Electricity 101

Understanding the powerful force that empowers our lives.

PACIFIC POWER

Let's turn the answers on.

Table of contents

Electricity

It's such an important part of our daily lives that it is almost impossible to fathom a world without electrical power. Think about it – a power outage during a heavy storm leaves us in the dark and reminds us of how dependent we are on all that electricity provides. Knowing how electricity works and travels will help us understand it as a powerful force, one than can cause serious injury, even death, if used without caution.

Electricity's physical properties – What is it?

Although electricity is invisible, odorless and has no shape or form, the earth's atmosphere is charged with it. You'll see proof of its presence during a lightning storm. Though the electricity we use in our daily lives is man-made, it is a phenomenon with absolute characteristics.

Electricity always seeks a path to the ground. All electrical contact accidents occur when a person accidentally becomes part of electricity's pathway to the ground. Making contact with a power line in the ground can be just as dangerous.

Electricity travels at the speed of light. It is made up of electrons that flow rapidly in an electrical current. Electrical currents move so fast, in fact, that they cover the distance of the world's circumference 7.5 times per second.

Electricity is attracted to materials known as "conductors" that allow it to flow readily. Some conductors include:

- Metal
- Water
- Wet objects
- Trees (they contain moisture)
- People (bodies contain water)
- Dirt on insulators

Unlike conductors, electricity does not flow easily through certain insulating materials, such as:

- Rubber
- Glass
- Plastic
- Porcelain

Harnessing the power

The electricity we use every day is generated in power plants where energy from several sources in nature is converted into electricity. For example, plants can generate hydroelectric power from rivers, solar power from the sun, fossil-based energy from coal, oil or natural gas, and wind power from the wind.

To generate energy from natural sources we use a few basic principles of physical science in our power plants, which house power generators comprised of large magnets that spin inside coils of wire. To get the magnets spinning, high-pressure steam or water is forced against the generator's turbine blades. As the loops of wire rotate between magnetic poles, a flow of electrons, or electric current, is produced. It is then transferred to transmission lines for distribution through a vast power grid.

In addition to all those sources, electricity can be generated by burning so-called biofuels to create energy that churns the turbines in the generators. Biofuels are produced from forest by-products and renewable agricultural crops, including vegetative and organic waste matter.

The steam used to spin magnets in generators usually is produced from energy created by burning coal, natural gas or oil, from harnessing nuclear energy, and sometimes from geothermal sources. Dams and reservoirs on rivers harness the force of water that is released and used to spin the turbines. Now, more than ever before, wind power is being used to generate electricity.

Directing the current

Getting electricity from one point to another requires a complex network of transmission and distribution lines. Operating as a power distribution highway, electrical current travels along a designated path, sometimes traveling great distances to "load centers" where it is used. In order for the electricity to go great distance, the "pressure", or voltage, is increased.

For safety purposes, very tall towers and poles are used to drape high-voltage transmission lines so they are high in the air and away from people and activity. Transmission lines transport electricity from its source to cities. Here the lines enter a substation where the voltage – or pressure – is lowered so it can be safely distributed to the local area. The electricity then flows out of the substation over distribution lines to either pole-top or underground transformers.

The job of the transformer is to lower, or transform, the voltage to the typical 120/240 level used in homes and small businesses. Transformers serving underground lines are housed in green metal boxes called pad-mounted ground transformers that rest above ground. The line hung from a pole to a home is called a service drop. This line carries the electricity through the meter into the circuits of homes and businesses.

Playing it safe

Electrical-related accidents can occur anywhere and anytime a person or conductor interrupts the flow of the current, providing it a path to the ground. Most of the time, using common sense and extra caution around electricity will prevent such accidents.

Look up

Most accidents associated with electricity occur when someone comes into contact with overhead power lines. That's why you must always be aware of your proximity to such lines, especially when lifting or moving tall or long objects such as rain gutters, TV antennas, pool skimmers, irrigation pipes and ladders. Such objects can conduct electricity directly through your body as it moves from the line to the ground. Another thing to remember: never fly kites or model airplanes around these lines.

Call before you dig

Digging into underground power lines is just as dangerous as coming into contact with an overhead line. While these underground lines are insulated, they are not designed to resist a shovel or backhoe blades. Digging into underground lines, in addition to being a safety hazard, can sever the line, causing expensive damage as well as the inconvenience of interrupted power. Because an increasing number of homes are serviced by underground electric cables, it is important to locate these cables before you disrupt the soil. To have your lines located free of charge, call 811 at least 48 hours before you plant a tree, dig holes for fence posts or install underground sprinklers.

