American Burn Association

ELECTRICAL SAFETY
Educator's Guide

A Community Fire and Burn Prevention Program Supported by the
United States Fire Administration Federal Emergency Management Agency

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GENERAL BACKGROUND INFORMATION

Our lives are dependent on electricity, 24 hours a day. It is such an important part of our day to day living that it is almost impossible to fathom a world without electricity. Even while we sleep, electricity is keeping our food cold and our security systems operating. Throughout the day, throughout the year, we tend to take electricity for granted. However, as fire and emergency service workers and burn care professionals, we see the results, often devastating, when electricity escapes its insulation or is taken for granted at the wrong time and place. The information in this campaign is designed to stimulate awareness of how electricity works, travels and is used, to help reduce its danger as a powerful force that can result in fire, injury and death.

In the United States, on average 400 die from electrocution and 4,400 are injured each year because of electrical hazards. Of these, 180 are related to consumer products. Another 325 die and 4,000 are injured in workplace electrical accidents, according to data published by the National Safety Council. Electricity also causes over 140,000 fires each year, resulting in an additional 400 deaths, 4,000 injuries and $1.6 billion in property damage. Total economic losses due to electrical hazards are estimated to exceed $4 billion annually.[1]

The age distribution of electrocutions is bimodal; the first peak occurring in early childhood (below age 6) and the second in young adulthood. Most electrocution deaths in adults in adults are work-related, and electrocution is a frequent cause of occupation-related death.[2]

The most severely injured victims of contact with electricity are treated in the nation's 125 specialized burn care facilities. According to the most recent (2005) report of the American Burn Association's National Burn Repository, 4.3% of the patients admitted to these facilities had suffered electrical burn injuries,[3] or about 1,100 patients a year. Many of these patients lose limbs or experience long-lasting damage to nerves, muscles and internal organs. Many thousand others are treated in hospital emergency departments.

Lightning, a naturally occurring manifestation of electricity, is responsible for up to 100 deaths a year, according to the National Oceanic and Atmospheric Administration. With the recent exception of the year 2005, when Hurricane Katrina killed an estimated 1,200 people, lighting normally results in the highest annual fatality total of any natural hazard in the United States.

Electrical injuries are on the increase world-wide, as access to electricity increases in areas where less protection from its hazards may be in place than in more developed countries. In reports from Turkey and the Dominican Republic, electrical injuries comprised a much higher proportion of burn center admissions than in the U.S.

1. *Data in this paragraph published by Electrical Safety Foundation International, 2006.*
2. *"Electrocution and Life-threatening Electrical Injuries ", C. Spies and R. Trohman, Annals of Internal Medicine 2006; 145:531-537*
3. *National Burn Repository 2005 Report, American Burn Association, Chicago, IL*

Understanding electricity

- Although electricity is invisible, odorless and has no shape or form, the earth's

atmosphere is charged with electricity. You'll see proof of its presence in a lightning storm. Though the electricity we use in our daily lives is manmade, it is a natural phenomenon with absolute characteristics.

- Electricity always seeks a path to the ground. All electrical contact injuries occur when a person accidentally becomes part of electricity's pathway to the ground.

- Electricity travels at the speed of light. It is made up of electrons that flow rapidly in an electrical current. Electrical current moves so quickly that it can, in fact, travel the distance of the world's circumference 7.5 times per second. Electricity is the medium which has made possible the rapid growth of global communication.

- Electricity is attracted to materials known as **conductors**, which allow it to flow rapidly. Some conductors include metal, water, wet objects, trees, (they contain moisture) and people (bodies contain water).

- Electricity does not flow freely through certain materials used as electrical **insulation**. These include rubber, glass, plastic and porcelain.

- Anyone working around electricity, on the job or around the home, should always be aware of their surroundings, especially of overhead or below ground power lines.

