Chapter 12

Safe Work Practices

Chapter Outline

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Tradesmen invest a lot of time and money to acquire the skills necessary to become proficient at their jobs so they can earn top dollar for their work. Business owners spend a lot of money building and promoting their company and making their business profitable. One of the key work practices that can either make or break a company or individual is safety. Safety is not a theory or good intention, it is the resulting outcome of specific actions. Safety is what you get if things are done properly and events go as planned. Electricity is intrinsically hazardous and demands those who work with or around it to plan for and guard against possible exposure. You have the right to leave work everyday in the same state of health as when you arrived to start your day. Customers expect electrical installations that will operate without risk of damage to their property or injury to the people who inhabit it. When you combine and comply with standards and regulations that have been established to minimize electrical hazards, you maximize your profitability and personal well-being.

Electricians who work safely have higher productivity and less worker turnover, lost time, and material waste. Contractors who focus on safe work practices have lower overhead costs, insurance costs, labor costs, and higher profit margins. On the other hand, contractors with negative safety records are viewed as dangerous and uncaring by their employees, resulting in higher labor turnover. Turnovers add to the costs for this type of contractor, who ends up with increased costs for training new employees over and over again. The contractor may settle for less skilled electricians or helpers, which increases production costs. Research has shown that newer workers have a higher rate of accidents on the job. This is usually because they do things like hurry to prove they can meet deadlines, or because they are unfamiliar with the equipment used or job site conditions in general. In the long run, it is less expensive to encourage and enforce safe working practices than it is to ignore them.

Safety conscious employer interviews

As a business owner or manager, you can begin saving your company money from the moment you interview a potential employee by determining their skill level. Begin your evaluation of their ability to perform the type of work you need them to do by using an employment application with a physical abilities section that targets their physical condition. Simple questions could include "Have you ever":

- Suffered from hearing problems or hearing loss?
- Suffered from visual problems or eye diseases?
- Had back problems, back pain, or back injuries or operations?
- Had foot or knee problems, injuries, or operations?
- Have you ever been a patient in a hospital for any reason? If YES, have them provide an explanation of dates and reasons for hospitalizations.
- Lost time from work in the past year for any reason? If YES, have them provide dates and explanations for the causes.
- Do you smoke cigarettes? Add a note that some job sites may be in smoke-free locations, or if your company prohibits smoking on company property or in company vehicles, add that note to this section as well.

These types of health situations can hamper a potential employee's ability to perform their job at an optimum level. Beyond these types of general health questions, you will want to know that a worker possesses the skill level required for the position you are hiring. The best way to establish this is to provide a separate sheet that lists the trade skills and physical requirements of the specific position you are hiring. For example,

- Study blueprints and schematics and determine methods, materials, and equipment needed to complete the work project. Perform material take-offs and complete permit applications, including confined space.

- Connect wires to plugs, switches, controls, light fixtures, appliances, motors, breaker panels, and switchboards. Pull wire through conduit.
- Test installations to ensure continuity of the circuit and the compatibility and safety of all components using test equipment such as an ohmmeter, ampmeter, voltmeter, etc.
- Perform the duties of the job site qualified worker by demonstrating knowledge and training on safe work methods for energized work, lockout/tagout, hazard analysis, short-circuit studies, and arc flash/blast boundaries.
- Proven knowledge of applicable PPE to meet OSHA requirements.
- Measure, cut, bend, thread, assemble, and install electrical conduit, junction, switch, outlet boxes, and switch boards using hand tools and equipment such as mechanical drills, cutters, benders, and threaders.
- Inspect and evaluate electrical equipment to ensure that it operates efficiently and safely; determine whether equipment and new installations meet requirements of the National Electrical Code.
- Assist in training lower-level electricians. Provide instruction and training in the proper methods, processes, and safe work practices necessary to carry out electrician assignments.
- Develop plans and estimates for electrical projects; includes determining time, equipment, and human and material resources needed to complete the work.
- Ability to lift 75 pounds and work overhead from a ladder or scaffold.
- Experience wearing a respirator and working in confined spaces.
- A valid driver's license with no violations within the past 5 years.
- A reliable means of transportation.
- No felony convictions.

On your employment application, include a statement that the applicant has read and understands the job description and is not aware of any

reasons or restrictions that would prohibit him/her from performing these duties. These questions allow you to compare any potential applicant's risks or areas that would require training or special accommodations.

There are, however, a number of questions that you are not permitted to ask during an interview. It is illegal to specifically ask an applicant's age, country of national origin, religion, marital or family status, or if they have ever incurred a work-related injury. Be especially mindful during the course of a comfortable interview not to ask seemingly innocuous interview questions that could be illegal, such as:

- What arrangements are you able to make for childcare while you work?
- How old are your children?
- When did you graduate from high school?
- Are you a U.S. citizen?
- What does your wife do for a living?
- Where did you live while you were growing up?
- Will you need personal time for particular religious holidays?
- Are you comfortable working for a female boss?
- There appears to be a large disparity between your age and that of the position's coworkers. Is this a problem for you?
- How long do you plan to work until you retire?
- Have you ever filed for workers' compensation?

