Electrocution occurs when a person is exposed to a fatal amount of electrical energy. Electrical hazards are highly dangerous and expose employees to burns, electrocution, shock, arc flash or arc blast, fire, and explosions.

Be Safe is an acronym used for electrical hazards. Electricity has become such an integral part of our daily lives that it can be easy to take it… and its hidden dangers for granted. Electricity can kill or severely injure people and cause property damage. Therefore, BE SAFE by recognizing, avoiding, and protecting yourself and other workers against all electrical hazards.

Burns are the most common shock-related injuries. Electrical, Arc-flash, and thermal contact are the three types of electrical burns.

Electrocution literally means to kill with electricity." Electrocution occurs when a person is subjected to a deadly amount of electrical energy.

When the body becomes a part of an electrical circuit, current enters at one location and exits at another, and electrical shock occurs.

Simply put, an arc flash is a phenomenon where a flashover of electric current leaves its intended path and travels through the air from one conductor to another or to the ground. The results are often violent and severe injury and even death can occur when a human is near the arc flash.

Consider these cases of electrocution in the construction industry. Two workers were moving a ladder made of metal. When the ladder came into contact with overhead power lines, one of them was electrocuted.

(A) A worker on a water well drilling vehicle was lowering a mast when it collided with high-voltage overhead lines, electrocuting him.

(B) When a rotary drilling truck boom collided with an overhead electrical line, a worker was electrocuted. The victim had just finished drilling a water well at a private home with another worker. The truck was moved away from the well by the victim. The victim was catapulted several feet away from the truck while standing at the controls, lowering the boom.

(C) While working from an eight-foot fiberglass step ladder, a worker was electrocuted and fell to the concrete floor, resulting in his death. The guy was working on a two-bulb fluorescent light fixture approximately eleven and a half feet off the ground and had an activated ballast.

What are some Major causes of Electrocution Hazards in Construction?

- Encountering overhead power lines.
- Improper use of extension and flexible cords; and
- Contact with electrified sources such as live parts, damaged or bare wires, or malfunctioning equipment or tools.

Overhead electricity wires can have voltages ranging from 120 to 750,000 volts. Electrocution, Burns, and Falling from Elevations are all causes of death with powerline work. Always watch for power lines when working on Cranes, ladders, and suspended aerial lifts.

Electrical shock and burns are the most severe dangers of coming in contact with electrified sources. When the human body becomes a part of an electric circuit, current enters the body at one point and leaves it through another point.

The severity and effects of electric shock depend on the pathway through the body, amount of current, exposure time, and water on the skin. This is because water is an electrical conductor that allows current to flow quickly through wet conditions and skin.

What are the hazards of flexible cords being used on construction projects? Wires can loosen or become exposed due to normal wear and use. Cords that aren't 3-wire are not built for heavy usage or modifying the cord has increased the danger of electrical current. Because the cords are exposed, flexible, and unsecured, extension and flexible cords are more susceptible to damage than fixed wiring.

When Around Electrocution Hazards, always keep a safe distance from overhead power wires and use ground-fault circuit interrupters, known as GFCIs. Always examine your extension cords and portable tools as well. If the cords are frayed or worn, let your supervisor know. It's always important and often overlooked, But follow the manufacturer's instructions while using power tools and equipment and always adhere to the lockout-tagout protocols.

For powerlines… Before starting work, ask yourself the following questions…

1. Has the utility provider de-energized and clearly grounded the power lines or erected insulated sleeves on the power lines?
2. Is the equipment located at a safe working distance from power lines?
3. Have both horizontal and vertical power line clearance distances been marked with flagged caution lines?
4. Finally, are non-conductive materials and tools being used?

When working on or around cranes and other high-reaching equipment, you'll need to confirm the voltage with the utility company and the safe working distance from the power lines.

Use an observer, an insulated connection, a boom cage guard, or a proximity device if available and practicable.