- Constant safety training and rigorous enforcement of rules for protective equipment and safe procedures are uniformly employed by utility companies and other organizations whose employees routinely work around high-voltage electricity.

- This document is intended mainly for educating those who may encounter high voltage infrequently in home maintenance activities, or who care for young children.

- What are the major electrical hazards? Many are the result of the growing use of electrical power, combined with aging wiring systems that haven't kept pace. Wiring hazards are a major cause of both electrocutions and home fires. Misuse of surge suppressors, power strips and extension cords is a frequent fire hazard. Contact with power lines and major appliances contribute significantly to death and injury statistics.

Lightning Injury

Thunderstorms produce lightning in varying amounts. Sometimes there is just an occasional flash or two, while at other times the storms produce lightning almost continuously, with lots of flashes to the ground. It is the flashes from the cloud to the ground ("CG flashes" for

short) that create problems. CG flashes typically are only a small percentage of the total flashes produced by a thunderstorm, as most lightning stays within the clouds. But it only takes one flash for someone to be injured or killed or for the lightning to cause a fire! Because the human body contains salty water, which conducts electricity better than air, a person's body may present a conduit for the lightning to reach the ground. Although lightning is random, there are some things you can do to minimize your risk of injury if you are caught in the open during a thunderstorm.

- The time from the flash of lightning to the sound of the resulting thunder is a rough measure of how far away the lightning is. If you see a flash, count the seconds from the time of the flash to its thunder. It takes sound five seconds to move a mile. However, there is no distance from a thunderstorm that is absolutely safe. If you can *see* lightning, then it is time to protect yourself from risk.

  CGs can occasionally jump out of a thunderstorm and strike the ground miles away, seemingly "out of the blue." The "30-30 Rule is now advocated to address this risk. Take shelter if the time from seeing a flash until the time you hear thunder is 30 seconds or less, and do not resume unprotected activities until 30 minutes have elapsed since the last lightning and thunder

- There is no "warning sign" that will reliably tell you that lightning is about to strike. Do not depend on having your hair stand on end. The first sign of a CG may be the flash itself. Of course, if your hair *does* stand on end, you should take steps to protect yourself immediately! If no suitable shelter is available, observe the following rules.

- If you are outdoors, avoid being the tallest object around, or near the tallest object, such as an isolated tree. Seek clumps of shrubs or trees of uniform height, ditches, trenches or the low ground. Get as low as you can, but don't lie prone on the ground. Go into a squat instead. Where possible, find shelter in a substantial building or in a fully enclosed car, truck or van, with the windows completely shut.

- At high altitudes above the tree line, seeking shelter among depressions in the rock or shallow carves will not offer much protection. Your best protection is to get down to a lower altitude as quickly as possible. Leave your gear behind; whatever it contains is not worth risking your life! You can always go back to retrieve it after the storm.

- If you are in the water, get out at the first sign of lightning. If you on a small boat within range of land, get to land and get off the boat as soon as possible.

- Avoid being near fences and power lines that lead into areas where lightning is occurring. An electrical charge can travel along the wires and jump out at you or cause an injury if you touch live wires or an energized fence.

- Avoid staying close to other people, and remain a minimum of 15 feet away if

possible. This will allow the current to go to ground more easily, making multiple injuries less likely.

- You do not have to be struck directly by lightning to be affected. Lightning can travel along the ground or jump from nearby struck objects, to strike you.

- If indoors, avoid water. Stay away from doors and windows. Do not use the telephone. Take off headsets. Turn off, unplug and stay away from major appliances, computers, power tools and TV sets. Because water may travel through and on pipes and tubing, lightning may strike exterior electric and phone lines, inducing shocks to inside equipment.

- If someone is struck by lightning, go to or call for medical help immediately! In the meantime, administer CPR to any victims if their heart and/or breathing have stopped. Cover the victims and do not move them. If they are conscious reassure them and try to keep them calm. Seventy to 80 percent of victims survive the shock of a non-direct lightning strike. Lightning victims do not retain an electrical charge and are safe to handle. Common lightning aftereffects include impaired eyesight and loss of hearing.