Pre-employment physical exams

Employment physical examinations are conducted to assess an applicant's ability to perform the duties required of a position. To protect against discrimination in hiring, the physical examination should be required after a job is offered. Physical Ability Tests Physical ability

tests measure the physical ability of an applicant to perform a particular task or the strength of specific muscle groups, as well as strength and stamina in general. Many employers contract with companies or medical facilities that specialize in these tests. Our company used a firm that performed thorough and unique physical assessment tests that demonstrated applicants' skills and safe work practices. For example, the company had a platform with several tiers at its testing site and a container of various PPE such as gloves, kneepads, goggles, and earplugs. Applicants were shown where the PPE was and were asked to perform a number of activities such as: go up and down stairs, squat down and pick up lengths of #1 AWG wire and place them on a shelf overhead, carry a 75 pound roll of wire for a specific distance, climb and stand on a ladder for 10 minutes while reaching up and repeatedly popping up a ceiling tile, use a screwdriver to attach different types of screws into a piece of wood, lift and operate a power saw (without a blade), and even crawl through a piece of corrugated sewer pipe (Figure 12.1).

Figure 12.1 Physical ability tests can be used to measure a potential employee's stamina, strength, vision, and knowledge of personal protective equipment requirements.

Not only did the tester measure the applicant's physical ability to perform these common tasks, but it was also noted whether the potential employee used applicable PPE. We were amazed at how many applicants never used any of the PPE during their testing. If an applicant doesn't think about putting on goggles to lift ceiling tiles, earplugs to run a saw, or kneepads or gloves to crawl on their hands and knees during a test, they are not intuitively safety conscious. It is one thing to possess the basic electrical skills required to do the job. It is another to have the physical capability to perform them day in and day out in a safe manner that protects an employee from harm. By focusing on safety from the first interview, an employer can increase the odds of hiring and keeping healthy, productive, safe electricians.

You can also provide a safety quiz for applicants to complete that will help you gauge their understanding of issues such as PPE and OSHA safe work standards. This shows potential employees that you are focused on safety and provides you with a tangible idea of their safe work practice experience.

Employee safety concerns

As an employee, you have the right to work in a safe environment and to have an employer who values your health and well-being as both a worker and a person. A business manager is not the only party who should ask safety-related questions during your interview process. You can learn a lot about your potential employer by asking a few questions of your own. Not just the typical inquiry about paid sick leave and health benefits, but questions about the employer's safety practices. For example, you could ask if the company has an injury and illness prevention program, or if they provide safety training on specific equipment, such as forklifts, that you may need to use as part of your job with the company.

Employee safety rights

Once you are working for a company, you need to keep your safety high on your priority list. Remember that OSHAs primary purpose is to establish and encourage workplace safety standards that are designed

to save lives, prevent workplace injuries and illnesses, and protect the health of workers. This means that as a worker, you have specific rights under OSHA. For example, you are allowed to request and receive information concerning OSHA rules and regulations so that you can become familiar with them. These regulations include conducting mandatory measuring or monitoring of toxic substances on your job site, and all emergency procedures.

> You also have the right to receive training that is required by OSHA standards. For example, if your employer wants you to move materials from delivery trucks using a forklift, you have the right and responsibility to request training and certification on forklift operation. Without proper training, you pose a safety risk not only to yourself, but to others as well.

You have the right to refuse to perform work assigned to you if you reasonably believe that a hazardous condition exists that poses a genuine threat of serious injury or death. If you request that your employer correct this type of condition and they fail to do so, you have the right to place a confidential safety complaint to OSHA concerning workplace conditions and to receive a follow-up inspection or investigation. You are permitted to participate in an OSHA walk-around, regardless of whether or not it is related to a complaint you filed. You also have the right to learn the results of any OSHA inspection that takes place at your company's site, as well as to participate in OSHA consultation services and be advised of those results (Figure 12.2).

Realistically, OSHA statistics gauge non-safety. When you really think about it, all OSHA measurements are based on the failure of the safety process—fatalities, lost workdays, recordable injuries, and the number of workdays lost per injury. For example, OSHA statistics show that 90% of fatalities occur in four categories—someone caught between objects, struck by objects, electrocution, and falls. OSHA does not provide figures on how many employees at any given company have not been involved in an accident or who are alive and well. OSHA views accidents as preventable and incidents that can be avoided with the proper safety training, precaution, and common sense. Safety, under the OSHA statistics approach, is measured by the occurrence of fatalities or events, known as mishaps or near misses. When a negative event happens, it manifests

Figure 12.2 You have the right to be an informed employee and to participate in OSHA inspections at your job site.

itself on the job site, leaving a trace to be measured. Most companies do not hand out rewards to workers who have not been hurt over time. So as an employee, the true measure of your dedication to safe-work practices is demonstrated by the fact that you leave work everyday uninjured. That statistic should be enough to make any of us happy.

Material safety data sheets

Safety precautions involve more than just being mindful of your surroundings and wearing proper PPE. There is a book that has to be kept on all construction sites, which, in my experience, few electricians ever open or peruse because they don't think it contains anything that applies to them. This is the book or folder that contains material safety data sheets. Material safety data sheets, known in the industry as MSDS, must be developed for all hazardous chemicals used in the workplace, and must list the hazardous chemicals that are found in a product in quantities of 1% or greater, or 0.1% or greater if the chemical is a carcinogen.

MSDS information is mandatory under OSHA paragraph (g) of 29 CFR 1910.1200.

The MSDS is a detailed informational document prepared by the manufacturer of a hazardous chemical that describes the physical and chemical properties of the product. The MSDS contains useful information such as a chemical's flash point, toxicity, storage guidelines, and procedures for spills and leaks.

