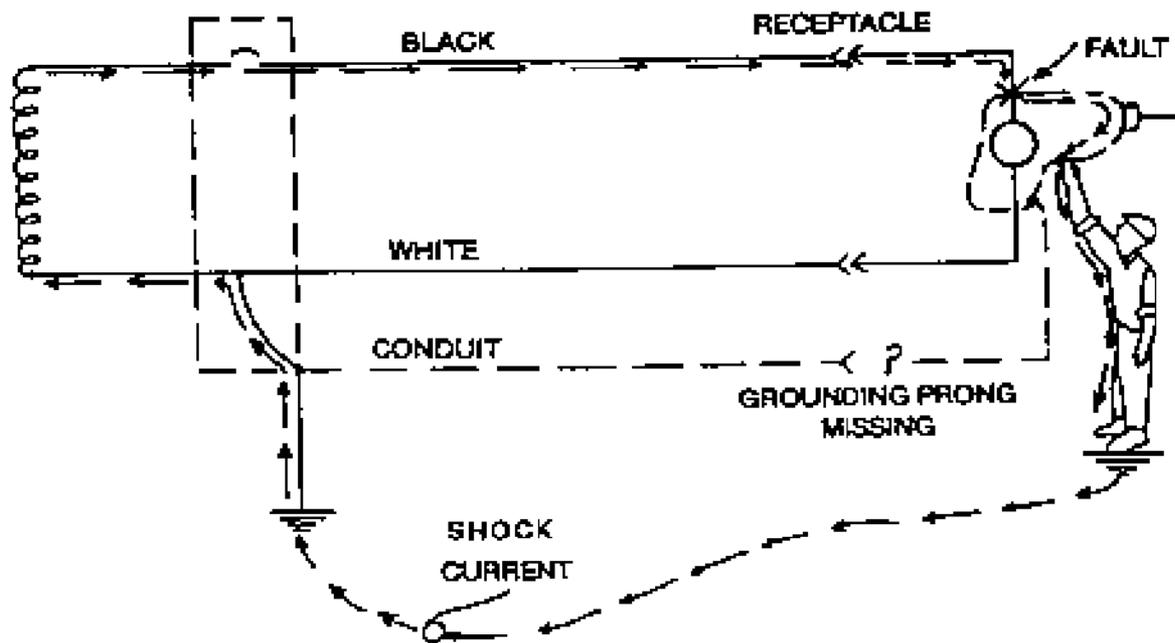


Figure 14: SHOCK FROM IMPROPERLY GROUNDED TOOL

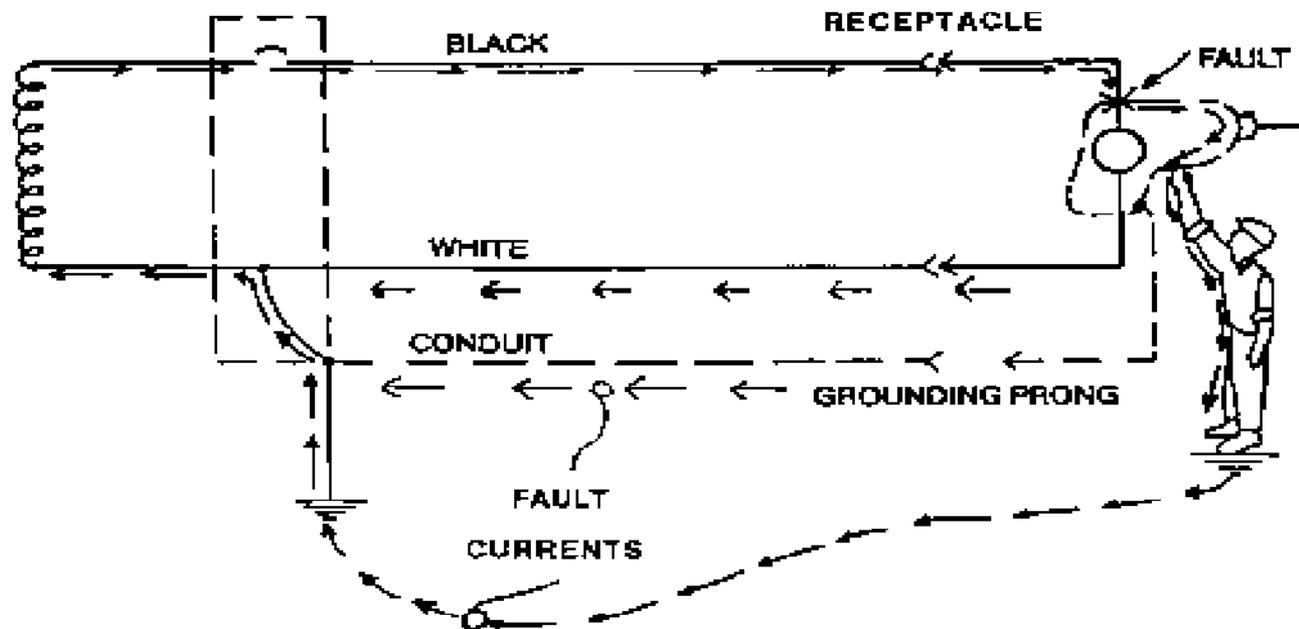


Figure 15: FAULT CONDITIONS SENSED BY A GFCI

Fundamentals of Electrical Hazards

Have You Ever Been Shocked?

THE BASICS



Fundamentals of Electrical Hazards

- ✓ **More than 3 ma**
painful shock
- ✓ **More than 10 ma**
muscle contraction “no-let-go” danger
- ✓ **More than 30 ma**
lung paralysis- usually temporary
- ✓ **More than 50 ma**
possible ventricular fib. (heart dysfunction, usually fatal)
