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NEBOSH

INTERNATIONAL GENERAL CERTIFICATE IN OCCUPATIONAL HEALTH AND SAFETY

Element 11: Electricity

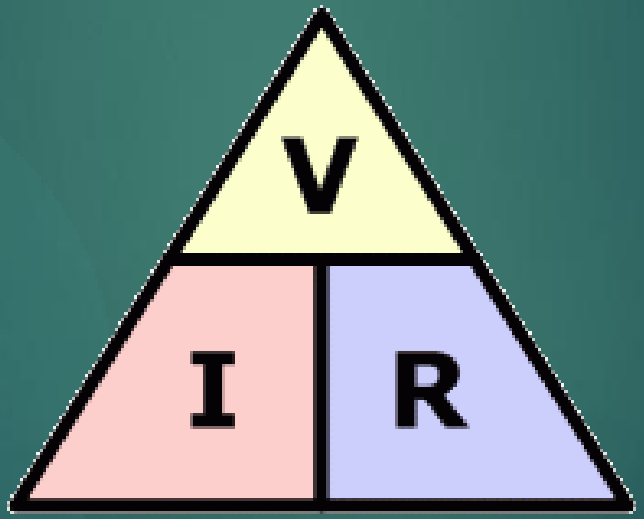
SCOPE OF LEARNING

11.1 Hazards and risks
11.2 Control measures

11.1 HAZARDS AND RISKS

BASICS OF ELECTRICITY

- Voltage
- Current
- Resistance
- Electric Power



OHM'S LAW

Ohm's law states that the voltage across a conductor is directly proportional to the current flowing through it, provided all physical conditions and temperatures remain constant.

$$V = IR$$

$$I = \frac{V}{R}$$

CAUSES OF ELECTRICAL ACCIDENTS

1. **Direct contact**
2. **Indirect contact**

Examples of such may include-

- **Faulty appliance**
- **Damaged or frayed cords or extension leads**
- **Electrical appliances coming in contact with water**
- **Incorrect or deteriorated household wiring**
- **Downed power lines**
- **Lightning strike.**

ELECTRICAL SHOCK

Electric shock is the sensation and muscular spasm caused when electric current passes through the body.

There are 4 factors determining the severity of the shock.

(i) The resistance of the body against the stream flow. (Or the amount of circulating shock current)

(ii) Current follows a path through the body..

(iii) The duration of the current's passage through the body.

(iv) Supply Frequency

EFFECTS OF ELECTRIC CURRENT IN HUMAN BODY

Effect of electrical currents in the human body	
Currents	***Reaction***
Below 1 mA	Generally not perceptible
5 mA	Slight shock felt. Not painful, but disturbing. Average individual can let go.
6 o 25mA (women)	Painful shocks. Loss of muscle control.
9 to 30mA (men)	The freezing current. If muscles are excited by shock, the person may be thrown away from the power source. Individual can not let go.
50 to 150mA	Extreme pain, respiratory arrest, severe muscle reactions. Death is possible.
1.0 to 4.3A	Rhythmic pumping action of the heart ceases. Muscular contraction and nerve damage occur. Death is likely.
10 A	Cardiac arrest, severe burns, death is probable.

ELECTRIC BURNS

Burns from electricity are not the same as burns from fire. They happen when an electric current passes through body tissue and heats it up. Because of this, they are usually caused by an electric shock and usually happen in or on the skin at the point of contact with the electric system. Electric burns are often very painful, take a long time to heal, and leave permanent scars.

FIRES OF ELECTRICAL ORIGIN

Electricity can cause fire in a number of ways, including:

- **Conductor and cable overheating due to overloading.**
- **Leakage of current to earth or between conductors due to insufficient insulating resistance.**
- **Overheating of combustible materials placed too close to properly running electrical equipment.**
- **Ignition of combustible materials due to arcing or the dispersion of hot particles caused by an electrical failure.**
- **Burns are the most common type of fire-related injury, but inhaling smoke can also cause harm.**
- **Electric arcing**

WORKING NEAR LIVE OVERHEAD POWER LINES

Contact with overhead electricity lines is one of the leading causes of fatalities involving mobile plant and equipment. Any voltage that permits sufficient current to travel through the heart is potentially harmful or lethal if it creates contact with live overhead power lines. Contact with live electricity can potentially result in severe burns due to the release of electrical energy. Additional concerns include fires and explosions that could disable the involved equipment. To receive a lethal electric shock from a high voltage overhead power line, direct contact is not required. Being too close can be fatal.

People can be killed and injured by electric shock, electrical arcs (which cause explosions), and fires when underground cables are destroyed. This frequently leads to serious burns on the hands, face, and body, even when protective equipment is worn.

CONTACT WITH UNDERGROUND POWER CABLES DURING EXCAVATION WORK

Damage can be caused when a cable is:

- cut through by a sharp object such as the point of a tool; or
- Crushed by a heavy object or powerful machine.

Cables that have been previously damaged but left unreported and unrepaired can cause incidents.

WORK ON MAINS ELECTRICITY SUPPLIES.

The voltage of the mains supply may vary between workplaces. In certain locations, the voltage could be 230V or 440V. In certain locations, such as power plants and the transmission sector, the supply voltage may be measured in the thousands or millions. Working on these mains is fraught with danger, as a shock from any of these voltages can be lethal.

SECONDARY HAZARDS

- Person falling from height
- Dropping of tools and object

11.2 CONTROL MEASURES

CONTROL MEASURES

'COMPETENT' FOR THE TASK

Competent refers to the possession of adequate training, skill, and knowledge for the task in order to prevent injury to oneself and others. Assure the safety of the electrical installation

Make sure that:

- new electrical systems are installed in accordance with a relevant standard, such as BS 7671 Standards for electrical installations, and then maintained in a safe condition;
- existing installations are maintained in a safe condition; and
- You must offer sufficient socket outlets since overloading socket outlets with adaptors can result in a fire.

