

JOB ROLE – Cable Jointer Electrical Power System

Sector: Power
(Qualification Pack Code : CON/Q1002)



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Unit 1: Electricity

Session 4: Importance of Earthing System

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Session Objectives

1. The student will be able to understand the need of earthing for electrical apparatus.
2. Know the procedure for installation of proper earthing.
3. Ensure safety of human life and his property from electric shock and fires.
4. Know how Earthing System works

Introduction

The proper metallic connection between electrical machines and devices with the earth plate commonly known as earth electrode through a thick wire of low resistance to provide safety is known as Earthing.

Earthing System in Electrical circuit is for safety purpose. The Main objective of earthing system is to provide an alternative path for high and dangerous current to flow in the general mass of earth so that the problem of electric shock and damaging of equipment will be protected.

Metallic part of an equipment are earthed and if the equipment's insulation fails than there will be no dangerous current present on the surface of the equipment. The circuit gets sorted and fuse will blow immediately due to low resistance of earth.

Earthing

- Earthing means connection of non-current carrying parts (metallic parts) of electrical apparatus to the general mass of earth to discharge of electrical energy takes place without any danger.
- Earthing is done by connecting the appliance or machinery to earth by good conductor known as earth electrode. Earthing is done to save human life from the danger of electrical shock, in case human body will come in contact of live wire of electricity.
- If earthing has done in proper manner and the metallic part come in the contact of live wire, the discharge takes place to the earth. In this condition due to low resistance of earth a large current flows to the earth. If the flowing current is exceed the limiting value of fuse blow off or MCB will trip and cut off the appliances from supply.

- Different Terms used in Electrical Earthing
- **Earth:** The proper electrical connection between electrical installation and general mass of earth is known as Earth.
- **Earthed:** When an electrical machine, appliance or wiring connected to the earth through earth electrode, it is known as Earthed.
- **Earth Electrode:** When a pipe or plate buried in the earth for discharge of electricity is known as Earth Electrode.
- **Earthing Lead:** The conducting wire or conductive strip connected between Earth electrode and Electrical installation and machine is called Earthing lead.
- **Earth Resistance:** This is the resistance between earth electrode and earth in Ohms.

Specification for earthing

- Distance of earth from building -- More than 1.5 meter from the building.
- Size of Earth Electrode -- Not be less then 2.9mm^2 or 14 SWG
- Resistance of Earth -- not greater than 8 ohm.
- The earth electrode and earth wire will be same material.

- **Points to be earth:**
- Earth pin of 3 pin and 5 pin plug and socket.
- All metal part of electrical machine e.g. motor, heater geyser, and mixer.
- Metallic frame of electrical machines.
- The neutral conductor of 3phase 4wire system.
- Pole, tower, armoring of cable.
- Stay wire of overhead lines.

Importance of electrical earthing:

To save human life from the danger of shock from leakage current.

To maintain the line voltage constant.

To protect large machine and building from atmosphere lighting.

To avoid the risk of accident in electrical substation and other installation.

Earth Resistance of different Electrical Installation:

Large Power Station -- 0.5 Ohm.

Major Power Station -- 1.0 Ohm

Small Sub-Station -- 2.0 Ohm

In House wiring and such other case - 5.0 to 8.0 Ohm

Types of Earthing

Strip Earthing: In this type of earthing galvanized iron strip of 25mmX4mm or copper strip of 25mmX1.6mm are laying in horizontal trenches of min. depth of 0.5 meter and covered with charcoal and salt.

Rod Earthing: In this type of earthing system 12.5 mm diameter of solid rod of copper or 16 mm diameter of solid rod of galvanized iron are driven vertically into the earth not less then 2.5 meter on earth surface.

Pipe Earthing: Pipe earthing is very cheaper and best form of earthing. In this type of earthing a hollow pipe of 38 mm diameter and 2.5 meter long GI placed underground the earth and covered with charcoal and salt.