For mobile, heavy equipment, use the installed riding posts beneath the power lines, if available, to avoid working too close to the lines.

Always use a non-conductive ladder and ensure it's been retracted before moving it.

Prior to work on powerlines, do a bit or housekeeping to ensure there are no materials stacked beneath electrical lines.

Then, demarcate the area under power lines with caution tape and signs.

If working on Excavations… Before digging, locate and identify the markings with the help of a local underground line locator service or a utility provider.

Dig by hand within three feet of the cable's location.

It's possible that multiple underground cables are buried in the vicinity of locator markers.

A ground-fault circuit interrupter, or GFCI, is a device that protects individuals from potentially fatal electrical shock. The term "GFCI" is also known as "GFI."

A GFI detects ground faults and blocks the flow of electric current, protecting workers by minimizing the duration of an electrical shock.

There are three types of GFCIs: Receptacle, Temporary or Portable, and Circuit Breaker

Receptacle GFCI's are usually seen on construction sites, outdoor areas, and other places where moist conditions exist or may exist.

When an electrical device is connected to the GFCIs-protected outlet, the GFCI receptacle fits into the conventional outlet box and protects consumers from ground faults.

Receptacle GFCIs should be tested after installation and once a month. To test, you'll first turn on a test light or a power tool by plugging it in. Then, press the receptacle's test button. Once you press the button, it should pop up, and the light or tool should then be turned off automatically. Now, you'll want to restore electricity to the outlet, so press "Reset." If these steps were successful, the GFCI passed the test and is operational; if the GFCI fails the test, it must be removed from service.

A portable or temporary GFCI combines an extension cord and a GFCI. It gives you more options when using receptacles that aren't protected by GFCIs.

Extension cables with GFCI protection should be used when permanent protection is unavailable.

- Temporary or portable GFCIs must be evaluated before each use as follows:
- Examine the device visually for flaws and broken parts.
- Connect an extension cord to a test light or tool.
- Press the "Reset" button on the GFCI.
- Press the "Test" button to ensure the outlet isn't plugged in. For instance, the light or tool should shut off.
- Press the "Reset" button to confirm that power has been restored.

A GFCI circuit breaker is a type of circuit breaker that regulates a whole circuit and is used to replace a circuit breaker on the main circuit board.

One GFCI circuit breaker can safeguard the entire circuit rather than several GFCI outlets.

This type of GFCI can be installed in a panel box to protect specified circuits at sites with circuit breakers.

Before using extension cords, workers must inspect them for cuts or abrasions. The insulation on the extension cords may have deteriorated, or the insulation inside an electrical tool or appliance might be damaged at times. When the insulation is broken, exposed metal parts may become electrified if a live wire inside meets them. Insulation within electric hand tools that are old, broken, or mishandled may be damaged.

Flexible cords must be connected to devices and fittings to avoid tension at joints and terminal screws. Because flexible cords are finely stranded for flexibility, stretching them might cause one conductor's strands to loosen from under the terminal screws and encounter another conductor.

Door or window edges, staples, fastenings, abrasion from surrounding materials, or aging can all damage a flexible cord. There is a risk of shocks, burns, or fire if the electrical wires become exposed. Replace any cords that are frayed or broken. Cords should not be run over sharp corners or edges.

According to OSHA requirements, flexible cords must be rated for harsh or extra-hard use. The National Electrical Code dictates that these ratings be indelibly marked nearly every foot along the length of the cord.

Extension cords must be three-wire grounded, allowing any tools or equipment connected to them to be grounded.

Electric current can leak from a wet cord connector to the equipment grounding conductor and anyone who picks up the connectors if they give a path to the ground. Leakage can occur anywhere on the conductor's moist surface, not simply on the conductor's face. Use waterproof or sealable connectors to protect connectors and tools from excessive dampness. Here are a few critical power tool safety tips when working around electrical hazards:

- Never carry a tool with the cord attached.
- Never disconnect the cord by yanking it.
- Keep cords away from extreme temperatures, grease, and sharp edges.
- When not in use, disconnect tools and change accessories such as blades and bits.
- Avoid starting the device by accident. While carrying a plugged-in tool, do not keep your fingers on the switch button.
- And wear gloves and the proper footwear.