CONTROL MEASURES

PROVIDE SAFE AND SUITABLE EQUIPMENT

- Choose equipment that is suitable for its working environment.
- Sometimes, electrical hazards can be eliminated by employing air, hydraulic, or hand-powered instruments that are particularly useful in tough environments.
- Make sure that equipment is safe when supplied and that it is then maintained in a safe condition.
- Install an easily accessible and well labeled switch near each fixed machine for emergency power shutoff.
- For portable equipment, use nearby socket outlets so that equipment can be detached simply in an emergency.
- The outer sheath of flexible cable ends should always be firmly fastened to prevent the wires (especially the earth) from pulling out of the terminals.
- Replace damaged sections of cable completely.
- Employ appropriate connectors or cable couplers to interconnect cable lengths. Using strip connector blocks coated with insulating tape is not permitted.
- Several equipment types are double-insulated. They are frequently denoted by a "double-square" symbol. The supply leads only have two wires: live (brown) and neutral (white) (blue). Ensure they are attached properly if the plug is not molded.
- Protect light bulbs and other equipment which could easily be damaged in use.
- In potentially flammable or explosive environments, only electrical equipment suitable for these conditions should be utilized. You may require expert assistance

CONTROL MEASURES

REDUCE THE VOLTAGE

- One of the best ways of reducing the risk of injury when using electrical equipment is to limit the supply voltage to the lowest needed to get the job done, such as:
- temporary lighting can be run at lower voltages, eg 12, 25, 50 or 110 volts;
- where electrically powered tools are used, battery-operated ones are safest; or
- Portable tools designed to be run from a 110 volt centre-tapped-to-earth supply are readily available.

CONTROL MEASURES

PROVIDE A SAFETY DEVICE

An RCD (residual current device) can provide additional safety if equipment operating at 230 volts or more is utilized. An RCD is a device that detects certain, but not all, electrical system defects and quickly disconnects the power supply.
The ideal location for an RCD is the main switchboard or the socket outlet, as this provides permanent protection for the supply lines. If this is not practicable, a plug containing an RCD or an RCD adapter that plugs into an outlet can also give further safety.
People-protecting RCDs have a maximum rated tripping current (sensitivity) of 30 milliamps (mA). Remember:

- an RCD is a valuable safety device, never bypass it;
- if it trips, it is a sign there is a fault – check the system before using it again;
- consult the maker of the RCD if it trips regularly and there is no obvious system failure; and
- the RCD has a test button to check that its mechanism is free and functioning – You should use this regularly.

CONTROL MEASURES

CARRY OUT PREVENTATIVE MAINTENANCE

An appropriate system of maintenance is strongly recommended. This can include:

- user checks by employees, e.g. a pre-use check for loose cables or signs of fire damage;
- a visual investigation by a knowledgeable individual, such as examining the interior of the plug for internal damage, bare wires, and the correct fuse; and
- Where necessary, a portable appliance test (PAT) conducted and interpreted by a person with the requisite expertise and experience.

CONTROL MEASURES

WORK SAFELY

Ensure that individuals working with electricity are qualified for the job. Even basic actions, such as wiring a plug, can be hazardous; therefore, individuals should be well-informed before beginning.

Check that:

- Suspicious or broken equipment is taken out of use, marked "DO NOT USE," and put in a safe place until it can be checked by a qualified person;
- tools and power outlets are turned off whenever possible before being plugged in or taken out; and
- Equipment is turned off and/or unplugged before it is cleaned or fixed.

Repairing equipment or making changes to an electrical installation are more complicated jobs that should only be done by people who know the risks and precautions they need to take.

You can't let people work on or near exposed, live parts of equipment unless it's absolutely necessary and the right precautions have been taken to keep workers and anyone else in the area from getting hurt.

CONTROL MEASURES

UNDERGROUND POWER CABLES

When digging in the street, sidewalk, or near a building, you should always expect to find cables. To avoid danger, make sure your service plans are up-to-date, use tools to avoid cables, and dig carefully.
Service plans should be available from regional electricity companies, local governments, highway authorities, etc. The HSE has a publication called Avoiding danger from underground services that gives more information (HSG47).

CONTROL MEASURES

OVERHEAD POWER LINES

Overhead lines are the cause of more than half of the electrical accidents that kill people every year.
When working near power lines, the owners may be able to turn them off if given enough notice. If this can't be done, talk to the owners about how close you can work without getting hurt.
Don't forget that power lines can still spark even if plants and equipment don't touch them. The HSE has a publication called Avoiding danger from overhead power lines that gives more information (GS6)

END OF SESSION QUIZ

1. RCD stands for which of the following?

(Choose the correct option)

1. Reduced Current Device
2. Residual Current Device
3. Reducing Current Device

END OF SESSION QUIZ

Which of the following is a factor influencing the consequence of Electric Shock?

(Choose the correct answer)

1. Voltage
2. Amount of Current
3. Body Resistance
4. Duration of Flow
5. All of the above

END OF SESSION QUIZ

Which of the following to be used before Excavation work to look for underground cables?

(Choose the correct option)

1. MCB
2. RCCB
3. Cable Locators
4. RCCB

END OF SESSION QUIZ

Why is the sensitivity of RCCB set at 30mA?

END OF SESSION QUIZ

Which of the following is a Residual Current Device?

(Choose the correct answer)

1. MCB
2. Switch
3. RCCB
4. Fuse