ELECTRICAL SAFETY FACT SHEETS
FOR COMMUNITY DISTRIBUTION

- Electrical Burns and Other Injuries
- Home Electrical Safety: General Guidelines
- Home Electrical Safety: Guidelines for Parents and DIYs
- Household Extension Cords
- Downed Utility Lines
- Electrical Safety and Car Batteries

ELECTRICAL BURNS AND OTHER INJURIES

- A severe electrical shock can cause much more damage to the body than is visible.
- The most common electric shock-related injury is a burn.
- Electrical burns are the result of the electric current flowing through tissues and bone. The heat generated by the current flow through the body causes tissue damage. Electrical burns are very serious and should receive immediate medical attention.
- Arc or flash burns are caused by an electric arc or explosion, but are not true electrical burns, because the current does not pass through the body. They are still serious injuries and should also receive prompt medical attention.
- Contact burns may result when skin comes in contact with hot surfaces of electrical appliances or overheated electric conductors or equipment.
- Clothing may be ignited in an electrical accident, resulting in a flame burn.

HOME ELECTRICAL SAFETY: GENERAL GUIDELINES

- Disconnect appliances by pulling on the plug, not the cord.
- If an appliance has a three-prong plug, use it only in a three-slot outlet. Never force it or remove a prong to make it fit a two-slot outlet.
- Check electrical tools regularly for signs of wear. If a cord is frayed or cracked, replace it. Replace any tool if it causes even small electrical shocks, overheats, shorts out or gives off smoke or sparks.
- Never use electrical appliances near water
- Before attempting any appliance repair, unplug it.
- Attach extension cords to appliances before outlets.
- Keep clothes, curtains and other potentially combustible items at least three feet away from all heaters, whether electric, gas or kerosene-fueled.
- If an electric power line is down on or near your home, keep everyone out of the area and call 9-1-1 or your local electric utility.

HOME ELECTRICAL SAFETY: GUIDELINES FOR PARENTS AND "DIYs"

IF THERE ARE SMALL CHILDREN IN YOUR HOME:

- Don't allow children to play with or near and keep them away from electrical appliances such as space heaters, irons and hair dryers.
- Use plug covers on any electrical outlets accessible to small children. Outlet caps that attach to the outlet plate with screws give better protection than those that plug in.
- Make sure plug in caps are a similar color to the outlet.
- Make sure such caps are not big enough to be a choking hazard.
- Make sure any night lights used in child's room do not resemble toys.
- Teach children to respect electricity as soon as they old enough. This is usually about age three Two thirds of electrical burn injuries occur to children aged 12 and under.

IF YOU ARE PLANNING A "DO-IT-YOURSELF" PROJECT

- Professional electricians can help make sure that large projects are preformed according to any electrical codes that apply to your home.
- Always turn off circuit breakers and test circuits to make sure they are de-energized before doing any household rewiring.
- When doing outside work which requires a ladder, pay attention to the location of overhead power lines, before pruning branches, cleaning gutters, painting above the first floor level, or working on the roof.
- When doing outside work that requires significant digging, such as putting in fence posts, planting trees or large bushes, or installing a sprinkler system, call your electric utility to see if any underground lines would be affected.

HOUSEHOLD EXTENSION CORDS

- The U.S. Consumer Product Safety Commission estimates that about 4,700 residential fires originate in extension cords each year, killing 50 people and injuring 280 others.

- Overheating of extension cords can occur at the plug, the socket or over the entire length of the cord. Hot plugs and sockets are often caused by deteriorated connections to the cord wires.

- Overheating of the entire cord is usually caused by overloading (connecting appliances that need too much power for the cord's wire size). Many older cords are made with small wire that can overheat easily

- Check the temperature of extension cords when they are in use. If they are hot to the touch, disconnect the appliance.

