



# ELECTRICAL SAFETY

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**Environmental  
Health and Safety**

EAST TEXAS A&M



# INTRODUCTION

- An average of one worker is electrocuted on the job every day
- There are four main types of electrical injuries:
  - Electrocution (death due to electrical shock)
  - Electrical shock
  - Burns
  - Falls

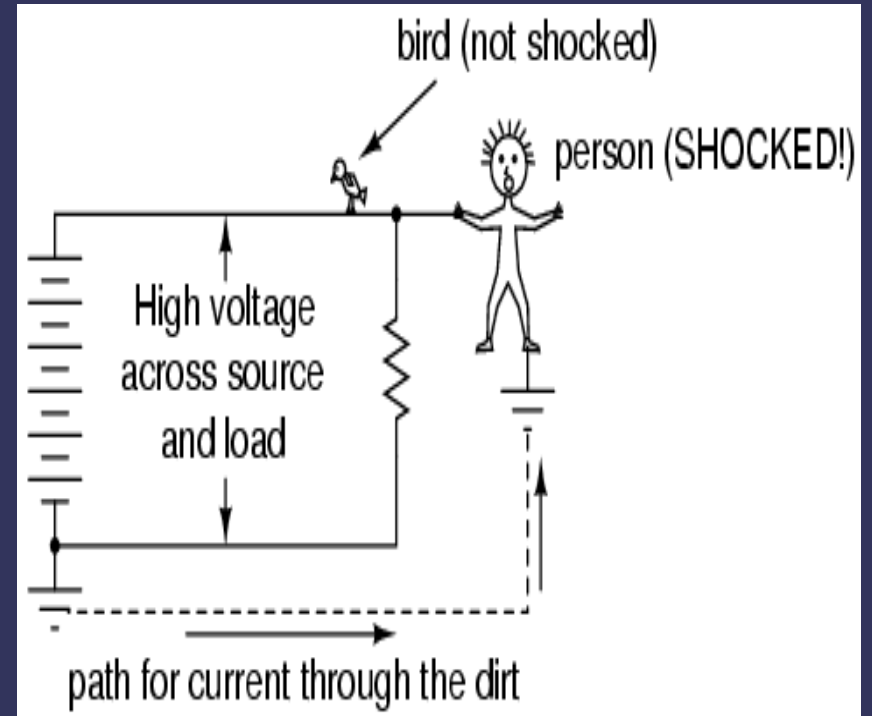


# ELECTRICAL TERMINOLOGY

- **Current**- the movement of electrical charge
- **Resistance**- opposition of current flow
- **Voltage**- a measure of electrical force
- **Conductors**- substances, such as metals, that have little resistance to electricity
- **Insulators**- substances, such as wood, rubber, glass, and bakelite, that have high resistance to electricity
- **Grounding**- a conductive connection to the earth which acts as a protective measure

# ELECTRICAL SHOCK

- Received when current passes through the body
- Severity of the shock depends on:
  - Path of the current through the body
  - Amount of current flowing through the body
  - Length of time the body is in the circuit
- LOW VOLTAGE DOES NOT MEAN LOW HAZARD



# DANGERS OF ELECTRICAL SHOCK

- Currents greater than 75mA\* can cause ventricular fibrillation (rapid, ineffective heartbeat)
- Will cause death in a few minutes unless a defibrillator is used
- 75mA is not much current – a small power drill uses 30 times as much

\*mA= milliampere = 1/1,000 of an ampere

# HOW IS AN ELECTRICAL SHOCK RECEIVED?

- When two wires have different potential differences (voltages), current will flow if they are connected together
  - In most household wiring, the black wires are at 110 volts relative to ground
  - The white wires are at zero volts because they are connected to ground
- If you come in contact with an energized (live) black wire, and you are also in contact with the white grounded wire, current will pass through your body and **YOU WILL RECEIVE A SHOCK**

# HOW IS AN ELECTRICAL SHOCK RECEIVED? (CONT)

- If you are in contact with an energized wire or any energized electrical component, and also with any grounded object, YOU WILL RECEIVE A SHOCK
- You can even receive a shock when you are not in contact with a ground
  - If you contact both wires of a 240-volt cable, YOU WILL RECEIVE A SHOCK and possibly be electrocuted



