

Session: Earthing

Learning Objective	Evaluation Criterion
Explain the process of earthing and testing the earth resistance	Interactive Questioning



Duration 30 Minutes



Resources PowerPoint Presentation, Markers and Whiteboard



Facilitator’s Notes Explain the process of earthing to participants through interactive questioning and a structured audio-visual presentation. .

End of Note



1. Tell:

Welcome to the video presentation on “Earthing” or “Grounding”.

All of us, whether electricians or common people, have heard about ‘earthing’.

Ask:

Now, can anyone tell me the meaning of ‘earthing’?

Possible Responses:

- Grounding
- Arrangement made for safety purpose
- Arrangement made to avoid electrical shock

Tell:

That’s right! In this session, we will learn about earthing, how it is done and how to check if the earthing has been done correctly.



2. Tell:

By the end of this session, you will be able to explain the process of earthing and testing the earth resistance.

Let me ask you a few more questions before we proceed further.



Facilitator’s Notes:

- Encourage all the participants to answer the questions
- Provide hints if someone is unable to respond
- Ask these questions so that the participants themselves give out the importance of earthing
- You can ask more questions or cite examples from your experience to make it more interactive and interesting
- Appreciate the responses

- Write the important points on the board

End of Notes



3. Ask:

In case current is leaking from an electrical appliance, what will happen if you touch a non-current electrical part of the appliance, which is not earthed?

Possible Response:

We will experience an electric shock.

Ask:

- What is the impact on you if earthing is done?
- Will you then receive electric shock in case the current is leaking?

Possible Responses:

- No
- We will be safe as the appliance is earthed

Ask:

- Why don't you get an electric shock when the appliance is earthed?
- What does earthing do to the appliance?

Possible Responses:

- Voltage is absorbed by the earth
- The leaking current is diverted towards the earth

Ask:

This is the last question. What is the importance of earthing?

Facilitator's Note:

- Capture the responses
- Appreciate the participants

Tell:

Thank you for participating in the question and answer session! Now, let us proceed with the session.



Tell:

As we all know, earthing is the most important aspect of a power system for safety of people and protection of the electrical network. Always ensure that the earthing of systems, equipment and lines is maintained well.



4. Tell:

There are two types of earthing. They are plate earthing and pipe earthing. Let us first look at the step-by-step execution of plate earthing.



5. Tell:

For executing the plate earthing work, make a bore of size 60X60 cm on the ground up to 1.5 to 3 metres in depth. Then, place an earth plate of size 60X60 cm and thickness of 3.18 mm, duly connected with nut, bolt and the earth wire vertically. This plate is covered with layers of 15 cm charcoal and salt. Then, the earth wire is concealed inside a GI pipe of 12 mm and taken up vertically to the ground level. The GI pipe is fitted with a funnel at the upper portion for pouring water into the pit. A masonry cement concrete box is prepared with a cast iron cover.

In case of heavy load on the system, you can use plates of 90X90 cm instead of a 60X60 cm plate.



6. Tell:

Let us next look at the step-by-step execution of pipe earthing.

Dig a 60X60 cm size bore of 4.75 metres depth on the ground. Then, vertically lay a 2-metre long GI pipe of diameter 38 mm and perforated with holes of 12 mm with a tapered edge at the bottom. Then, pour water in the GI pipe till the water gets absorbed into the soil through the perforations. A fine layer of charcoal and salt must then be filled around the pipe. Then, a 19-mm GI pipe is fitted through a reducing socket. The earth wire connection is made at the bottom of the perforated pipe through cable socket. It is taken inside from the pipe and brought out at the upper portion through the funnel. The funnel is kept 5-10 cm above ground level. A masonry cement concrete box is prepared with a cast iron covering.



7. Tell:

A typical arrangement of earthing the equipment and structure of the distribution substation of 11 KV/433-250 Volts with AB switch and Horn Gap fuses is shown here as per REC Construction Standard F- 2.



8. Tell:

As shown in the figure, the earth pits should be located in accordance with REC Construction Standard F-5.

One of the earth electrodes on either side of a Double Pole Structure should be connected with a direct connection from LT Lightning Arresters, if provided, and a direct connection from the lightning arrester on HT side of 11KV.

Three separate connections are then made to each of the remaining two earth electrodes. They are one from neutral, the other from transformer body and the last connection from the earthing terminals of the poles.



9. Tell:

A typical arrangement of earthing the equipment and structure of the distribution substation is shown here as per REC Construction Standard F-10.

A 40-mm GI wire should be used as earth lead. There should be no joints in the earth wire. The transformer neutral earth pit should be independent just opposite the LA earth pit. Adequate quantity of charcoal and salt should be used to keep the earth moist. Water should be poured into the dump to keep the surrounding soil wet. In dry rocky areas, black cotton soil should be filled in the earth pit. The value of the combined earth resistance should not be more than 2 Ohms.



10– **Facilitator’s Note:**

11.

Click to play the video.

Ask:

What have you observed in the video?

Facilitator’s Notes:

- Appreciate the responses
- Debrief

Tell:

We have watched a video clip explaining the earthing pit.

The earthing pit has two connections. One is connected from the neutral and another is connected from the transformer body. Both the connections are different. The transformer is connected to three earthing pits.

When you see inside the pit, there is a bore inside every earthing pit. It is deep enough to reach the water level for natural earthing and up to the moisture level for artificial earthing.