- When not in use, store tools in a dry location
- Never use tools in wet conditions
- Work in a well-lit environment
- Make sure cords don't become a tripping hazard
- Discard any tools that are damaged
- Use tools that are double insulated
- And, In hazardous settings, such as those containing flammable or combustible dust or gases, use intrinsically safe or explosion-proof equipment

Misusing tools intended for electrical work can be a hazard. For example:

- Employing multi-receiver boxes designed to be placed by attaching a power cord to them and setting them on the floor
- Building extension cords with ROMEX wire
- Using equipment labeled for use only in dry, indoor environments outdoors
- Connecting three-prong cords and tools with ungrounded two-prong adaptor plugs
- Using circuit breakers or fuses with incorrect ratings for over-current protection, such as a 30-amp breaker in a system with 15- or 20-amp receptacles.
- Using cords or tools that have been changes; and
- Using cords or instruments that have worn insulation or exposed wires

These are all examples of what not to do.

Lockout-Tagout is a critical safety technique that protects workers from injury when working on or near electrical circuits and equipment. Lockout/Tagout also prohibits contact with operational equipment parts such as blades, gears, shafts, and other moving parts. Lockout-Tagout also helps to avoid the unintentional release of hazardous gases, liquids, or solid matter in locations where workers are present.

Lockout/Tagout also helps to avoid the unintentional release of hazardous gases, liquids, or solid matter in locations where workers are present.

1. Bleeding, blocking, grounding, and other methods can be used to deplete stored energy.
2. Use a lock to signal to other workers that a power supply or piece of equipment has been turned off.
3. And, before unlocking and reactivating equipment and circuits, double-check that all personnel are safe and accounted for. Only a qualified individual can assess when re-energizing circuits are safe

Employers are required to keep workers safe from electrocutions. They can do this by:

- Ensuring the safety of overhead power lines.
- Isolating electrical components.

- Providing GFCIs.
- Make sure workers are adequately grounded.
- Make certain power tools are in good working order.
- Make sure workers are adequately guarded; and
- Provide training! Employers must enforce safety-related work procedures such as lockout Tagout; And ensure workers are using flexible cords correctly

FALLS IN CONSTRUCTION

Falls are the most significant cause of death in the construction industry. Annually, falls account for around 34% of construction fatalities. And, across all industries, falls account for around 14 percent of fatalities.

For construction projects, fall protection must always be used if a worker could fall six feet or more onto risky equipment, or from any height onto dangerous equipment. When inspecting, examining, or reviewing workplace conditions before or after work begins or ends, fall protection is not necessary.

Employers are obligated to check the working and walking surfaces.

Employees are not permitted to work on certain surfaces until the strength and structural integrity of these surfaces have been determined. Employers must provide a training program that enables any person who is at risk of falling to recognize falling hazards and adopt necessary measures to reduce the risk of falling. The employer must ensure each employee receives appropriate training from a competent person, knowledgeable in the following eight areas:

1. Nature of the workplace's fall dangers.
2. How to install, maintain, disassemble, and inspect the fall prevention systems that will be used.
3. Guardrail systems, personal fall arrest systems, safety net systems, warning line systems, safety monitoring systems, and their use and operation.
4. Controlled access zones, as well as other security measures, will be implemented.
5. Limitations on the use of mechanical equipment during the performance of roofing work on low-sloped roofs.
6. Correct procedures for handling and storage of equipment and materials, as well as the erection of overhead protection when this system is used.
7. The role of each employee in the safety monitoring system.
8. Plus, the importance of employee participation in fall prevention plans.