Plate earthing: In this type of earthing system, a plate of either copper with dimensions 60cm x 60cm x 3.18mm or galvanized iron (GI) of dimensions 60cm x 60cm x 6.35 mm is buried vertical in the earth pit which should not be less than 03 meter from the surface of ground.

Atmospheric Lightning: Atmospheric Lightning is a form of visible discharge of electricity between a rain cloud and the earth. The electric discharge is seen in the form of a arc between cloud and earth surface. When the electrical potential between a cloud and the earth reaches a sufficiently high value the air becomes ionized along a narrow path and lightning flash results.

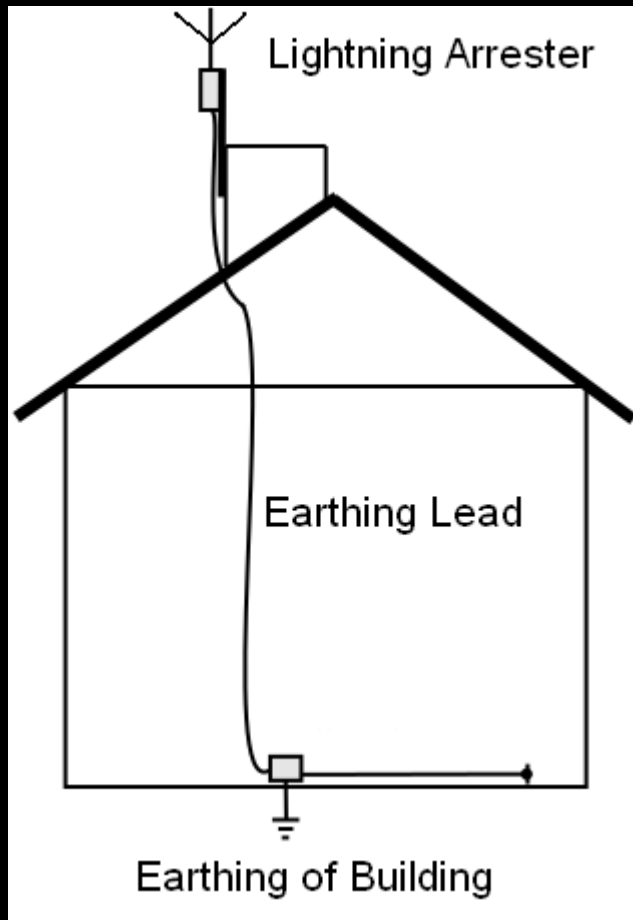
The possibility of lightning is on tall trees and buildings rather than to ground. Buildings are protected from lightning by metallic lightning rods called Lightning arrester extending to the ground from a point above the highest part of the roof. The conductor has a pointed edge on one side and the other side is connected to a long thick copper strip which runs down the building. The lower end of the strip is properly connected to the earth. When lightning strikes hits on the rod than current flows down through the copper strip. These rods provide a low-resistance path for the lightning discharge and prevent it from travelling through the structure of building itself.

Lightening Arrester

The principle of the lightning arrester was first discovered by Benjamin Franklin in 1749, which in the subsequent years developed his invention for household application.

Lightening arresters are devices which prevent damage of apparatus due to high lightening voltages. The lightening arrester provides a low resistance path to ground for the current from a lightning strike.

When a high voltage or greater than the normal line voltage exists in the circuit, the lightening arrester immediately provide a path to earth and thus limits and drains off the excess voltage.