# MOST COMMON CAUSES OF ELECTROCUTION

- Contact with Overhead power lines
- Contact with live circuits
- Not following Lock-out / Tag-out procedures
- Poorly maintained extension cords
- Defective power tools





# DIRECT AND INDIRECT TYPES OF ELECTRICAL INJURIES

## **Direct**

- Electrocution or death due to electrical shock
- Electrical shock
- Burns
- Hearing loss from arc blast

## **Indirect**

- Falls
- Fire

# ITS YOUR RESPONSIBILITY TO KNOW THE WORK HAZARDS

- Know the hazards of electricity
- Know the equipment
- Use safe work practices
- Inspect your PPE before each use
- Don't work on energized circuits without permission

# OVERHEAD POWER LINE HAZARDS

- High wires are usually not insulated
- Examples of equipment that can contact with these power lines:
  - Crane
  - Ladder
  - Scaffold
  - Backhoe
  - Scissor lift
  - Raised dump truck bed
  - Aluminum paint roller

# OPERATING EQUIPMENT NEAR OVERHEAD POWER LINES

- The OSHA requirements limit crane operations to a minimum clearance of 10 feet for lines rated at 50 kilovolts (kV)
- Follow safe distance operating instructions for all power lift equipment

## 29 CFR 1926.1408

### Table A

<b>Voltage</b>	<b>Minimum Clearance Distance</b>
Up to 50 kV	10 feet
Above 50-200 kV	15 feet
Above 200-350 kV	20 feet
Above 350-500 kV	25 feet
Above 500-750 kV	35 feet
Above 750-1000 kV	45 feet
Above 1000 kV	(As established by the utility owner/ operator or registered professional engineer who is a qualified person with respect to electrical power trans- mission and distribution)

Figure 1. OSHA's minimum clearance distances.



# FLASHOVER

- High-voltage electrical short circuit made through the air between exposed conductors
- Can occur when equipment is operating too close to overhead power lines

# ARC BLAST/FLASH

- When an arc fault occurs, the result is a massive electrical explosion. The light and heat emitted by the explosion is known as the arc flash, and the pressure wave is known as the arc blast
- Pressure waves generated by an arc flash explosion can carry a force up to thousands of pounds per square inch
- Powerful enough to knock down or throw nearby workers, and cause damage to the eardrums, lungs, brain and other organs. Other effects of arc blast include: High temperatures

# PROPER PPE FOR ELECTRICAL SAFETY WORK

- 100% cotton long sleeve shirts
- Heavy duty leather coat
- Heavy duty cotton long pants
- Safety glasses or arc flash shield
- Hearing protection
- Leather work boot – non-steel toe
- Gloves rated for the electrical work with outer leather
- DO NOT WEAR polyester clothing or clothes that are highly flammable



# ELECTRICAL SAFE WORK PRACTICES INCLUDE

- Use barriers and guards to prevent passage through area of exposed energized equipment
- Pre-plan work, post hazard warnings
- Keep working spaces and walkways clear of slip, trip, and fall hazards

## Electrical Safety

### ELECTRICITY CAN KILL

- Each year about 1000 accidents of work involving electrical shocks to people are reported to Health & Safety Division.
- Around 20 of these are fatal.
- Shocks from voltages over 50 volts AC or 120 volts DC are hazardous.
- Even non-lethal shocks can cause severe performance injury.

### ASSESSING THE RISKS

Health and safety risk assessment should take into account the risks associated with electricity.

**Risk assessment points of 3 stars**

- Identifying the hazards.
- Deciding who might be harmed and how.
- Estimating the risks and deciding on controls.
- Recording your findings and implementing them.
- Reviewing your risk assessment and updating it if necessary.

**What you can take your team**

- Contact with live parts.
- Electrical tests and the risks are greatest where the equipment contains a fault current.
- Flammable or explosive atmospheres.
- Worst conditions where insulation equipment can easily become hot and can under its surroundings fire and dangerous.
- Confined spaces where it is electrical test equipment, it will be very difficult to avoid a shock.
- Some of the equipment such as sensitive tools and test leads which are particularly liable to damage.