GUARDRAILS, TOPRAILS, MIDRAILS, & TOE BOARDS

Guardrails and top rails must be between 39 and 45 inches above the walking and working surface. They must be able to bear 200 pounds of force; and they must also have a diameter or thickness of at least one-quarter inch.

Midrails must be installed halfway between the top rail and the walking or working surface. They must be one-quarter inch in diameter or thickness and able to withstand a force of 150 pounds. They can be made of screens, mesh, vertical members, or solid panels.

Toe boards must be at least three and a half inches tall and capable of withstanding a 50-pound force. Top rails and Midrail material can be pipe, rope, wood, structural steel, or wire rope. Wire rope must be flagged with high visibility material, not more than every 6 feet. Steel or plastic banding is not permitted.

CONTROLLED ACCESS ZONE

A controlled access zone is a work area where specific tasks can be completed without the use of guardrails, personal fall arrest systems, or safety nets, and where access is limited to those who are doing the work.

Control lines, used to define controlled access zones, must be erected between six and twenty-five feet from the unprotected edge, and:

- Marked at least every six feet with high-visibility material
- Raised on stanchions between 39 and 45 inches above the walking or working surface
- Composed of 200-pound-resistant ropes, wires, tapes, or equivalent materials; and
- Connected to a guardrail system or a wall on each side.

Safety Nets

Safety nets must be installed as close to the walking or working surface as possible, but no lower than 30 feet. Also, the safety net openings must not be more than 6 inches on each side. Border ropes must withstand a breaking force of at least 5,000 pounds, and the connections should be as strong as the net and no more than six inches apart.

A Drop Test is done for testing safety nets. For this test, a 400-pound sandbag is dropped from the highest surface, where employees are exposed to fall dangers. Before performing a drop test, ensure adequate room beneath the safety net for clearance. All safety nets must be put to the drop test after installation, relocation, repair, and every six months, even if they haven't been removed.

Safety net Inspection is mandatory and must be performed at least once a week or following an incident that could compromise the net's structural integrity.

Objects that fall onto the net must be removed as soon as possible and always before the following shift.

Any employees, vehicles, equipment, or materials that may be imposed on the cover must be able to support double their weight. To avoid accidental movement, covers must be secured. Covers must be color-coded with the words HOLE or COVER.

PERSONAL FALL ARREST

Personal Fall Arrest Systems, also called PFA's, must limit an employee's maximum arresting force to 1,800 pounds and their fall to 6 feet. The worker must also be unable to reach a lower level; and have enough strength to withstand twice the potential impact energy of an employee free falling from six feet or the free fall distance permitted by the system, whichever is less.

The Personal Fall Arrest System must be strong enough to bring an employee to a complete stop and limit the maximum deceleration distance to 3 and ½.

Before each usage, PFAs must be examined for wear and other degradation. Any defective items must be withdrawn from service.

When using PFAs, body belts are forbidden. PFASs are solely used to safeguard people from falling and are never used to lift materials. After a fall, there must be an immediate rescue. When it comes to PFAs, always follow the manufacturer's directions.

A PFA is made up of Anchorage, Body Support, and Connectors. Anchorages must be Independent of any anchorage used to support or suspend platforms; and able to sustain five thousand pounds per employee. Otherwise, a system with two-factor safety must be used.

The requirements for connectors require D-rings to be PFA compliant. D-rings and snap hooks must be proof tested to 3,600 pounds and have a minimum tensile strength of 5,000 pounds. Only snap hooks with a locking mechanism can be used. The breaking strength for lanyards and lifelines must be at least five thousand pounds.