The electrode is 3 metres in length. A 40-mm diameter GI pipe is used in place of the earthing electrode.



12– **Tell:**

13.

Now, the lineman will show how to place this earthing electrode inside the bore.

Facilitator’s Note:

Click to play the video.

Tell:

The electrode is inserted inside the bore and then removed to check the depth.

When we remove the earthing electrode out from the bore, you can see that the earthing electrode is wet at the end. This shows that the electrode has reached the water level.

After checking the depth of the water or moisture level, the lineman again places the electrode inside the bore.

Once the earth electrode is connected to the earth lead, the resistance of the earthing is tested.



14– **Tell:**

16.

Let us first see the tools required for earth resistance testing.

Facilitator’s Note:

Click to play the video.

Ask:

What have you observed in the video?

Facilitator’s Notes:

- Appreciate the responses
- Debrief

Tell:

The tools required for testing earth resistance are spikes, Digital Earth Resistance Tester and wires.

In this video, you have noticed the spikes, the Digital Earth Resistance Tester and its terminals. The connection diagrams are shown at the back of the tester. The wires include a 15-metre lead wire and a 30-metre lead wire, which are connected to the spikes. The other wire is used as the earthing terminal.

Let us now watch another video clip to see how the earth spike is fixed.



17– **Facilitator’s Note:**

18.

Click to play the video.

Tell:

The first spike has been kept 30 metres away. The other spike has been kept 15 metres away. Both the lead wires have been connected to the ‘earth tester’.

You might have noticed that the two wires are connected to the digital earth resistance meter. The 15-metre lead wire is connected to one spike and the other 30-metre lead wire is connected to the other spike. The third wire is under test, which can measure the earth resistance. It is connected to the earthing electrode.

Let us now see how the actual value can be known by using the Digital Earth Resistance Tester.



19. Facilitator’s Note:

Click to play the video.

Tell:

First, switch on the tester.

Then, press the ‘Test’ button. You must have noticed the actual value displayed on the screen. It is 0.16 or 0.17, which is less than 1 Ohm.

As the actual value is less than 1 Ohm, this test can be considered positive.

Let us now look at the tips to maintain the earthing resistance.



20. Facilitator’s Note:

Click to play the video.

Tell:

The electrode has a layer of salt and coal to maintain the moisture. However, during summer season, the level of water decreases.

To maintain moisture, you must regularly pour some water once a month.

There are other tips to improve the earth resistance. You can increase the depth of the electrode. You can also increase the size of the electrode and the number of electrodes.

If earth resistance is very high, then dig a 1-metre deep pit near the electrode. Fill the pit with saline water, so that the electrode may remain in contact with the saline water.



Tell:

At the beginning of the session, we learnt how earthing absorbs overvoltage.

Ask:

How do you think the earthing has absorbed the overvoltage in the video shown so far?

Facilitator's Notes:

- The participants may or may not come up with the right responses, as we did not show how the extra current or leakage current is absorbed
- If there are any responses, appreciate them
- Debrief

Tell:

The earthing absorbs overvoltage or lightning current through a mechanism explained in the video that we are about to view.



21. Facilitator's Note:

Click to play the video.

Tell:

The bodies of all the equipment in the electrical installation, namely, switchgears, transformer, metering cubicles and so on are always connected to the double earthing. There is a separate earth connection for the Lightning Arrestor (LA) and transformer neutral.

You can see here that there are 3 lightning arrestors on the line. They are connected to the main line. The lightning arrestors absorb the extra charge into the earth in case of lightning, thereby saving the equipment. You can see here that the three lightning arrestors are connected with the earthing terminal.



22. Tell:

Let us now learn about earthing of a transformer mounted on a double pole or DP structure.

Facilitator's Note:

Click to play the video.

Tell:

You can see here that a transformer of 315 KVA is fixed on the DP. It has five earthing connections. One earthing is connected to the body and the second earthing is connected to the body of the transformer. Here, you can see the double earthing connected to the neutral. The body earthing goes into one earthing pit. The earth connected to neutral goes into the second earthing pit. The earth connected to the lightning arrestor goes into another earthing pit. Thus, every pole-mounted transformer in DP structure is connected to three different earthing pits.



23. Tell:

Let us now learn about maintenance and improvement of earth resistance.

There are four ways to improve earth resistance:

1. By increasing the depth of the electrode
2. By increasing the size of the electrode
3. By increasing the number of electrodes
4. Through salt treatment

Ask:

What should we do if the earth resistance is too high?

Facilitator’s Notes:

- Capture the responses on the whiteboard
- Appreciate the responses

Tell:

Well! Dig a one-metre deep pit near the electrode and fill it up with saline water. The ground will absorb the water and remain in contact with the electrode.



Tell:

Before we conclude, let us quickly recollect the important points of the session.

Key Learning Outcomes



24. Tell:

In this session, we have learnt:

- The way earthing is done and how a Digital Earth Resistance Tester is used to measure the earth resistance
- Double earthing is used for every equipment and there is a separate earth for Lightning Arrestor and the transformer neutral
- While designing earthing, we should also know how the fault current passes through the earth connection
- The cross-sectional size of the earth wire is always kept on the higher side for easy flow of fault current to the earth
- The four ways of maintaining and improving earth resistance are:
 - Increase the depth of the electrode
 - Increase the size of the electrode
 - Increase the number of electrodes
 - Apply salt treatment