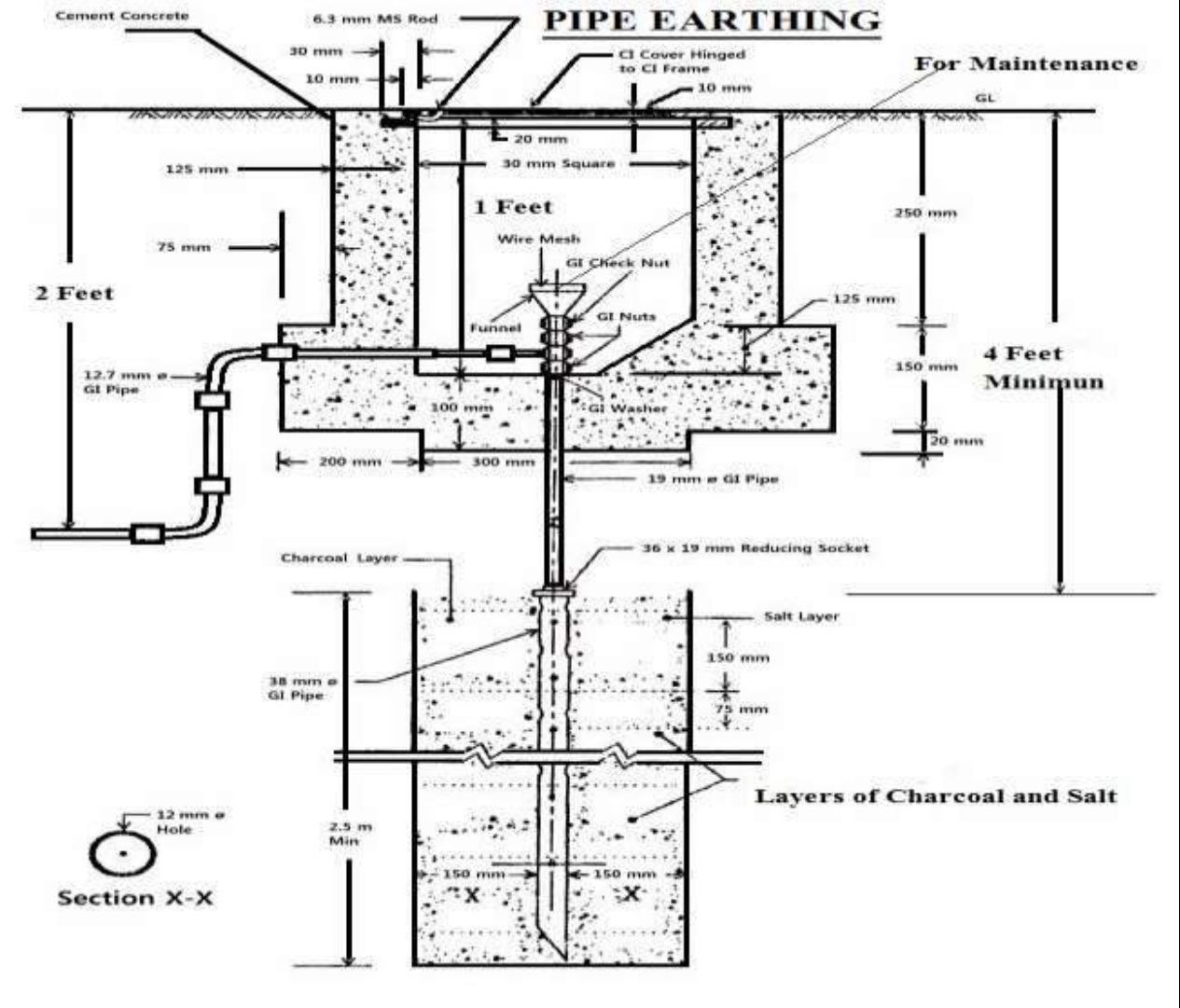


Working of Lightning Arrester

- Lightning arrester does not absorb the *lightning*.
- Lightning arrester not Stop the *Lightning*.
- Lightning arrester Divert the *Lightning* to Ground.
- Lightning arrester limit the Voltage produced by Atmospheric Lightning.
- Lightning arrester will work at the time of lightning because lightning produces very high voltages.
- The *lightning arrester* provides protection against lightning surges during rainy session.