Lanyard and lifeline ropes and straps must be composed of synthetic fibers and the lifeline must be safeguarded from cutting or abrasion. Self-retracting lifelines that limit free falls to two feet must be able to withstand a tensile stress of at least 3,000 pounds. Self-retracting lifelines that do NOT limit free falls to two feet, must be able to withstand a tensile stress of at least 5,000 pounds. Connectors must meet the following requirements:

- A body harness's connection point should be near shoulder level above the head in the center of the wearer's back.
- A positioning device system is a body belt or body harness designed so a worker can operate with both hands while leaning against elevated vertical support structures, such as a wall.

- Systems for positioning devices must be able to be secured to an anchorage capable of holding at least twice the potential impact weight of an employee's fall, or 3,000 pounds, whichever is larger.
- They must also be set up so workers can free fall no more than two feet.
- They must have snap hooks, d-rings, and other connectors that satisfy the same standards as personal Fall arrest systems, and
- They must be inspected and all defective components removed before each use.

WARNING LINES

Warning lines are a fall protection system that surrounds all sides of the work area, are placed at least 6ft from the edge, and are made up of supporting lines such as rope, wires, or chains flagged with high visibility material.

The idea behind the warning line system is to ensure employees know there's an edge there. Once you get up to a certain pitch, you can't use them anymore because it will not stop anybody from falling off. Just like in the term, it's a warning line. It lets them know, hey, there's an edge here. If you were backing up and weren't paying attention, you need to stop and check your surroundings

The warning line system is not strong enough to prevent an employee from going over the edge like a guardrail system is. So, it is the least preferred method and requires the most significant amount of supervision to ensure it's being used correctly.

When it comes to warning lines, the size of the job usually dictates whether to use a warning line or go ahead and tie it off. Because if it's a minor job, it doesn't make much sense to have a six-foot warning line when you've only got another 5ft behind you. You might as well tie off and work in that area

But if you've got a pretty good size job, like a commercial job, that you can put a flag system up, and then have a big area to work behind; that usually works out best for us. So, you are restricted to the roof's slope on a warning line.

You can only use a warning line up to a two-twelve pitch. Anything below that you're okay, but anything above a two-twelve pitch, you have to go to the standard fall protection scenarios.

Lines of caution must include the following:

- Positioned at least 6-feet from an unprotected edge;
- Flagged with high-visibility material every 6-feet;
- Made of ropes, wires, or chains with a minimum tensile strength of 500 lbs;
- Erected between 34 and 39 inches, including sag, from the walking-working surface; and
- Have support for warning lines that can withstand a horizontal tipping force of 16 lbs.

A fall prevention system, where an employer chooses a competent person to monitor the safety of workers, is known as safety monitoring. The employer is responsible for ensuring the safety monitor is competent in recognizing fall hazards and can warn workers of fall hazard dangers. The Fall Protection competent person also detects unsafe work practices and is on the same walking or working surface as the workers so he or she can see them. The fall protection competent person must stay close enough to communicate orally with workers and has no other current duties to divert attention from the monitoring.

Any openings in guardrail systems intended to prevent materials from falling from one level to another must be small enough to prevent falling objects from passing through. Except for masonry and mortar, no materials or equipment may be stored within four feet of the working edges.

Excess mortar, broken or scattered masonry units, and other materials and debris must be removed regularly to keep the working area free.
Unless guardrails are installed at the roof edge, materials and equipment must not be stored within six feet of the edge during roofing work. Stable and self-supporting materials must be heaped, clustered, or stacked near a roof edge.

Toe boards must provide protection from falling objects and erected far enough along the edge of the overhead walking or working surface to protect employees below. Toe boards must safely withstand a force of at least 50 pounds applied in any downward or outward direction. Toe boards must be a minimum of 3 ½ inches in vertical height from the top edge to the walking-working surface and shouldn't have more than a ¼ inch clearance above the walking-working surface. Tow boards must be solid or have no more than one inch of aperture.

There are numerous practices to prevent falling from a ladder; here are three to get you started.

- Select the appropriate ladder for the assignment.
- Ensure a ladder is a proper tool for the job. Is it better to use scaffolding or a mechanical lift?
- Use the correct ladder.