The chemicals that pose a potential health hazard present on a job site could be as simple as cleaning products, bleach, paint, waterproofing products, and soldering flux. Used independently and with adequate ventilation, these products are safe to use; however, many products used in the construction industry pose serious health risks if combined with other chemical products. One of the factors listed on an MSDS is chemical reactivity. This is the ability of a material to undergo a chemical change. A chemical reaction can occur under conditions such as heating, burning, contact with other chemicals, or even exposure to light. Here is an example that happened to one electrician. He was running wires for a remodeling job in a dormitory bathroom when he tugged on the wire and knocked over a container of bleach that was on the top of the toilet. He wiped up the bleach with a rag and then sprayed a bottle of cleaner he found in the site trailer on the area to remove the bleach residue. He closed the bathroom door, replaced the bottle of cleaner and then returned to finish his work. When he opened the door and went back into the bathroom to finish his work, he became dizzy and nauseous. What happened? The industrial spray cleaner actually contained hydrochloric acid. When this combined with the chemicals that make up bleach, a toxic gas chlorine was produced and trapped behind the closed bathroom door. Chlorine gas, also known as bertholite, has been used as a chemical weapon since World War 1. When chlorine is inhaled, it reacts with the water in the mucus in your lungs and forms the irritant hydrochloric acid, which can be lethal. All of this happened because the electrician never stopped to check the MSDS to see if the cleaner he grabbed could chemically react with the substance he was cleaning up.

The physical characteristics that are listed on the MSDS include whether a material is corrosive under any conditions. A corrosive material can corrode metals and cause metal containers or structural materials to become weak and eventually to leak or collapse.

The can also burn or destroy human tissues on contact and can cause permanent scarring or blindness. An example of a corrosive product that you have probably used if you have ever had to solder any materials is flux, which contains phosphoric acid. Rust remover also contains phosphoric acid.

One of the important items of information provided on the MSDS is the exposure limit for chemical compounds. An exposure limit is the concentration of a chemical in the workplace air that most people can be exposed to without experiencing harmful effects. Some products list this exposure as the short-term exposure limit (STEL). This is the average concentration to which workers can be exposed for a short period (usually 15 minutes) without experiencing irritation, long-term or irreversible tissue damage, or reduced alertness. Another part of the data to pay attention to is any explosive limits that may be listed. Explosive limits specify the concentration range of a material in the air that will burn or explode in the presence of an ignition source such as a spark or a flame. The MSDS will also list how chemicals in the product enter your body, such as topically, as a vapor or gas, or if swallowed (Figure 12.3).

Information included in a material safety data sheet needs to be available to help you select safe products, understand the potential health and physical hazards of a chemical, and understand how to respond effectively to exposure situations. Each sheet lists the label name of the product, the chemical and common names of the substance, all ingredients, and any specific hazards such as chemical reactions. Additionally, there will be a statement of any ingredients that are known carcinogens. As you can see, the safety aspects of material safety data sheets are something that you should become familiar with before you use any substance that contains chemicals.

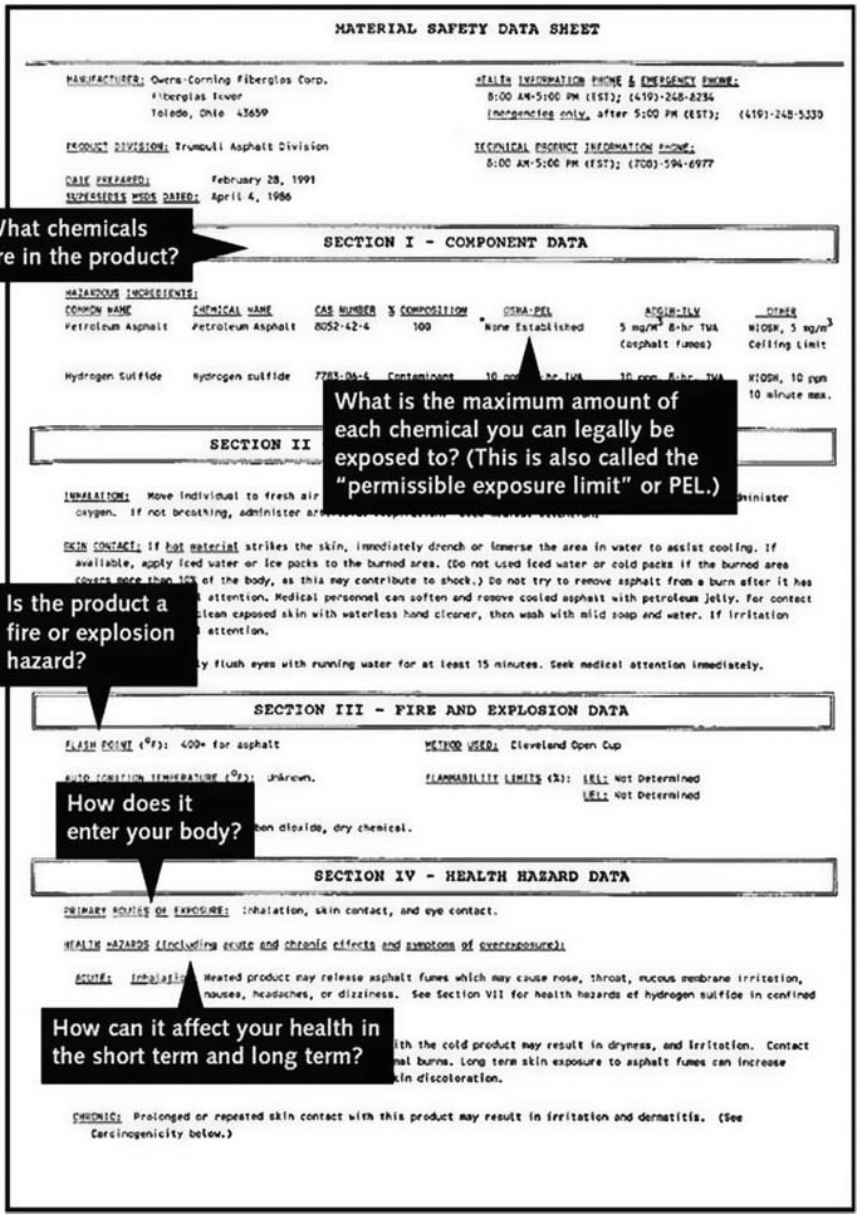

Figure 12.3 Material safety data sheets provide information on any hazardous aspects of a product's chemical makeup.