DOWNED UTILITY LINES

- Assume that all downed utility lines are energized power lines. You may recognize telephone or cable TV lines as such, but they may be touching damaged and energized power lines on nearby poles.

- A downed power line that appears to be dead may suddenly become re-energized as the power company attempt to re-route power.

- If you are near a downed power line, move away from the line and anything touching it. Move away by shuffling with small steps, keeping your feet together and on the ground at all times.

- If you see that someone is in direct or indirect contact with a downed line, do not touch them. Call 9-1-1 instead.

- Do not attempt to move a downed line or anything in contact with it by using another object such as a broom or stick. Even normally non-conductive materials like wood or cloth, if slightly wet, can conduct electricity and then electrocute you.

- Be careful not to step near water where a downed power line is located.

- Do not drive over downed power lines.

- If you are in your car and it is in contact with the downed line, stay in your car. Warn others to stay away from your vehicle.

- If you must leave your car because of fire or other danger, JUMP away from the vehicle so that you don't touch the vehicle and the ground at the sane time. Land with your feet together.

ELECTRICAL SAFETY AND CAR BATTERIES

When jump-starting a vehicle, take the following precautions:

- Wear safety glasses
- Put out all cigarettes and other flames in the vicinity
- Make sure the vehicles are not touching
- Turn off the ignition of the assisting vehicle
- Do not jump-start unless both vehicles are negative grounded and have the same voltage.
- When **attaching** battery cables:
  Clamp one end of first cable to positive pole of dead battery, then clamp other end to positive pole of good battery.

  At good battery, clamp second cable to negative jumper pole, then clamp cable's other end to the dead car's engine block, on the side away from the battery.

  Start the car with the good battery; then start the car with the dead battery.
- **Detach** battery cables in this order:
  Remove one cable from engine block and other car's negative pole

  Remove other cable from positive poles.

GETTING THE MESSAGE TO THE MEDIA

- Sample Public Service Announcements

Sample Public Service Announcements

Contact Name: _____

Organization: _____

Telephone: _____

Email address:_____

Subject: ELECTRICAL INJURIES
Release Date:

Reading Time: 10 seconds
Electricity is in every home and can injure someone you love. Call *(insert local identification)* for free information on electric safety tips at *(telephone number).*

Reading time: 20 seconds
This is Burn Awareness Month and *(insert local identification)* wants you to know that electricity can injure someone you love. Check your lamp and appliance plugs and cords to make sure they are not loose or frayed. For free electrical safety information, call *(insert local identification)* at *(telephone number.)*

Reading time: 30 seconds
Over 4,000 Americans suffer serious electrical burn injuries every year, and thousands more are injured in fires started by electricity. Be sure your house wiring and your electric circuits are safe and strong enough to handle the demands your appliances place on them. For free electrical burn safety and prevention tips, call *(insert local identification)* at *(telephone number)*

Subject: LIGHTNING INJURIES
Release Date:

Reading Time: 10 seconds
Up to 100 people die each year in the U.S. from lightning strikes. Call *(insert local identification)* at *(insert telephone number)* for free information on lightning safety

Reading Time: 20 seconds
Severe weather can occur with little warning. Seek shelter or stay inside as soon as you see lightning, until 30 minutes have passed from the last thunder or flash. Call *(insert local identification)* at *(insert telephone number)* for more information on lightning and

electrical safety.

Reading Time: 30 seconds

This is Burn Awareness Week and *(insert local identification)* wants you to know that lightning can kill or injure someone you love. Lightning has the highest average annual death toll of any natural disaster. For additional information on lightning and electrical safety, call *(local identification)* at *(telephone number).*

REFERENCES/RESOURCES AND GLOSSARY OF ELECTRICAL TERMS

Founded in 1994 through a joint effort between Underwriters Laboratories Inc. (UL) the U.S. Consumer Product Safety Commission (CPSC) and the National Electrical Manufacturers Association (NEMA), the **Electrical Safety Foundation International (ESFI)** is North America's only non-profit organization dedicated exclusively to promoting electrical safety in the home, school and workplace.