The ladder is often the only physical support you have while working. That's why it's critical to find the correct ladder if you need to use a ladder. Step ladders, straight ladders, and extension ladders are the three primary types of ladders that are used in construction.

If the ladder doesn't reach three feet above the landing, on slippery terrain, or where it could be displaced by work operations or traffic, tie the top and bottom of the ladder to fixed points. Secure the top of the ladder on both sides to a fixed point on the roof or other high surface near where you're working. A fixed location on the ground should be tied to the bottom. Prior to work, tie off the ladder and untie it at the end of the day. This takes roughly five

minutes. That could mean the difference between life and death for you. Allow extra time for this critical stage if you need to move the ladder, or consider using something else, such as a scaffold.

While climbing the ladder, don't carry any tools or other things in your hands.
Use caution when climbing or descending a ladder. Use a tool belt, create a rope and pulley system, or tie a rope around your materials and pull them up once you've reached the worktable.

If you need more than one hand to pull them up, ask for assistance.

Climbing the ladder with anything in your hands can throw you off balance when ascending or descending the ladder; always use at least one hand to hold it.

Slipping, Tripping, Falling

To keep from slipping, tripping, and falling while on scaffolds, workers must not work on platforms covered in ice, snow, or other slippery material unless the material is removed. Operating scaffolds during storms or heavy winds are prohibited unless a competent person has assessed that it's safe and the employee is protected by a personal fall arrest system or a windscreen. When employees are more than 10 feet above a lower level, fall protection is necessary. Also, in this case, PFASs must be lanyard-attached to a vertical lifeline, horizontal lifeline, or scaffold structural element when used with scaffolds.

Scaffolds

Scaffolds must only be erected, moved, dismantled, or altered with the supervision and guidance of a qualified person. Before each work shift, a competent person must inspect all scaffolds and scaffold pieces, as well as after any occurrence that could compromise the scaffold's structural integrity. Supported scaffolds cannot be more than four times the length of their smallest base dimension, and scaffolds that exceed this height ratio must be connected with guys, ties, or braces.

Base plates, mud sills, or another sufficient, stable foundation must support poles, legs posts, frames, and uprights. The spacing between planks should be no more than one inch broad, with each plank's abutted end resting on its support surface. Unless they are confined so that they do not move, planks that overlap must do so 12 inches over support.

Platforms

Platforms must have a minimum width of 18 inches and must be able to support four times their planned load plus their own weight. Gaps of more than 14 inches are prohibited. Wooden platforms must be constructed of scaffold-grade wood and must not be painted.

All component pieces must be of the same type and match and unless cleated or otherwise restricted by hooks, each end of a platform must extend at least six inches beyond its support.

Unless the platform is designed and installed so the cantilevered portion can support employees and materials without tipping, or if the platform has guardrails that block employee access to the cantilevered end, each end of the platform, 10 feet or less in length, must not extend more than 12 inches. And in cases where the platform is longer than 10 feet, it must not extend more than 18 inches over its support

When working on suspension scaffolds, each rope must be capable of supporting no less than six times the required load. Suspension scaffolds must always be secured, and wire ropes that have been repaired are forbidden to be used as suspension ropes.

Aerial Lifts

When working on aerial lifts, employers must first ensure staff is trained and authorized to set brakes and use outriggers. Workers must never exceed the boom and basket load restrictions during operation, and fall protection attached to the boom or basket must be worn. And here's a warning. No equipment must ever be used to lift the employee above the basket.

Aerial lift modifications must be certified in writing by the manufacturer. The lift controls must be checked daily, and controls on the articulating boom and extended boom platforms, primarily designed as personnel carriers, must be clearly marked.

Sitting on… or climbing on the basket's edge is prohibited. Workers must stand on the basket floor of the aerial lift. Fall protection is required and includes a body harness and lanyard linked to the boom or basket no matter the height.