Workers' compensation facts

Almost every electrician has heard about workers' compensation and knows that it pays for medical expenses if someone gets hurt on the job. As an employee, there may be a number of facts about workers' compensation that you are not aware of. For example, your employer's workers' compensation insurance company gets to choose your initial medical provider. If you have to be referred to a medical specialist, the insurance company gets to choose that particular doctor as well. Many workers' compensation insurance companies will reimburse you for gas used driving to and from your doctor appointments. Once you are examined by the doctor, your injury will be classified as either a temporary total disability (TTD) or a temporary partial disability (TPD).

A TTD means that you are currently medically unable to perform any of your pre-injury work activities. Temporary partial disabled employees are able to return to work with doctor-imposed physical restrictions that prevent them from performing all of the duties of their pre-injury position. Don't let these terms intimidate you. For example, if you are a journeyman electrician and you are going to be on crutches for 6 weeks because you broke your ankle, then you are not able to perform any of your duties for that period of time. You can't carry tools, operate equipment, pull wire, install fixtures or trim, or even safely navigate your way through a construction site. You are temporarily totally disabled. On the other hand, if you broke a finger you could still carry tools, move safely around a job site, and maybe install trim materials such as outlet and switch covers. A doctor would probably allow you to work with restrictions such as no overhead work, or equipment operation and so you are only temporarily partially disabled. These types of injuries should heal without permanent complications and you should be back on the job full-time soon enough. However, if you have incurred a back, neck, or head injury you may suffer from physical impairments that will last a lifetime (Figure 12.4).

An impairment rating is a way for a doctor to rate the severity of your injury and is provided at the end of your medical treatment. If your doctor assigns an impairment rating that exceeds an established percentage, say 20%, you may be entitled to permanent total disability

Figure 12.4 A workplace injury means that you will lose time and full wages from your job, not to mention the worry and burden to your family. Safe work practices will minimize your risk of being injured.

benefits. This means that you will probably not be able to perform all of the duties of your job without pain or risking additional injury. Situations such as these will require you to re-think your vocation and, if possible, change jobs to a career that is less physically demanding.

Let's assume that you will be able to return to work after a period of time completely healed. In the meantime, you will be collecting workers' compensation payments for your wages. In my experience, most electricians seem to think that they will receive 100% of their hourly wage, based on what they were making when they got hurt. I have actually had electricians who had just finished working overtime ask me why their payments were less than what they brought home in their last check. The answer is that while your work accident compensation is based on your average weekly wage, known as your AWW, it is not determined by your last or highest full-time check. The AWW is calculated by averaging your wages during the 13-week period immediately preceding that date of your accident or injury. So that overtime that you just started is only a portion of your wage base. If you have been injured before you worked a full 13 weeks, your employer can use wages from another employee that has worked 13 weeks and is employed in the same position that you hold. As you can see, being

injured and on workers' compensation is not your ticket to easy street and a free check every other week. While workers' compensation exists to make sure that you receive some reparation for your wages while you are recuperating, the best way to ensure that your livelihood is not affected is to stay safe and unharmed while you are at work.

Employer workers compensation facts

An employer's workers' compensation MOD rating is based on a number of factors, including the cost of workers' injuries over a period of time. This means that fewer injuries directly equates to lower insurance premiums. It can also be the difference between being awarded contracts and not being eligible to bid on a job. Many large companies and institutions, such as colleges, will only accept bids from contractors with a workers' compensation MOD below a set level. Your MOD can save you money in premiums and earn you money by providing you the ability to bid on a wide-range of projects. For these reasons, it is important for an employer to understand what data is used to establish a MOD rating.

When a MOD is analyzed, employers can see a history of their claims. The data includes the cost of the injuries by employee name, and the number of modification points attributed to each injury. If there has been an increase in premiums for the current year, the costs will be broken down by specific employee injuries. The cumulative increased premium cost over a 3-year period will also be shown.

Workers compensation costs

Job classification is the main factor determining the cost of your premiums. Electricians, roofers, and construction tradesmen who work around heavy equipment have the highest risks of severe injury, and office workers have the lowest risk. So it is up to you, as an employer, to ensure that you keep your premiums as realistic as you can to control costs.

When you assign job titles, duties, and categories, it is important to consider how these factors will affect the premium to be assessed for

each employee. Each work classification is assigned a workers' compensation code and costs are based on the number of employees you have in each code. For example, there is a code for electrical wiring—within buildings (#5190), a different code for electricians who work only with low voltage systems such as communication systems or alarms (#7605) and then one code for electrician, electrical assistant, electrician senior level, electrician supervisor, and electrician senior supervisor (#3179). There is a separate code for laborers. Electrician helpers or apprentices would be considered a code #3179, unless the majority of their duties classify them as a laborer. The rate for a low voltage electrician is approximately half that of the standard electrician class. The best way to determine the premiums for each code is to consult your workers' compensation insurance carrier for an explanation of the duties associated with the various codes.

The basic workers' compensation rates for each job classification are set by each individual state and are based on payroll costs. When paying an employee time and a half for overtime, you may only have to report the regular wages, decreasing the amount of payroll that determines your insurance premiums. Many insurance carriers will quote you lower rates if your company implements pre-claim and post-claim programs. Some of these risk management measures include the following practices.