- ✓ **100 ma to 4 amps**
certain ventricular fibrillation, fatal
- ✓ **Over 4 amps**
heart paralysis; severe burns. Usually caused by >600 volts





Fundamentals of Electrical Hazards



Current can kill or injure a worker



Voltage determines how-
either by burning or
electrocution



Fundamentals of Electrical Hazards

Hazards of Electricity

Electrocution

Shock

Arc Flash

Arc Blast

Burns

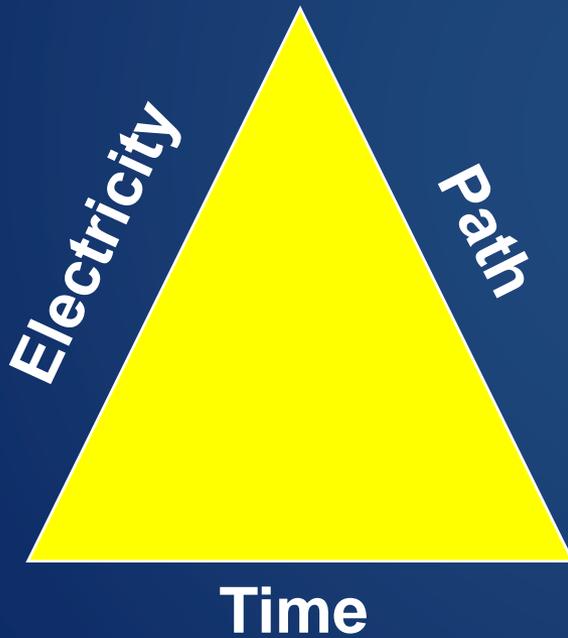


Preventing Accidental Electrical Contact (Shock and Electrocution)