Description of Various Earthing

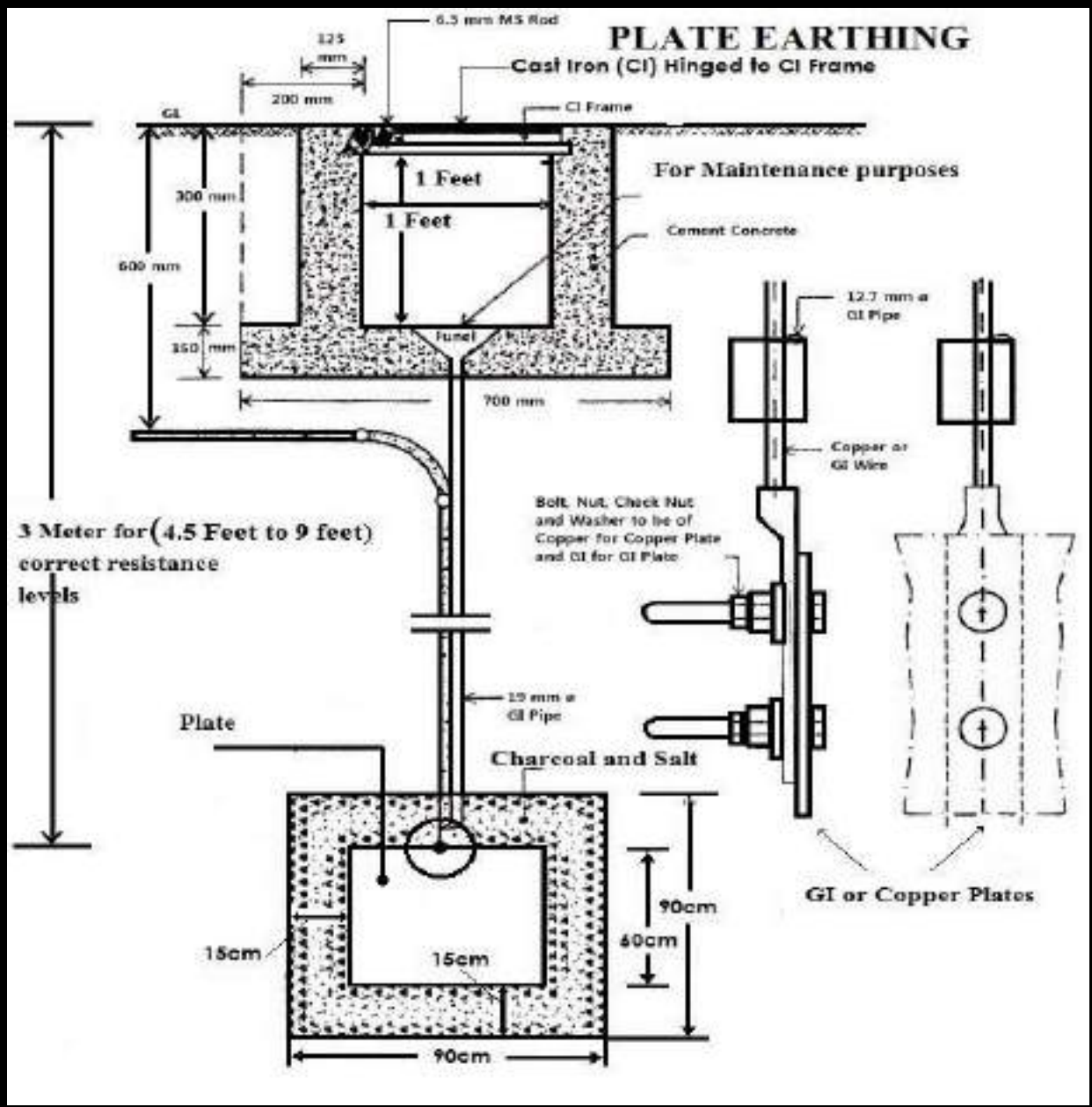
- **Description of Pipe Earthing:** This type of earthing is used widely in Industries and house wiring system. In this system of earthing a GI pipe of 30 mm diameter and 2.5 Meters length is buried vertically in ground to work as earth electrode but the depth depend upon the soil conditions, there is no hard and fast rule for this. The earths are connected to the top section of the pipe with nut and bolt. The pit area around the GI pipe filled with alternate layer of salt and charcoal for reducing earth resistance. It can take heavy leakage current for the same electrode size in comparison to plate earthing. Water is filled through pipe to maintain the resistance of earth electrode. Pipe earthing is best form of earthing and it is also very cheap method of earthing.