Return to work programs

Establishing a return to work program allows an employee to come back to work in a number of capacities. An employee can return to work part time or to a position that accommodates any restrictions they may have. Let's think about the type of jobs and duties that are performed by a typical electrical contracting firm that do not require a lot of physical activity. Someone has to estimate work, perform material take-offs, and prepare bids and presentations. Orders need to be processed and expedited, deliveries need to be received and checked, and inventory such as fittings, covers, lightbulbs, and other lightweight items need to be taken to job sites. These are all tasks that an electrician who is not yet 100% can perform.

Modified duties are another way to get employees back to work. For example, an employee who is restricted from working on a ladder or overhead could install outlets and switches. If the same employee cannot stand for long periods of time, he/she could sit on a stool to trim out the receptacles. Rising workers' compensation costs are primarily due to the increased use of benefits and longer durations of disability. The more time an employee spends on disability, the more wage replacement and medical services increase in cost. By getting employees off workers' compensation quickly, you reduce the duration and expense of their claim. This benefits employees as well, by getting them back into the swing of regular working hours and including them in aspects of the business that they may not have experienced before.

Analyzing previous claims

Look for a pattern to claims. Do some locations or areas in your business have more claims than others? Determine the reason why. You can use your accident investigation forms, first injury reports, and OSHA Form 301 Injury and Illness Incident Report to analyze repetitive injuries or site locations. This will help you to identify areas within your company that require specific or more frequent safety training. Perhaps you need to provide additional training to a site supervisor or change the type of equipment you have been using. Once you have identified hazard or risk issues and begin targeted safety, you can provide documentation to your workers' compensation insurance carrier as proof that you are taking steps to reduce injuries and illness within your company. The result should be fewer claims and by reducing the number of workers' compensation claims your business safety record will improve. This means you are a much better risk to an insurance company, making it more likely they will give you better rates in the long run (Figure 12.5).

You can also implement a number of pre-claims programs aimed at preventing accidents and provide your insurance carrier with this information as well. Document every form of safety training that your company provides, including safety talks, regular safety checks,

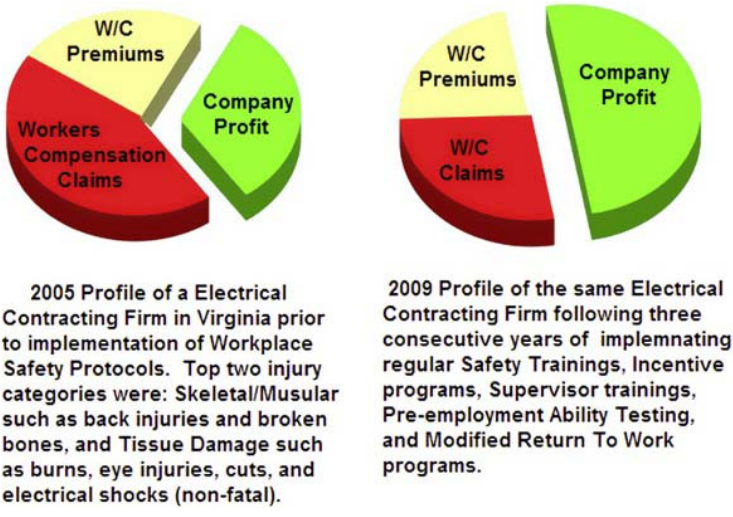

Figure 12.5 This graphic illustrates how reducing workers' compensation claims lowers premiums and results in higher overall profits.

equipment service and maintenance records, revisions to your company's safety manual, and period site inspections. If your company offers a safety incentive program, be sure to provide your insurance carrier with a list of the number of employees who have received acknowledgements or rewards for their safe work practices. Additionally, you will want to give your carrier a list of all specific safety programs offered over the course of a year, such as respirator training, first aid and CPR courses attended by your employees, forklift or scissor lift trainings and certifications, and any preferred doctors or medical clinics that you use for employee assessment and treatment. You will also want to detail any corrective measures your company has taken based on your safety analysis procedures, as well as improvements that exist as a result (Figure 12.6).

The right tools for safety

Using the right tool for the job is a simple and extremely effective safe work practice. This can be as basic as choosing the correct type of saw blade for the material you need to cut. Taking the time to match the

Figure 12.6 A spot inspection of this contractor's job site identified a number of safety infractions. The supervisor snapped this photo and then marked-up and posted the picture on the job site as a reminder for all employees to think about safety and practice safe work methods.

blade to the material means it will take you less time in the long run to cut a material and decrease the risk of the saw kicking back, skipping across the material, or becoming bound up and damaged.

As an electrician, your meter is one of your best safety tools. We have already discussed the importance of making sure that circuits and equipment are de-energized before you start working on them. The first way to confirm that no electricity is present is to use an ammeter because it specifically measures the electric current in a circuit. To measure larger currents, a resistor called a shunt is placed in parallel with the meter. Most of the current flows through the shunt, and only a small fraction flows through the meter. This allows the meter to

measure large currents. If you detect current where there should be none, you will want to determine the source of electricity. Your voltmeter should be used for measuring the electrical potential difference between two points in an electric circuit. Of course, you could use a combination multimeter that will give you the versatility of measuring voltage, current, and resistance in ohms.