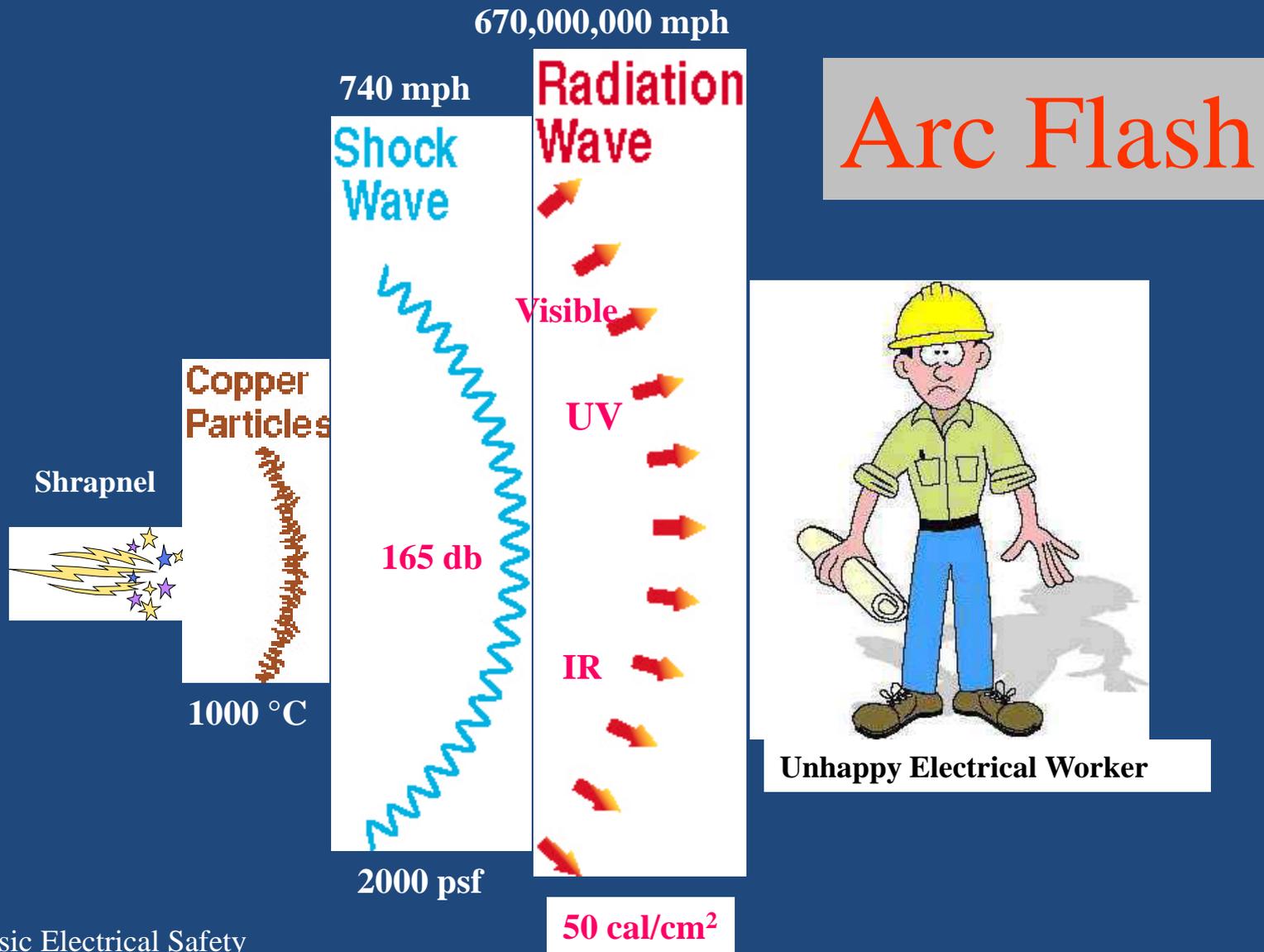
Electrocution

LOTO

Prevention



The Other Electrical Hazard





Some Consequences of an Arc Flash

Shrapnel

Human Projectile

Loss of Sight

Loss of Hearing

