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Electirical Installations and Lighting

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Electrical Hazards and Accidents

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Introduction

Electrical accidents can occur everywhere, for example at home, workplace, indoors and outdoors. The source of the electricity can be the power line, devices connected to it or lightning. It has been said wisely that electricity and water do not mix. The presence of water not only provides a means for improving contact with the body, but also provides a ground-return path. Water issuing from a tap or hose provides an excellent ground. There are a lot of types of electrical accidents and in my work I will list some of them.

1 Historical background

Generators that convert mechanical energy to electrical energy first appeared around the middle of the 19th century; electrical energy was first used to drive motors in factories and in locomotives. The outdoor gas lamps were replaced by electric arc lamps for street lighting in the late 1800's. However, it was the development of the carbon-filament electric lamp by Swan in the UK and Edison in the US in 1879 that brought electricity into the home. Edison's direct current could not be transmitted efficiently very far from the generating station because of the need for large-diameter conductors.Tesla and Westinghouse solved this problem by using alternating current, thereby eliminating the distance limitation with a transformer to step up the voltage for longdistance transmission with low current, requiring only small-diameter conductors. A step-down transformer at the user site recovered the electrical energy at any desired voltage.

With the increasing availability of electrical energy from the mid 1850's, there arose the opportunity for accidents. Jex-Blake (1913) was the first to collect early accident reports and wrote: "I believe that no loss of human life from industrial currents of electricity occurred before 1879, though currents strong enough to have caused death were employed in lighting the operatic stage in Paris at the first performance of Meyerbeer's Le Prophete as long ago as 1849, and in lighthouses on and off the coast of England in 1857. In 1879 a stage carpenter was killed at Lyon by the alternating current of a Siemens dynamo that was giving a voltage of about 250 volts at the time.

2 Types of electrical accidents and hazards

Electric shock

You can get an electric shock when you come into contact with an electrical current. The electrical energy flows through the individual's body causing a shock. The body is made up mostly of water and is, therefore, a good conductor for an electric current. The electrical shock injuries may be mild, moderate or devastating. A mild shock only leaves a light tingling sensation while a moderate shock can cause the muscles in the body to contract. However, severe electrical shock may result in devastating heart or respiratory failure, and even death. It must be noted that electric shock injuries are less common than burn injuries.

Electrical burns

Electrical burns are usually the results of a severe electric shock. This can damage internal and external tissues, it can cause inury to organs and it may even cause death after prolonged exposure. As technology continues to evolve and more electrical equipment is introduced to homes and workplaces, the incidences of electrical burns continue to rise. Certain professions such as cable servicing, construction, and electrical repair put people at higher risks for electrical burn injuries. These electrical burn injuries range from first-degree to third-degree, and can either be internal or external. They occur when electricity causes the body tissues to burn. Even though the burn may look trivial, the extent of internal damage may be quite severe. That being said, there are six main types of electrical burns: arc burns, low voltage burns, high voltage burns, oral burns, flash burns, and flame burns.

Electrical fires

While electric shocks and burns are employee-related accidents, electrical fires are invariably due to the work environment – usually caused by exposure to highly flammable materials. Besides combustibles, Electronic Static Discharge and electrical sparks may also cause an electrical fire; and failure to immediately put it out can lead to serious inuries and environmental damage – causing anything from company downtime to death.

Electrical Hazards

The following is a list of a common electrical hazards:

- Improper grounding
- Exposed electrical parts
- Inadequate wiring
- Overhead power lines
- Damaged insulation
- Overloaded circuits
- Wet conditions
- Damaged tools and equipments

3 Electrical accidents at home

The home can be a hazardous environment because it has both a source of electrical energy (the power line), grounded devices and water.

Electrical hazards at home:

1. Poor wiring and defective electric wires – Good quality wiring that conforms to safety standards is vital for safety. Poor wiring can increase chance of fire, power surges, arc faults, and other serious consequences. For this reason, it's always best to avoid do-it-yourself electrical work and get professional electricians to perform electrical wiring around the house. Damaged, worn, cracked or corroded electrical wires can increase the chance of electrical accidents. Some hazards include:
    a) Loose or improper connections, such as electrical outlets or switches
    b) Frayed appliance or extension cords
    c) Pinched or pierced wire insulation, which could occur from, for example, a chair leg sitting on an extension cord
    d) Cracked wire insulation caused by heat, age, corrosion or bending
    e) Overheated wires or cords
    f) Damaged electrical appliances
    g) Electrical wire that has been chewed by rodents
2. Outlets close to water – Outlets in bathrooms, kitchens, and other living areas with water should be installed a fair distance away from the water source. As water conducts electricity, keeping outlets away from water reduces the chance of electric shock. Never use a radio, hair dryer, phone, or other device in the bath, near the pool, or anywhere with a wet floor.
3. Wet hands – Similarly, electrical appliances should never be handled with wet hands as this heightens the chance of getting an electric shock. Yet too many of us tend to reach for the hair dryer with wet hands out of the shower. Keep appliances far away from sinks, bathtubs, showers, and taps.
4. Pouring water on electrical fires - A common error is pouring water on electrical fires. If an electrical fire does occur, avoid pouring water on the flames as water will further fuel the fire and could cause electrocution. Keep a fire extinguisher on site if you're worried about electrical fires and use that instead of water in times of emergency. If you don't have one nearby, turn off your electrical power, evacuate your home and call the fire brigade.

5. Extension cords - Extension cords should be carefully fixed in place where possible to reduce the chance of tripping or accident. Use plastic socket closures on unused sockets. Don't use extension cords as a permanent substitute for additional power sockets, and avoid using them for too many appliances at once.
6. Lightbulbs – We don't often think of lightbulbs as being electrical hazards, but the potential for an electrical fire arises when lightbulbs are kept near flammable materials. These can include beds, drapes, plastics, or other items such as upholstery. Lights, like all sources of electricity, can also cause electric shock, so ensure you always turn the light switch off before replacing a light bulb, and never replace a light bulb or touch a light switch with wet hands. Always ensure you use a light bulb with the correct wattage to prevent overheating.
7. Covered electrical cords and wires - Heavy covering of wires can cause the cords to overheat, which could lead to an electrical fire. Keep cords and wires away from other items and keep them uncovered. Similarly, make sure that items like computers and televisions have enough space around them for ventilation, to prevent them from overheating.

3.1 Examples of home accidents

A householder was standing on a metal stepladder in the basement starting to repair a light fixture. The switch was off and there was some water on the floor. When he touched one of the wires to the fixture, he received a strong shock and fell off the ladder, injuring his back. On investigation, it was found that the light switch was in the cold (ground) side, rather than the hot (ungrounded) side of the power circuit. His fall disconnected him from the power line and probably saved his life.

An adult female was using the telephone during a thunderstorm. There was a lightning strike nearby and the woman was thrown from her chair to the floor. She felt a shock to the head and complained of ringing in the ear with temporary hearing impairment. It is important to recognize that lightning is characterized by a series of very short-duration pulses and that an ohmic contact is not needed between the subject and the telephone. The metal parts in the headset and the hand and the head form the "plates" of a capacitor through which very short-duration pulses pass readily. Whether the muscular response was due to the current flow or the startle reaction due to the loud auditory sensation is not known. The subject returned to work on the following day and recovered completely.

3.2 Prevention of home accidents

- Never touch anything electrical with wet hands or while standing in water. Wear rubber shoes in wet areas. If you get a tingle or shock when touching a sink, tub, or other wet area, turn off the power at the main panel (if it's safe) and immediately call an electrician.
- Don't use frayed or broken cords or plug in anything with a missing prong.
- Cover unused outlets. Keep metal objects such as silverware away from outlets.
- Don't overload sockets. Use a power board with a safety switch and only use one per wall outlet.
- When unplugging, don't yank! Pull by the plug, not the cord.
- Don't run cords under rugs or furniture. Also keep them away from pets that like to chew.
- Always clean the lint filter for your dryer. If an item says "do not put in dryer", trust the warning!
- Test safety switches each year.
- Don't fly kites near power lines. The kite or string can conduct electricity sending it right through you to the ground.
- Never touch a downed power line or climb a utility pole.

4 Electrical accidents at the workplace

Electrical accidents are common, if not unavoidable, in the manufacturing environment. They occur for a number of reasons, whether it concerns the management, equipment, or employees.