- Earthing pipes are also known as earthing electrode pipes, these can be used at house, office as well as in power stations. Earthing pipes are used in electrical installation, transmission line and other. Copper Pipe is generally use in earthing system.
- The Pipe size depends upon the current to be carried and on soil type. Pipe Earthing is reliable, durable, easy to handle and highly secure. Connectivity of the Pipe Earthing is up to the Chamber or earth terminal. The connection of earth wire from machine to Galvanized Iron pipe, being above the ground level makes it easy to check for any discontinuity. To have an effective earthing in summer session, Pipe earthing gives us freedom to put 2-3buckets of water through the funnel, which gives an affective earthing. So that It is one of the most widely used method of earthing.

Description of Plate Earthing: In this type of earthing a plate of copper or G.I. is buried into the ground at a depth of greater than 3 Meters. Earthing plate should not be buried less than 3 Meters.

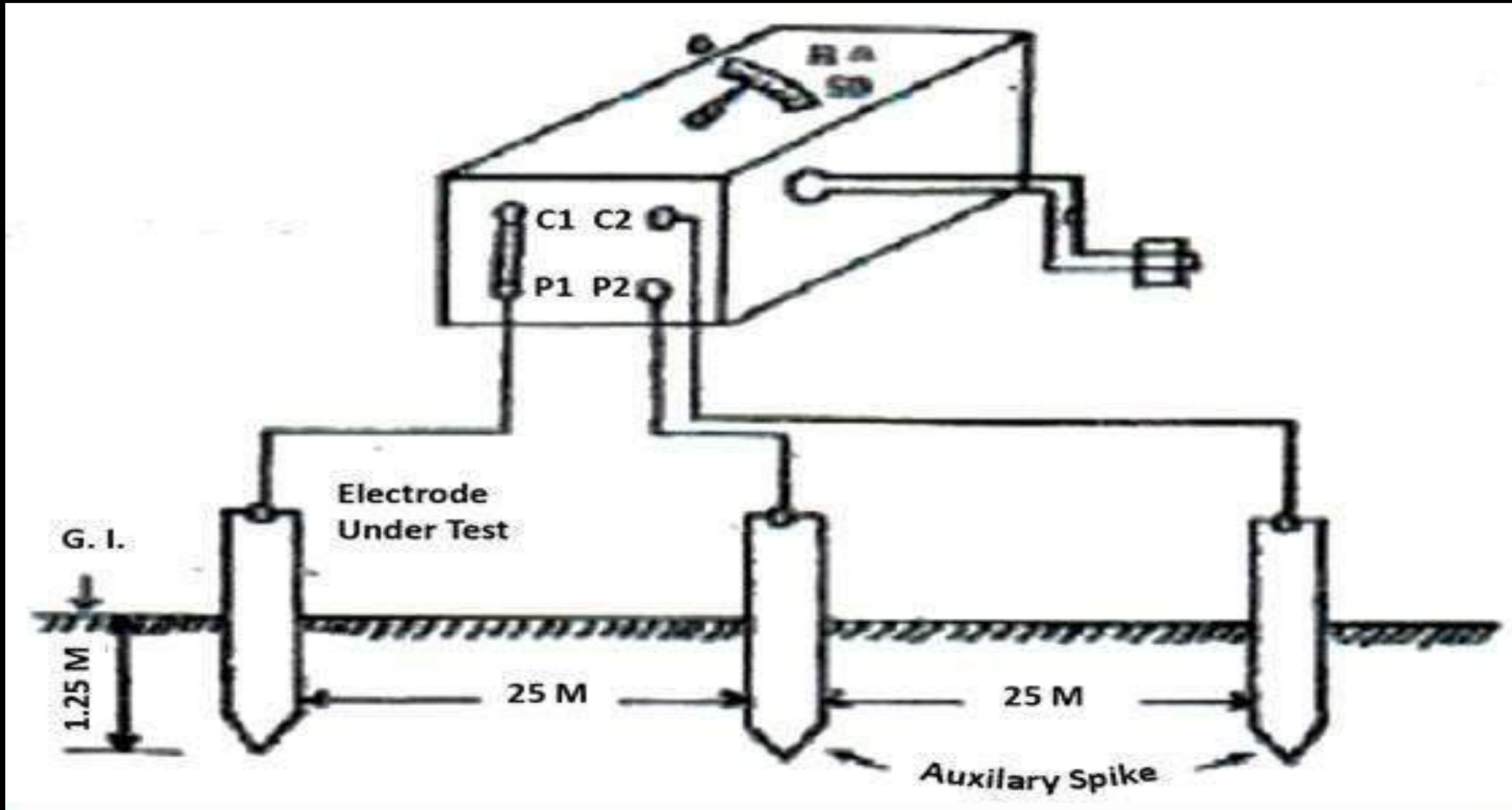
- Earthing plate is filled with alternate layers of salt and coke not less than 1.5 feet so to provide lesser resistance due to absorb of moistures .The earth conductor is properly bolted to an earth plate with the help of nut and bolt and washer made of copper, in case of copper plate earthing and of G.I. in case
- Or GI plate earthing.
- For GI earthing Plate Size should be -- 600 mm X 600 mm X 8.30 mm
- For Copper earthing Plate Size should be-- 600 mm X 600 mm X 3.15 mm
- Pit Size made for maintenance should be 1 Feet X 1Feet so as to provide ease of accessibility of maintenance of these earthing pits and for testing of earthing pits.



Earth Tester & Earth Resistance