Death

Loss of Limb

Clothing Ignition



Tissue Burning



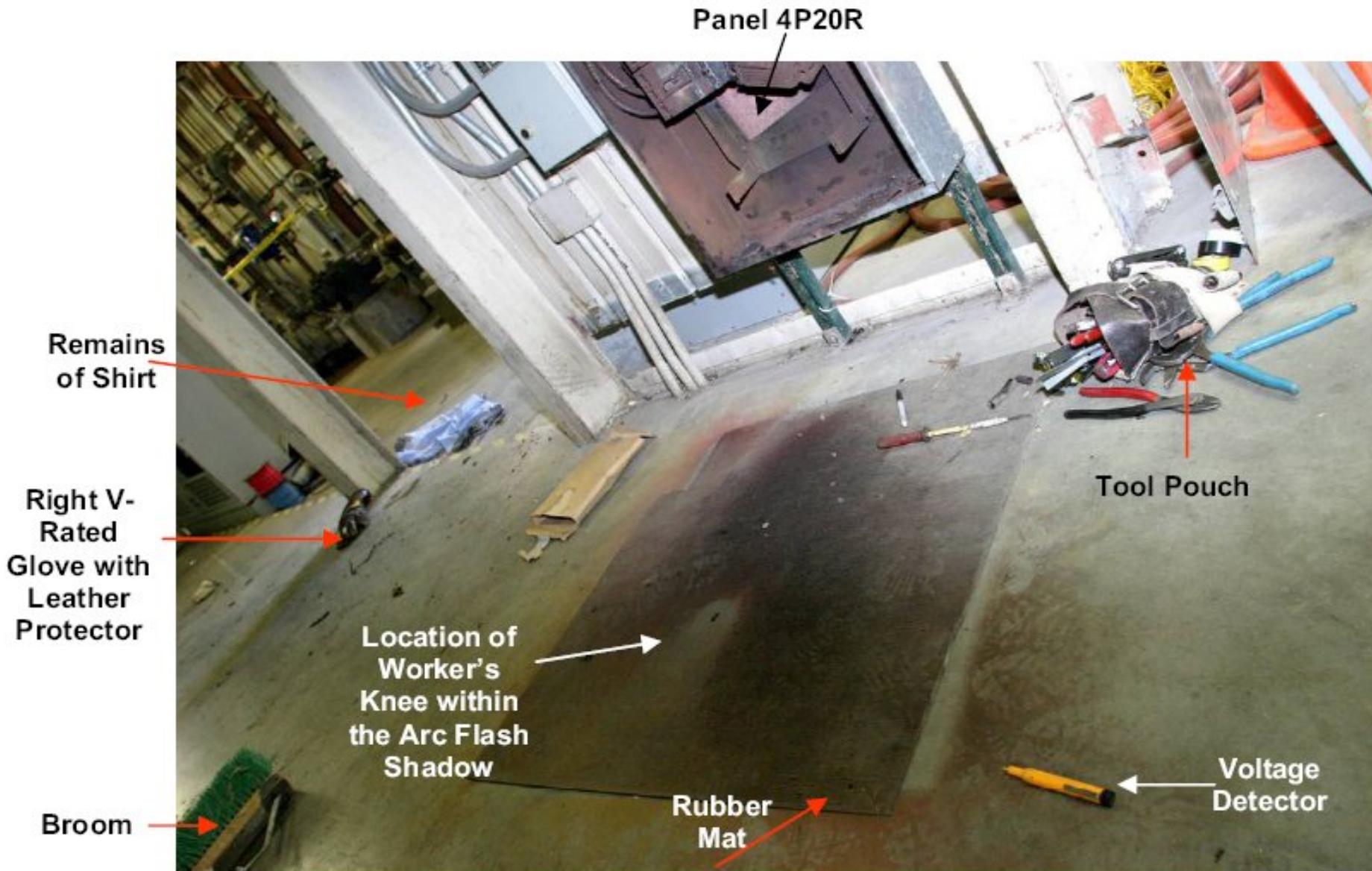


Figure 2-3. The insulating mat with the outline of BSE-1's knee in the arc flash shadow