There are a number of factors to consider when you decide which meter type to use for a particular application. First of all, the meter needs to have a voltage capability that is at least equal to or greater than the voltage of the circuit you will be measuring. The meter also needs to have internal short circuit protection to ensure that if it fails internally it will not cause a short circuit to appear at the measuring probes. This means you should select a meter with resistance leads or internal fuses. Additionally, you want to choose a meter that is capable of reading the lowest voltage that should be present from all sources, such as back-feed current as well as the normal voltage. Impedance is the final aspect for you to take into consideration. You need the meter to be capable of measuring current that is couple to the circuit and has a high enough circuit impedance so that it doesn't load the circuit and reduce the system voltage to what only appears to be a safe level (Figure 12.7).

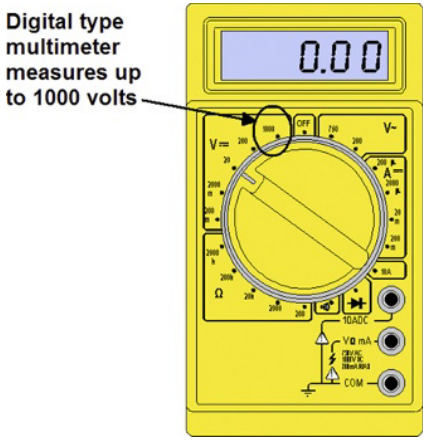

Figure 12.7 A typical example of a multimeter that is capable of measuring voltage up 1000 V rather than a cap limit of only 600 V.

The IEC 61010 is a standard that defines the usage of various types of meters by establishing categories based on voltage and applications. For example, a category I meter should be used for electronics with inherently low energy. This would be equipment that is cord-connected and has built-in transient suppression in the equipment or supply. Category II meters should be used for single-phase receptacle-connected equipment, such as portable tools, branch circuits, and appliances. Indoor lighting circuits, motors, switchgear, and industrial applications including bus and feeders should be measured using a category III meter. These are designed for three-phase or single-phase distribution systems that are isolated for main utility power supplies by transformers or other surge protection. The final group is category IV meters which are used for current that is directly connected to utility circuits and feeders, such as service entrance equipment and power utility service meters. Additionally, Section 110.6(D)(1)(e) of NFPA 70E-2009 requires workers to be trained in the use of voltage detectors and understand the readings and settings of the metering equipment.

If you need to work on energized circuits, you will need to use high-voltage tools that are designed to insulate against current. A hot stick electrically insulates you from energized conductors and provides a physical separation from the device being operated to reduce the chance of burns that may result from electrical arcing if there is a malfunction of the device being operated. Fiberglass hot sticks are used by electric utility workers on live-line work or by commercial electrical contractors. For utility workers, a hot stick allows them to perform operations on power lines without de-energizing them or when the state of the power line is not yet known. This is essential because some operations, such as opening or closing combination fuse/switches, must occasionally be performed on an energized line. Additionally, after a fault has occurred, the exact state of a line may not be certain and utility workers must treat the line as though it were energized until it can be proven that it is not. Depending on the tool you attach to the end of a hot stick, you can test for voltage, tighten nuts and bolts, open and close switches, replace fuses, or lay insulating sleeves on wires without exposing yourself or a crew to a large risk of electric shock (Figure 12.8).

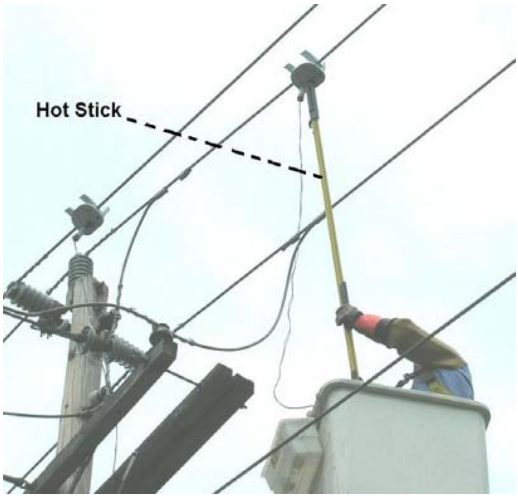

Figure 12.8 Insulated hot sticks provide insulation and separation between an electrician and an energized circuit.

A hot stick and any tools attached to it need to be wiped clean and stored so that it is protected from moisture. A hot stick with a defect, such as a surface rupture, needs to be repaired or replaced. American Society for Testing and Materials (ASTM) Standard F 711 specifies stringent requirements for hot sticks. Industry regulations for hot stick testing include IEEE Standard 978-1984 and OSHA Standard 1910.269 (j)(2)(iii) which require that live-line tools used for primary employee protection must be removed from service, inspected, and electrically tested every 2 years.

Electrical protective gloves

High voltage gloves are a form of PPE that is required for employees who work in close proximity to live electrical current. OSHAs Electrical Protective Equipment Standard (29 CFR 1910.137) provides the design guidelines and in-service care and use requirements for electrical-insulating gloves and sleeves as well as insulating blankets, matting, covers, and line hoses (Figure 12.9).

Figure 12.9 High voltage gloves must be rated and tested for safety in accordance with OSHA and ASTM standards.

Electrical protective gloves are categorized by the level of voltage protection they provide. Voltage protection is broken down into the following classes:

- Class 0—Maximum use voltage of 1000 V AC/proof tested to 5000 V AC.
- Class 1—Maximum use voltage of 7500 V AC/proof tested to 10,000 V AC.
- Class 2—Maximum use voltage of 17,000 V AC/proof tested to 20,000 V AC.
- Class 3—Maximum use voltage of 26,500 V AC/proof tested to 30,000 V AC.
- Class 4—Maximum use voltage of 36,000 V AC/proof tested to 40,000 V AC.

Once the gloves are issued, OSHA requires that they be maintained in a safe, reliable condition. This means that high voltage gloves must be inspected for any damage before each day's use, and immediately following any incident that may have caused them to be damaged.