For further guidance please visit HSE's website (www.hse.gov.uk/elect)

### REDUCING THE RISKS FOR EMPLOYERS

Ensure people working on or with electrical equipment or systems are 'competent' for the task.

**Ensure the electrical installation:**

- Complies to BS 7671 Requirements for electrical installations.
- Is maintained in a safe condition.
- There are enough protection systems implemented.

**Minimise work with energised equipment:**

- Equipment must be suitable for its working conditions.
- Consider using air, hydraulic or hand-powered tools in such conditions.
- Provide a switch over each fixed machine to cut off power in an emergency.
- Replace damaged sections of cable completely.
- Special electrical equipment should be used in particularly hazardous or explosive atmospheres.
- Consider asking for specialist advice.

**Reduce the voltage:**

- Temporary lighting can be run at lower voltages.
- Warning signposted tools are safer.
- Portable tools designed for use from a 110 volt extra-protected supply are available.

Provide a safety device per RCD-T equipment operating at 230 volts in higher a user. An RCD-T is a device which detects water leaks in the electrical system and quickly switches off the supply.

### WHAT DO THE REGULATIONS REQUIRE?

The Health and safety at Work Act 1974 states that:

- Employers are responsible for ensuring the safety and health of their employees and the public.
- This is to be done from work activities.

**The Electricity at Work Regulations 1989 states that:**

- Electrical systems must be maintained in a way that prevents danger.
- Employers, employees and self-employed must maintain the electrical systems as necessary to prevent danger.
- Employers, employees and self-employed must work only on electrical systems covered by a way that prevents danger.
- Electrical equipment used in hazardous environments must be constructed or certified to prevent an increasing danger.
- Only those with competent knowledge or experience in order to safely undertake electrical work with, or on, electrical equipment that poses such danger to safety.

**The Reporting of Injuries, Diseases and Dangerous Occurrences Regulations 1995 states that:**

- The enforcing authority must be notified immediately by telephone using the Incident Reporting Line (044 500 9000) or via the Health and Safety Executive's Incident Report page.

### REDUCING THE RISKS FOR EMPLOYEES

Visual inspection checks must be done by employees.

**Check safety:**

- Equipment in faulty condition must be taken out of use, labeled 'DO NOT USE' and kept in store until repaired by a competent person.
- If possible, tools and power cables should be switched off before plugging in or unplugging.
- Equipment should be switched off and/or unplugged before starting or making adjustments.

Always report faults to the person and the other things in the shop, regardless of how bad they are.

Have overhead electric lines further up if possible or ensure safe working distance from the lines.

The size of track opening category must be compatible before starting work with electrical safety on overhead.

**CRITICAL SAFETY FAILED**





## CONTROL — USE OF GFCI (GROUND-FAULT CIRCUIT INTERRUPTER)

- Detects the difference in current between the black and white wires as low as 2mA
- If ground fault is detected, GFCI shuts off the electricity in 1/40<sup>th</sup> of a second
- Protects you from the most common form of electrical shock hazard, the ground fault
- Will not protect you from line contact hazards – such as holding two hot wires and hot wire and neutral in each hand or from an overhead power line

# OSHA'S ELECTRICAL STANDARDS, NFPA 70 AND 70E

- OSHA's electrical standards are based on the National Fire Protection Association Standards NFPA 70, and NFPA 70E, Standard for electrical safety for employee workplaces
- Only qualified employees may conduct electrical work
- Special training is required for qualified employees:
  - Safe work practices
  - Isolation of electrical sources
  - Test equipment
  - Tools and PPE

**Is compliance with NFPA 70E standard for electrical safety in the workplace mandatory?**

**Answer: No**

**NFPA 70E** is a national consensus safety standard published by NFPA primarily to assist OSHA in preparing electrical safety standards. Federal OSHA has not incorporated it into the CFRs

**Can I be cited for not complying with NFPA 70E?**

**Answer: Yes**

The employer must assess the workplace for electrical hazards and the need for PPE under 29 CFR 1910.335(a)(1)(i). The employer is expected to use the best means available to comply with this requirement that is done through consensus standards. In the event of an injury or death due to an electrical accident, if OSHA determines that compliance with 70E would have prevented or lessened the injury, OSHA may cite the employer under the general duty clause.