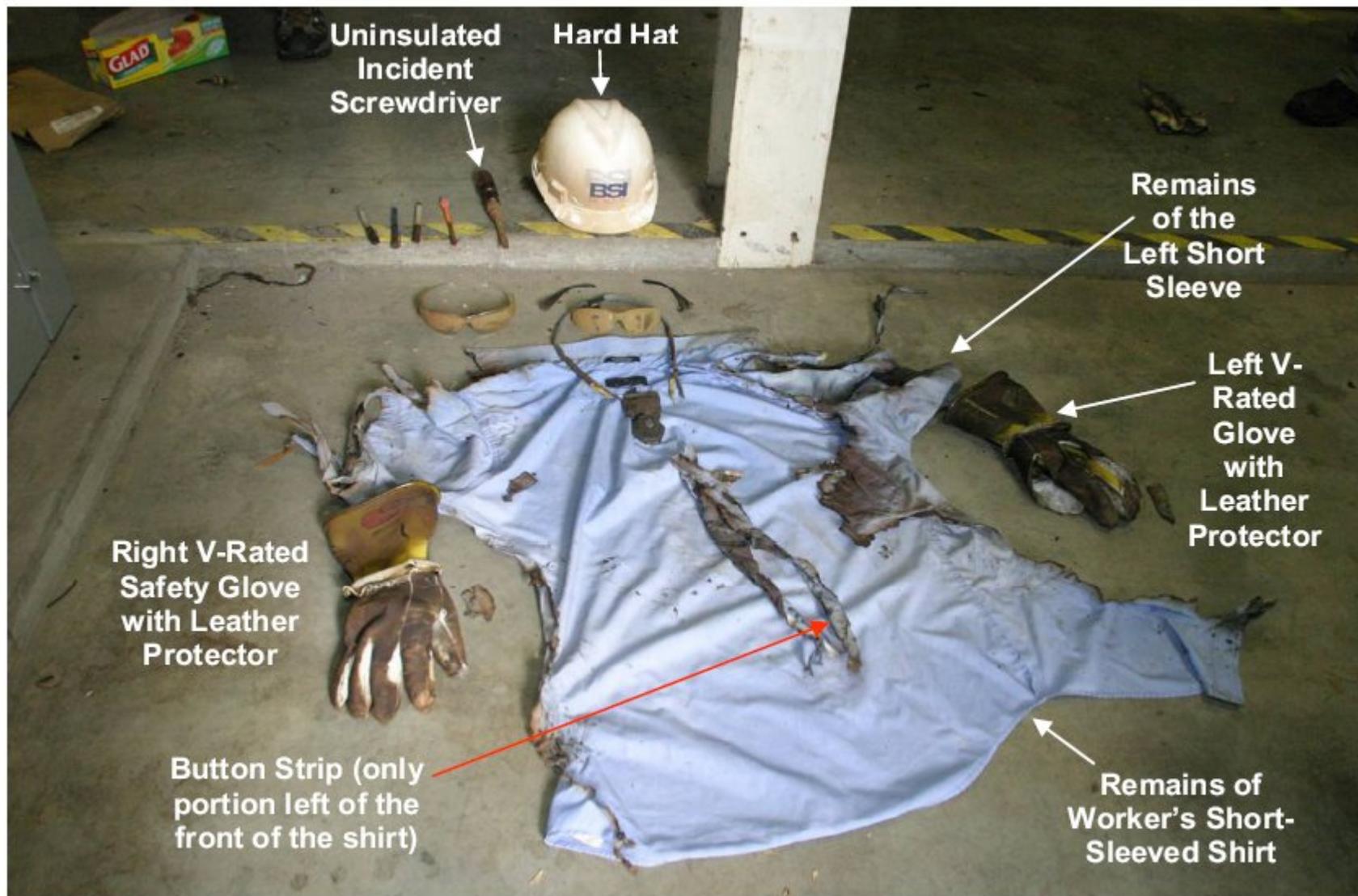


Figure 2-6. BSE-1's burned shirt and his flash-damaged PPE and tools



How Do We Protect Ourselves from the Flash?

- Recognize when energized electrical work is ongoing.
 - Barriers
 - Warning Tape
 - Safety observer (verbal warnings)
 - Signs
 - Personal Protective Equipment in [use](#)
- Stay 10 feet away when possible, but in all cases stay no closer than 4 feet away (Flash Protection Boundary).



Safe Practices

- Inspect any electrical cord for frayed conductors and missing grounding pins.
- Before plugging equipment to a GFCI make sure you test the receptacle.
- No daisy chaining of cords.



Safe Practices

- Damp areas and electrical equipment don't mix.
- Do not handle electrical equipment with wet hands.



How Do We Protect Ourselves From the Flash?

- Recognize the personal protective equipment used by electricians when conducting LOTO or energized work (testing and troubleshooting)



Safe Distances- Transmission Lines (For Unqualified Workers)

- If working in an elevated position near overhead lines (Village) you must stay at least 10 feet away.
- With a conductive object in your hands (elevated or not) the closest distance from the conductive object to the energized line is also 10 ft.