ESFI sponsors National Electrical Safety Month each May, and engages in public education campaigns and proactive media relations to help reduce property damage, personal injury and death due to electrical accidents. Electrical safety tips are available at the ESFI website, at www.electrical-safety.org, or can be obtained by calling 703-841-3229.

Other organizations with information on electrical safety include:

American Burn Association
www.ameriburn.org

National Fire Protection Association
(publishers of the National Electrical Code)
www.nfpa.org

National Institute for Occupational Safety and Health
www.cdc.gov.niosh

PACIFICORP
Pacific Power Utah Power
www.pacificorp.com

SafeKidsCanada
www.safekidscanad.ca

Underwriters Laboratories
("UL Standards for Safety established the basic safety principles for America")
www.ul.com

U.S. Consumer Products Safety Commission
www.cpsc.gov/cpscpub/pubs

U.S. Fire Administration
www.usfa.fema.gov

GLOSSARY OF ELECTRICAL TERMS

Amps (amperes): The standard unit for measuring electrical current flow.

Breaker Box: An insulated panel on which electrical wires are mounted. Typically fuses, circuit breakers or other current-interruption devices are also included.

Circuit Breaker: A device that automatically interrupts the flow of an electrical current.

Electrical Load: 1) The amount of power delivered by a generator or carried by a circuit. 2) The devices to which the power is delivered.

Electrical Panel: An insulated panel on which electrical sires are mounted

Energy-Isolating Device: A mechanical device that prevents the transmission or release of energy.

Ground-Fault Circuit Interrupter (GFCI): A mechanical device to detect grounding problems and shut electricity off to prevent a possible accident.

Hazardous Energy Sources: Stored or residual energy provided by capacitors, springs, elevated machine members, rotating flywheels, hydraulic systems, and air, gas, steam, or water pressure.

High Voltage: Term utilized in electrical industry referring to electrical equipment that operates at more than 600 Volts (for terminal to terminal operation) or more than 300 Volts (for terminal to ground operation). Low voltage, high current AC or DC power supplies are also considered to be high voltage. In the burn (medical) literature, electrical potential exceeding 1000 volts is considered to be high voltage

Lockout: The placement of a tag on an energy-isolating device. This prevents workers from operating a piece of equipment until the lock is removed.

Tagout: The placement of a tag on an energy-isolating device. A tagout device is a prominent warning device of a lockout.

Voltage: Electromotive force expressed in volts. If we compare electricity flowing through a wire to water flowing through a pipe, voltage is similar to the pressure of the water and amperage is similar to flow past a given point in gallons or liters per minute.

Watt: A unit of electrical power, equal to the power developed in a circuit by a current of one ampere flowing through a potential difference of one volt.

EVALUATION FORM

ELECTRICAL INJURY

We appreciate any suggestions and recommendations for future improvements in the community fire and burn prevention education programs. Please take a moment to print and complete this form; return it to the American Burn Association, 625 N. Michigan Ave., Suite 2550, Chicago, IL 60611 (Fax – 312-642-9130). Thank you.

Name (optional) _____ Date: _____

Affiliation: Hospital _____ Fire Service ___ Burn Support Organization _____
Other (describe) _____

1. Did the content covered in the campaign kit meet your learning needs?
   Yes No

2. If you answered no, please tell us what we should add, or subtract?

3. Did the length of the topic coverage provide what you needed?
   Yes No

4. Were the fact sheets helpful?
   Yes No

5. What did you like most about this campaign?

6. What did you like least about this campaign?

7. What pieces of this campaign did you use? Please check all that apply.
   ___Statistics ____PSAs
   ___Fact Sheets ____PowerPoint Presentation
   ___Press release