Stay away to stay safe

The transmission and electrical lines you see draped on poles throughout neighborhoods are not insulated. For safety purposes, we hang these power lines high in the air, away from people and activity. Even in cases where service drops are insulated, the insulation can break down over time and render the line dangerous. To be on the safe side, treat all power lines you see as being energized and dangerous. Simply stay away from them.

Taking serious safety precautions

Around the house

To avoid electrical-related accidents around the house, always be alert for unsafe situations. For example, you should "childproof" electrical outlets, discard worn or frayed cords, avoid circuit overloading and use ground fault circuit interrupter devices (GFCIs). GFCIs are outlets equipped with "test" and "reset" buttons. In some states, these devices include a sticker indicating the "test" and "reset" buttons are on the breaker. When installed properly, GFCIs will instantly disconnect power to an outlet if a short-circuit or grounding event has occurred with the appliance.* GFCIs are important safety devices particularly for bathrooms, kitchens, garages and outdoors where electric appliances are frequently used in proximity to water. Always remember that electrical appliances and water don't mix. Keep items such as radios and hair dryers away from sinks, bathtubs and puddles.

** Even with a GFCI, injury may occur.*

Tree pruning

Pruning trees is another task that requires extra caution when overhead power lines are in the proximity. That's because a tree or branch can fall into a line creating an electrical path to the ground that can run through you and the tree. To prevent such an accident remember these key points:

- Always be aware of your proximity to power lines – stay as far away as possible.
- Branches can conduct electricity.
- Wood- or fiberglass-handled tools can conduct electricity if the handle is wet or dirty.
- If any trees on your property are growing into power lines or if you need assistance, contact Pacific Power toll free at 1-888-221-7070. Do not attempt to prune them yourself.

Rooftop projects

Long or tall objects inadvertently coming into contact with power lines are major causes of electrical-related accidents and can be fatal. Antennas, ladders, satellite dishes, rain gutters, pool skimmers and other similar objects should be kept away from overhead lines. That is because such objects typically are metal and conduct electricity, causing risk of serious injury or death to the person holding them. To avoid such accidents, you should:

- Always be aware of power line location when installing or moving anything on or near your roof.
- Stay as far away as possible – and at least 10 feet away – from all overhead power lines.
- Be aware that shock from electrical contact can lead to secondary injuries, such as falling from a roof.

Storms and downed power lines

It can happen in an instant – a storm can take down a power line causing it to come in contact with and energize a tree, a fence and the ground around it. In such a case, caution is paramount. You should stop, think, look around you and don't make a move that could cause you pain or even prove to be fatal. Electricity will travel through any conductor, including you.

- Never touch or go near a fallen power line, and do not touch anything on which the wire is resting. Always assume a downed line and the ground surrounding it are energized and dangerous.
- If you see a downed line, tell others to stay away and immediately call 911, then call us toll free at 1-888-221-7070.
- Do not touch or go near a person in contact with a downed power line. Call 911.
- If a power line falls across your car while you are inside, stay put until help arrives. If you attempt to leave the vehicle, you may be electrocuted. If the car is on fire and you must exit, jump as far away as possible, with both feet together. Take care never to be in contact with the car and the ground at the same time. Continue to hop, with both feet together, away from the area.

Generator safety

If you use a portable electric generator, use an approved transfer switch to prevent back-feed into nearby power lines. Such back-feed is a safety hazard and can damage your property. In addition, it can create a hazard to our line repair personnel as they work to restore power. A few more safety tips: never plug your generator into an outlet and do not connect a generator directly into your home's main fuse box or circuit panel. Generator exhaust contains potentially dangerous carbon monoxide. Never use a generator indoors. Locate your generator outdoors where it will vent safely, away from doors, windows and vents in your home.

On the job

Most electrical injuries sustained on the job are associated with a conductive object, such as metal, coming into contact with overhead wires. This diverts the electricity from the wires to the ground through the person handling the metal. At work sites you should:

- Use the help of "spotters" when operating lift trucks or other power equipment.
- Always work with a heightened sense of electrical awareness.
- Be aware of overhead lines – look up and always observe the 10-foot circle of safety. Keep tools and materials you are handling and the equipment you are operating at least 10 feet away from all power lines. Stay even further away if you're working around lines transmitting 50,000 volts or higher. Also remember, the minimum approach distance is 20 feet for cranes and derricks. Not only is this an important safety rule, it's the law.
- If you cannot get your work done without moving into the 10-foot circle of safety, call Pacific Power toll free at 1-888-221-7070. We will help you do the job safely by de-energizing or grounding the lines or by using other safety measures.
- If a crane, tractor or other piece of boom-type equipment comes into contact with an overhead power line the operator should move the equipment away from the line only if it can be done without knocking down the line or pole. If the operator cannot move the equipment without causing further hazards, he or she should stay put until the power can be turned off. The operator should never step off the equipment because contact between the energized equipment and the ground can result in electrocution. In such a case, warn others to stay a safe distance from the area until the power can be turned off. That is important because the ground surrounding the equipment will be energized by the electricity making its way through the equipment to the ground.
- In emergency situations, such as a fire, the operator should get off the equipment by jumping as far as possible from the machinery with feet together. He or she should use extra caution to not be in contact with the equipment and the ground at the same time. The operator should hop away with both feet together.
- Metal irrigation pipe and similar materials should be stacked away from overhead lines. Never tip pipes near power lines to clean. Be aware of the location of overhead lines and keep a safe distance from them before lifting or moving irrigation pipes.
- Before excavating, locate all underground utilities. This can be accomplished at no cost. Simply call 811 at least 48 hours before you plan to dig.

The dangers of electrical shock

Electricity can be dangerous because of the multiple impacts it can have on the human body. That is especially true for hazards associated with "household" current. Shock from low-voltage or low-amperage current can cause the heart to go into uncontrolled spasms because the current disrupts the body's normal circuitry. This could result in a heart attack or seizure. Higher voltages can cause serious external and internal burns. In many instances, high-voltage accidents result in lifelong disabilities or they can be fatal.

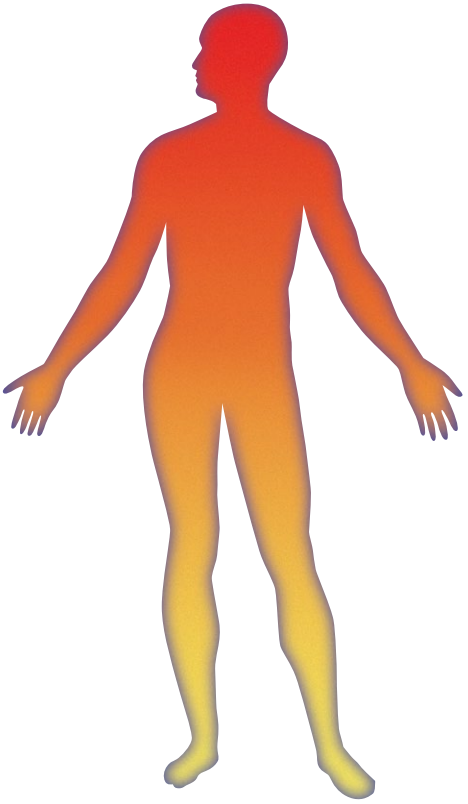
Secondary impacts of job-related accidents can occur at the time of electrical contact. The electrical charge can cause loss of body control that can result in injuries related to falling from trees, buildings or other dangerous locations.

Electrical shock and the human body

An amp is a unit of measurement of current. A milliamp is .001 amp or 1/1000th of an amp. Typical household currents range from 1 amp for an electric mixer, 10 amps for a toaster and 50 amps for an electric range.

Warning: Common household fuses or circuit breakers will not trip until current reaches 15,000-20,000 ma.

Contact with just 20 milliamps of current can be fatal.



2,000 ma (2 amps)
Cardiac standstill, internal organ damage

Over 200 ma (.2 amps)
Severe burns, may be fatal

50-200 ma (.05-.2 amps)
Ventricular fibrillation, may be fatal

20-50 ma (.02-.05 amps)
Difficult breathing, may cause damage to brain tissue and blood vessels, may be fatal

15-20 ma (0.15-.02 amps)
Loss of muscle control

8-15 ma (.008-.015 amps)
Pain

1-8 ma (.001-.008 amps)
Sensation, tingling

Current in milliamps (ma)

Giving aid to an electrical shock victim

Do not attempt to aid the victim until the source of the current is shut off and the victim is no longer a path to the ground.

Touching a person who is in contact with an electrical current provides the electricity with another path to the ground – through the rescuer. This could cause injury to the rescuer, and rescuers cannot provide help to victims if they are victims themselves. Normal instincts to provide assistance to a shock victim must be held in check long enough to analyze the situation. Despite what may be a very strong desire to help, it is essential to wait until the contact with the electrical source no longer exists or the current source is shut off.

Call 911 or call us at 1-888-221-7070 immediately for assistance, and keep others away from the injured person or any downed line.

To order safety materials or schedule a presentation on safety issues, call us at 1-800-375-7085 or visit **pacificpower.net/safety**. For all other information and for safety assistance around power lines, call toll free anytime at 1-888-221-7070.

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