Electrical Protection

- **Circuit Breakers**
 - Provided to protect **EQUIPMENT** not people
 - Do not reset breakers with a line voltage higher than 120V and only reset if you know why it tripped
- **GFCI's**
 - Provided to protect people
 - Trip range 4-6ma
 - Monthly test
- **Receptacles properly grounded.**

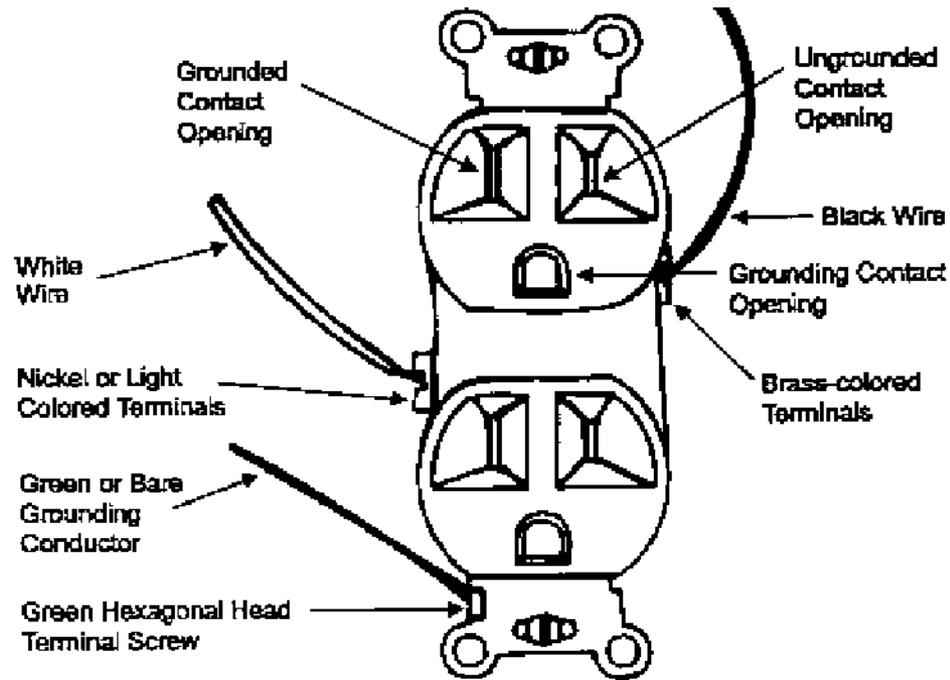


Figure 16: CORRECTLY WIRED DUPLEX RECEPTACLE

Electrical Protection

- **Distance**

- If you sense the presence of an electrical hazard or exposed conductors that may be energized, keep your distance and STAY AWAY

Electrical Protection

- Inspect all electrical tools and equipment
 - ☑ Frayed, cut, broken wires
 - ☑ grounding prong missing
 - ☑ Improper use of cube taps
 - ☑ Improperly applied or missing strain relief

Do's and Don'ts

- **Do** plug power equipment into wall receptacles with power switches in the Off position.
- **Do** check the receptacle for missing or damaged parts.
- **Do** unplug electrical equipment by grasping the plug and pulling. Do not pull or jerk the cord to unplug the equipment.

Do's and Don'ts

- **Do** plug power equipment into wall receptacles with power switches in the Off position.
- **Do** check for defective cord clamps at locations where the power cord enters the equipment or the attachment plug.
- **Do** unplug electrical equipment by grasping the plug and pulling. Do not pull or jerk the cord to unplug the equipment.

Do's and Don'ts

- **Do** check for frayed, cracked, or exposed wiring on equipment cords.
-
- **Do not** plug equipment into defective receptacles.

Do's and Don'ts

- **Do not** drape power cords over hot pipes, radiators or sharp objects.
- **Do not** use extension cords in office areas unless for temporary use. Generally, extension cords should be limited to use by maintenance personnel.

Do's and Don'ts

- **Do not** use “Cheater plugs”, extension cords with junction box receptacle ends or other jury-rigged equipment.
- **Do not** use Consumer electrical equipment or appliances if not properly grounded. (Look for the UL Label)

Do's and Don'ts

- Employees **should know** the location of electrical circuit breaker panels that control equipment and lighting in their respective areas. Circuits and equipment disconnects must be identified.

Do's and Don'ts

- Temporary or permanent storage of any materials **are not** be allowed within 3 feet of any electrical panel or electrical equipment. Why??
- Any electrical equipment causing shocks or with high leakage potential must be tagged with a Danger tag or equivalent.