This test method is described in the ASTM section F 496, Specification for In-Service Care of Insulating Gloves and Sleeves. Basically, the glove is filled with air, manually or by an inflator, and then checked for leakage.

> The easiest way to detect leakage is by listening for air escaping or holding the glove against your cheek to feel air releasing.

OSHA recognizes that gloves meeting ASTM D 120-87, Specification for Rubber Insulating Gloves, and ASTM F 496, Specification for In-Service Care of Insulating Gloves and Sleeves, meet its requirements. In addition to daily testing, OSHA requires periodic electrical tests for electrical protective equipment and ASTM F 496 specifies that gloves must be electrically retested every 6 months. Many power utility companies will test gloves and hot sticks for a reasonable fee.

Electrical safety tips

Don't get so focused on the big hazards, like arc blast, that you overlook the more common safety risks for electricians. For example, over 40 workers died last year from falls after they stepped or sat on skylights that then broke under their weight. To prevent falls like this, follow the same OSHA regulations that you would for open roof work and install guard rails around every skylight before starting work. Also, putting safety netting underneath any type of roof openings during construction can save lives.

Not many electricians would risk standing knee deep in water or in the pouring rain while they are testing electrical circuits. But not everyone thinks about the dangers of something as basic as damp conditions. Suppose it stopped raining an hour ago, but the ground or concrete is still wet, or it is humid and your clothes are damp. These are the times when you need to either avoid using electric tools or wear protective equipment such as insulated rubber gloves and boots. In hot weather, high humidity, or even foggy conditions, remind yourself to towel off frequently, because believe it or not, even perspiration can be conductive. Dry your hands carefully before handling flexible cords and

equipment that's plugged in, and if possible, turn off the electricity before you start working. Be cautious also not to run extension cords through damp or wet areas, especially if you are working on a ladder or scaffolding. Even a small shock could cause you to lose your balance. Additionally, any form of temporary wiring should only be used during remodeling, maintenance, repair, demolition and similar activities. Temporary wiring for 15- and 20-ampere 125-volt single-phase receptacles should also include ground-fault circuit interrupters.

And don't forget to make sure that every work site and company vehicle is equipped with a first aid kit to meet OSHA regulation 1910.151(b) and the ANSI Z308.1-2003 requirement. Basic first aid kits should include the basics, such as tweezers, knuckle fabric bandages, a gauze roll and pads, antiseptic wipes, an instant cold compress, and scissors. Construction site first aid kits should also include one blood bourn pathogen kit and mouth covers or protectors in case mouth-to-mouth resuscitation needs to be performed. It is an added bonus to include burn and antibiotic cream, aspirin, ibuprofen, and acetaminophen.

Trenches

Electricians don't usually have to work in trenches often enough to be familiar with safety protocols for this type of risk. Most workers know to call ahead of time and have underground utilities located and marked before they begin digging to install conduit or conduct repairs. But did you know that excavations and trenches that are more than 4 feet deep must have proper sloping and shoring, and a safe exit such as a ramp or ladder within 25 feet of every worker. Beyond that, trenches that are 5 feet or deeper must be inspected daily by a qualified environmental health and safety professional. Any excavated dirt, material, or other objects must be kept at least 2 feet from a trench opening. Additionally, no one is allowed to work on the sides of sloped or benched excavations above other employees unless the worker in the trench is protected from falling material. You also need to station a top person outside the trench to detect moving ground and warn workers to leave the trench. As you can see, working in a trench requires much more than just the knowledge of how to bend and run the conduit that goes in it.

Any excavating under the base or footing of a foundation or wall requires a support system designed by a registered professional engineer.

Code compliant safety

By now you have probably figured out that working safely demands planning, common sense, and a strong understanding of the safety codes that apply to the task you need to perform. Before you pick up your wire cutters or screwdriver, you should take the time to assess the site conditions and related factors such as power supplies, equipment, and tools that will be involved in your work for the day. If you are unsure of any of the codes that will apply to the type of work you are about to perform, here are a few cross-referenced codes for you to familiarize yourself with.

- Hazards: Have the hazards been identified and have you and those who will be working with you been trained in those hazards? See OSHA 1910.332(A) and NFPA 110.6(A). Will you be working in a hazardous location and has the hazard classification been determined? See OSHA 1910.307(a), NFPA 440.3(A), and NEC 500.5.
- De-energizing power: Has the current been de-energized and tested to confirm that all power has been disconnected? For de-energizing requirements, see OSHA 1910.333(a)(1), NFPA 70E 120.2, and NEC Table 110.26(A)(1). For lockout/tagout requirements see OSHA 29 CFR 1910.147 and NFPA 120.2.
- Energized Equipment: Would de-energizing power create a hazard? For regulations on working with energized equipment, see OSHA 1910.33(a)(2). NFPA 70E Article 110.8(B)(1) requires an electrical hazard analysis before work is performed on live equipment operating at 50 V and higher.
- Junction boxes: Are all the unused openings covered? See OSHA 1910.305(B), NFPA 400.8, and NEC 110.12(A). Are all live parts covered? See OSHA 1910.305(b)(2), NFPA 420.2, and NEC 314.25.
- Conductors: Is the overcurrent protection adequate for the conductor ampacity? See OSHA 1910.304(e), NFPA 410.9, and NEC 240.4.

R.E.C. safety practices

Safe work practices can be summed up in three words—recognize, evaluate, control (REC). Planning out a task, understanding code requirements, analyzing the power, equipment and working conditions, and then implementing safeguards to control risks and hazards are the essence of R.E.C.