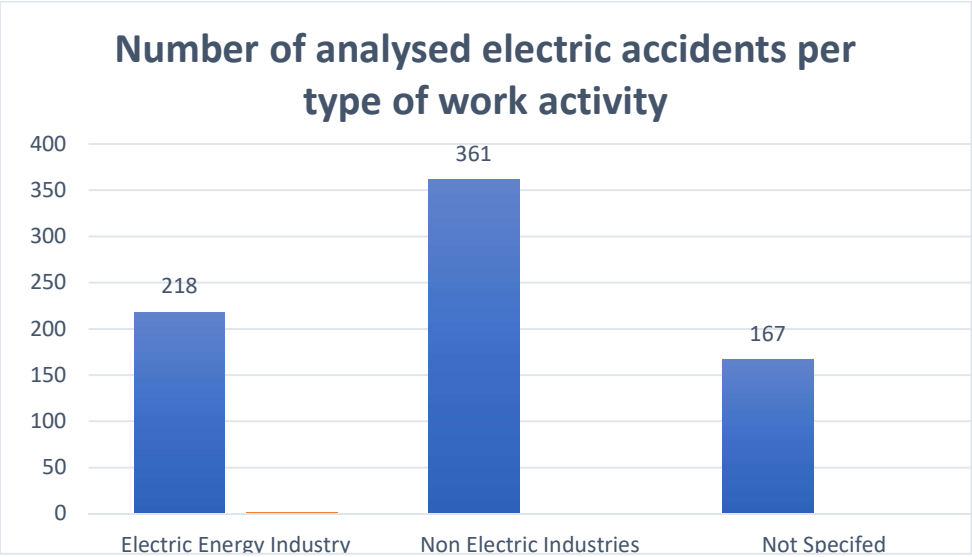
According to the Health and Safety Executive (HSE), who collect and analyze data on electrical accidents, among other things, there are 12 common causes of electrical accidents that happen while the equipment is being maintained:

- Unsafe system of work
- Inadequate information
- No training
- Inadequate isolation
- Unsafe Rules
- Poor control of work activities
- Working Live
- Unsuitable test equipment
- Poor maintenance
- Failure to manage work
- Person not competent
- Uninsulated electrical wiring

4.1 Examples of workplace accidents

A joiner was using a wooden-handled hacksaw, held in the right hand, to cut through an 11,000-volt cable believed to be dead. He supported the cable with the toe of his left boot. There was a sudden explosion and a flash which vaporized the hacksaw blade. The Joiner was quite definite that he did not receive a shock. The current had passed from the core of the cable and along the blade to the grounded armored casing of the cable. He was thrown out of the pit by the explosion, temporarily blinded by the flash, and was trembling all over and feeling very cold. He was given first-aid treatment (warmth and warm drinks) by his mate and taken to the nearest hospital where he was kept for three hours and then resumed work.

A 60-year-old laborer, wearing rubber boots, was standing in a damp trench sawing through (an armored) cable believed to be dead. In fact, the cable was energized to 11,000 volts. There was a sudden flash and he became rigid and was thrown backward into the trench; the saw was destroyed. He felt very dazed and although able to climb into the ambulance, he did not really recover consciousness until he arrived in hospital a few minutes later. He was kept only a few hours and then sent home. As a result of the accident the backs of his hands were scorched, but not badly enough to require dressing. He was off work only for one day. As he was wearing rubber boots it is considered more likely that the path of the current was from right hand to left hand (his left hand was holding the grounded armored covering of the cable) than from hands to feet. He was not wearing gloves.



While we might think that in the electric energy industries are more electrical accidents, we can see in the graphic that according to the book *Electric Accidents in the Production, Transmission, and Distribution of Electric Energy: A Review of the Literature* (2001) by Paraskevi E. Batra and Maria G. Ioannides, the number of electric accidents was higher in the non electric industries.

4.2 Prevention of workplace accidents

- Complete a detailed job plan and communicate it to all co-workers.
- Know safety requirements and follow them.
- Understand the construction and operation of the electrical equipment and the hazards involved.
- Identify all possible energy sources that could pose on-the-job hazards.
- Before working on or around electrical systems or equipment, identify the load circuits and disconnect. Remember, in some cases, turning power off may cause other hazards. Such hazards and additional guidance should be addressed in your work plan.
- Select the appropriate personal protective equipment (PPE). Remember, PPE must be worn until the electrical system is in a safe condition.
- Never assume that the equipment or system is de-energized. Remember to always test before you touch.
- Use lockout/tagout procedures.
- Make sure your test equipment is working properly both before and after you use it.
- If at any time the job becomes more hazardous than you had anticipated, stop and revise the plans.

Conclusion

Nowadays all the technical preventive aspects are well known, although electric accidents continue to occur. Whereas it is not easy to prevent all the electronical accidents, knowing the magnitude of the danger and its components is a first step.

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