Myths and Misconceptions

- **Electricity takes the path of least resistance.**
- **Electricity wants to go to ground.**
- **If an electric tools falls into a sink or tub of water, the item will short out.**

Myths and Misconceptions

- **AC reverse polarity is not hazardous.**
- **It takes high voltage to kill; 120 volts is not dangerous.**

**SAFETY
FIRST**

**THE SAFE WAY IS
THE BEST WAY**



8 cal/cm²

Coverall



Full Gear



\

(THIS PAGE INTENTIONALLY LEFT BLANK)

Tamper-Resistant Outlets

Your child could be at risk

Approximately 2,400 children receive emergency room treatment every year for injuries caused by inserting objects into electrical receptacles, according to a 10-year report released by the U.S. Consumer Product Safety Commission (CPSC). This equates to about seven children each day. Even more alarming is that the report found that over 70% of these electrical incidents occur at home, with adult supervision typically present.

Objects children insert are everyday, easily accessible household items:



Hairpin - 32%

Keys - 17%

Finger - 12%

Pin, wire, screw or nail - 11%

Plug - 11%

Unidentified - 8%

Paper clip or staple - 5%

Tool (i.e., tweezer, file or knife) - 3%

Jewelry or belt buckle - 1%

How serious are the injuries?

CPSC reported almost 95 percent of injuries involve burns. These range in severity, but a significant number of serious and fatal incidents result-and even minor injuries can leave emotional trauma. Pediatric burns can be particularly serious, because the skin is thin and offers little resistance to electric flow or heat. With infants and toddlers, burns and scars are even more severe.

These injuries can be prevented

Using a plastic outlet cap is a common solution to prevent children from sticking objects into outlets. Unfortunately, plastic caps are not the safest option and can be easily removed by a young child. A safer solution is installing tamper resistant outlets. These specialized outlets have been so effective in preventing injuries to children that the 2008 National Electrical Code requires that tamper resistant outlets be installed in all new homes constructed. However, these inexpensive products can easily be incorporated into older homes as well.

What are Tamper Proof Outlets? How do they differ from a typical electrical outlet?

Tamper Proof Outlets are standard wall outlets that feature a shutter mechanism that protects children from sticking foreign objects into the receptacle (like hairpins, keys and paper clips). The spring-loaded shutter system in the outlet only allows electricity to flow when equal pressure is applied simultaneously to both shutters such as when an electrical plug is inserted. During unused conditions, both shutters are closed, and openings are covered.

Are they easy to install in older homes?

Yes. It is easy to retrofit an older home with tamper-resistant receptacles. Installation of tamper-resistant receptacles is identical to installation of standard receptacles.

Take the time to replace your outlets. For as little as \$2 an outlet you can help avoid many preventable home injuries. Make your home a safer environment for your child by installing Tamper Proof Outlets.

2008 National Electrical Code (NEC) Basics

- The revision takes effect with the 2008 NEC, and states and municipalities will have to adopt the Code.
- NEC Article 406.11 states that all 125-volt, 15- and 20-ampere receptacles shall be listed tamper-resistant receptacles.
- The new Code will affect all new construction installations for single- and multi-family homes.
- Historical adoption rates indicate about 50 percent of the states will likely adopt the Code in 2008, and 80 percent will likely adopt by 2009.

To Learn More

- For NEMA's Real Safety campaign resources: www.childoutletsafety.org
- For manufacturer research and safety statistics: www.nema.org
- For U.S. incident statistics: www.cpsc.gov/library/neiss.html
- For the CPSC data-sheet of electrical safety: www.cpsc.gov/cpsc/pub/pubs/524.html
- For Canadian incident statistics: www.phac-aspc.gc.ca/injury-bles/chirpp
- For the *Consumers Union Report on Outlet Caps*:
<http://www.consumersunion.org/products/childsafeny698.htm>
- For the State Farm report on home electrical safety:
http://www.statefarm.com/learning/child_safety/learning_childsafety_elec.asp

Press Releases

- [NEMA Launches "Real Safety" Campaign to Boost Awareness of Child Electrical Safety](#)

Quick Facts/Resources

- [The 2008 NEC Tamper Resistant Code Requirement: Q&A](#)
- [Tamper-Resistant Electrical Receptacles \(Power Point\)](#)

Example of Tamper Resistant Outlets



Example of Regular Outlets



Home Safety Checklist: Electrical Safety

By Lore Postman and Laura Coyne

Even as technology improves, the electrocution hazards of the past can resurface and pose a danger to consumers, says the U.S. Consumer Product Safety Commission. Overall, the commission estimates about 200 consumer product-related electrocution deaths each year. Here's a room-by-room guide to keep you safe.