Recognize hazards

The first step is to recognize and identify the existing and potential hazards associated with the work you need to perform. A task and hazard analysis and pre-job briefing are two of the tools you can utilize to ascertain the risks involved in your work for the day. It's a good idea to include everyone who will be involved in the task or associated work to discuss and plan for the hazards. Sometimes a coworker will think of hazards that you have overlooked, and it will ensure that everyone involved will be on the same page. Careful planning of safety procedures reduces the risk of injury. Determine whether everyone has been trained for the job they need to do that day. Do you need to present a safety training focused on specific risks that are present today? Decisions to lockout and tagout circuits and equipment and any other action plans should be made part of recognizing hazards. Here are some other topics to address:

- Is the existing wiring inadequate?
- Is there any potential for overloading circuits?
- Are there any exposed electrical parts?
- Will you be working around overhead power lines?
- Does any of the wiring have damaged insulation that will produce a shock?
- Are there any electrical systems or tools on the site that are not grounded or double insulated?
- Have you checked the condition of any power tools that will be used to confirm that they are not damaged and that all guards are in place?

- What PPE is required for the tasks to be performed?
- Have you reviewed the MSDS for any chemicals present on the site or that will be used that could be harmful?
- Will any work need to be performed from ladders or scaffolding and are these in good condition and set-up properly? Is there any chance of ladders coming in contact with energized circuits?
- Are the working conditions or equipment likely to be damp or wet or affected by humidity?

Evaluate the hazards

After you have identified all possible hazards, you can accurately evaluate the risk of injury from each hazard. Occasionally a risk may seem low or insignificant until you take the time to evaluate a hazard. One aspect of your day to consider is that job sites and conditions are constantly changing, and something what was not a problem yesterday could have evolved into a hazard today. It could be something as simple as the fact that it rained or snowed overnight and now equipment and site conditions are wet or slippery.

Combinations of hazards increase your risk. Improper grounding and a damaged tool greatly increase your risk. You will need to make decisions about the causes of any hazards in order to evaluate your risk. For example, if a GFCI keeps tripping while you are using a power tool, it is an indication that a problem exists. Don't just keep resetting the GFCI. Look for the reason the GFCI is tripping. Here are some typical examples of situations or conditions that require investigation and evaluation:

- Tripped circuit breakers and blown fuses: These indicate that too much current is flowing in a circuit or that a fault exists. This condition could be due to several factors, including faulty or damaged equipment or a short between conductors. You will need to isolate the cause in order to control the hazard.
- An electrical tool, appliance, wire, or connection feels warm to the touch: This may indicate that there is too much current in the circuit or equipment or that a fault exists. You will need to figure out which one of these potential factors is causing the problem.

- A burning odor could be coming from overheated insulation. Worn, frayed, or damaged insulation around any wire or other conductor exposes the conductor, creating an electrical hazard. Damaged insulation could cause a short, leading to arcing or a fire, and contact with an exposed wire could cause a shock.

Controlling hazards

Once you have recognized and evaluated any electrical hazards, you have to control the risks to ensure your safety and the safety of the equipment and property you will be working on. Controlling hazards is accomplished by creating a safe work environment based on code-approved techniques and materials and by applying safe work practices.

A safe work environment reduces the chance of fires, burns, chemical hazards, falls, broken bones, and damaged equipment and materials. Safe work practices prevent electrical shocks, arcing, and hearing, back, head, and eye accidents and injuries that can last a lifetime. You can control many common hazards by identifying them in a timely manner, and even avoid them altogether with proper planning (Figure 12.10).

R.E.C. Process

Changing a Wall Ground Fault Circuit Interrupter (GFCI)

Task analysis	Hazard analysis	Hazard abatement
Removing the cover	Electric shock from exposed live wires	De-energize by opening circuit breaker or removing fuse
Removing old GFCI	Possible other live wires in opening	Test wires with appropriate voltmeter to ensure all wires are de-energized
Installing new GFCI	Possible connecting wires incorrectly	Check wiring diagrams to ensure proper connections
Replace cover and re-energize	Possible defective GFCI	Test GFCI

Figure 12.10 An REC example.

All of these precautions, plans, and practices would be easy to include in your day if a buzzer went off every time there was a hazard present. But you and I know that is not how it works. For most of us, there isn't someone standing behind us reminding us to put in our earplugs, or test for current, or not to open a panel because it's not de-energized. If you own your own business, you have to constantly try to balance profits with people's well-being. Maybe it would be easier if you made pillows for a living, but you are in the electrical trade. You work with and around one of the most dangerous elements in construction and you have to take the responsibility to protect yourself by working as safely as possible. Accidents are never planned, but safety can be. You owe it to yourself to take the little bit of extra time and effort required to ensure your safety everyday (Figure 12.00).

STEPS TO CONTROLING ELECTRICAL INCIDENTS

- Treat all conductors, even those that have been de-energized, as if they are energized and dangerous.
- Verify that circuits are de-energized and test for any residual current before starting work.
- Lock out and tag out circuits and machines. Don't ever assume that the "other guy" has done this step. Always confirm lockout/tagout for yourself.
- Prevent overloaded wiring by using the right size and type of wire.
- Prevent exposure to live electrical parts by isolating them.
- Prevent shocking currents from electrical systems and tools by grounding them.
- Prevent shocking circuits by using GFCIs.
- Prevent too much current in circuits by using overcurrent protection devices.
- Prevent physical injuries by using Personal Protective Equipment that is matched to and rated for the work you need to perform. Take care of your PPE and replace old or damaged PPE to make sure that it will be effective.

Figure 12.00 Guide to Controlling Electrical Injuries.