Use of Earth Tester:- Earth tester is used for measurement of Earth resistance. If earth resistance is more, certain process need to be done in such a case.

Working of Earth Tester:- There is hand operated D.C. generator. While feeding current to spike. D.C. current is converted into A.C. current by the converter and A.C. current received from spike is again converted in D.C. current by the help of rectifier, while going to generator. A.C. current is fed to the spike driven in earth because there should not be electrolytic effect.



In these method earth tester terminals C1 & P1 are shorted to each other and connected to the earth electrode (pipe) undertest. Terminals P2&C2 are connected to the two separates pikes driven in earth. These two spikes are kept in same line at the distance of 25 meters and 50 meters due to which there will not be mutual interference in the field of individual spikes. If we rotate generator handle with specific speed we get directly earth resistance on scale.

Note: - Spike length in the earth should not be more than 1/20th distance between two spikes.

Four Point Method: - In this method 4 spikes are driven in earth in same line at the equal distance. Outer two spikes are connected to C1 & C2 terminals of earth tester. Similarly inner two spikes are connected to P1 & P2 terminals. Now if we rotate generator handle with specific speed, we get earth resistance value of that place.

In this method error due to polarisation effect is eliminated and earth tester can be operated directly on A.C.

Earth Resistance

Earth resistance is depended on following factors:

- Type of earth soil.
- Temperature of earth.
- Humidity in earth.
- Minerals in earth.
- Length of electrode in the earth.
- Electrode shape and size.
- Distance between two electrodes.
- Number of electrodes.

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