Kitchen/Bathroom:

- ✓ Outlets around sinks should have ground-fault circuit interrupters or outlets that shut off when a current is flowing through a person. Consumers can buy interrupter adapters that plug into existing outlets in most hardware stores for \$20-\$30. Electricians must install permanent interrupters.
- ✓ Clean behind and underneath the refrigerator periodically to prevent dust and dirt buildup on coils and cords.
- ✓ Never touch an electrical device if you're in contact with water.

Bedrooms:

- ✓ An electric blanket that is "tucked in" or covered with another blanket may overheat and catch fire.
- ✓ Make sure light-bulb wattages match the specifications on lighting fixtures throughout the house.

- ✓ Keep items that are stored in closets a safe distance from light bulbs. Certain materials near a hot bulb may catch fire.

Living/Family Room:

- ✓ Install safety covers on outlets (in entire house).
- ✓ Keep cords out of walkways.
- ✓ Don't cover cords with carpeting or rugs. The cords could overheat.

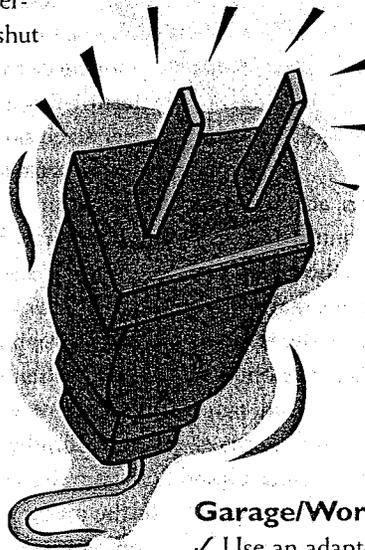
Laundry/Utility Room:

- ✓ Periodically vacuum your dryer's lint trap and exhaust hose. Lint buildup is a fire hazard.
- ✓ Make certain washer and dryer cords aren't pinched.
- ✓ Keep a 3-foot area around gas appliances, including dryers, water heaters and furnaces, clear of any clutter.

Garage/Workshop:

- ✓ Use an adapter to plug three-prong plugs into a two-hole receptacle. Replace tools without a three-prong plug or whose cords aren't double insulated.
- ✓ Never use a power tool if the grounding pin has been removed.

For more information on electrical safety, contact the National Fire Protection Agency at www.nfpa.org and the National Electrical Safety Foundation at www.nesf.org.



Top 10 Electrical Safety Tips

- 1 Check it out.** Check your home's electrical panel for a "last-inspected" date. Get another inspection if it has been more than 10 years.
- 2 Get unplugged.** Unplug heat-producing appliances when not in use. According to the National Fire Protection Association, you can leave a light burning for security, as long as the lamp is operating properly and the bulb is the correct wattage.
- 3 Watch the wattage.** Burning a 100-watt bulb in a lamp designed for 60 watts is a fire hazard. Most lamps have wattage instructions written along the socket.
- 4 Use cords with caution.** Extension cords are meant for short-term use and shouldn't be used to plug more items into a single outlet.
- 5 The urge to surge.** Use surge protectors wherever possible.
- 6 Give them a test.** Test ground-fault circuit interrupters monthly. Turn on a nightlight plugged into the outlet. Depress the "test" button. If the light turns off, the outlet is working properly. If the "reset" button pops out but the light stays on, the interrupter isn't working. Press the reset button to return the outlet to normal.
- 7 High and dry.** Keep appliances away from water. Never reach into water for a plugged-in appliance. Unplug it first. Have the item inspected before using it again.
- 8 Nice and tight.** Screw bulbs in securely. Loose bulbs can overheat.
- 9 No yanking.** Unplug appliances by the gripping area next to the outlet. Yanking or tugging can damage the cord wire or insulation and could cause electrical shock or fire, according to the National Electrical Safety Foundation.
- 10 Forget the pennies.** Pennies may be a quick fix for blown fuses, but they could cause the electrical panel to overheat and catch fire.

\

(THIS PAGE INTENTIONALLY LEFT BLANK)

