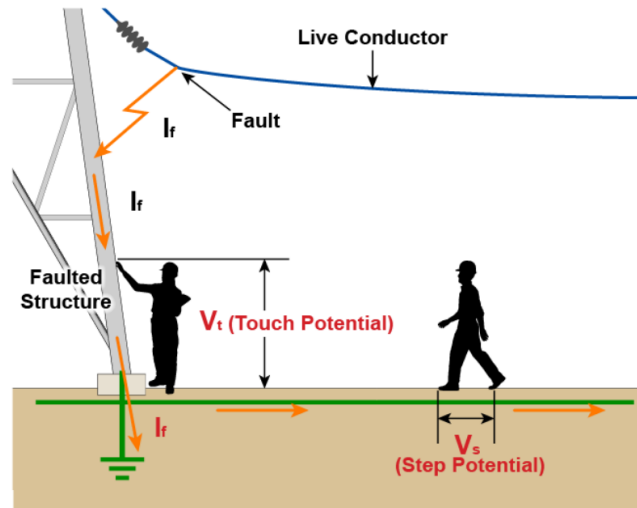**Title: Step & Touch Voltage**

In electrical systems, when there is a fault in the connection of the live wire to the ground or to the metal body of the devices, in this case the step and contact voltage can be defined for the system.



**Step voltage:** The voltage and potential difference between two individual feet (about one meter or three feet) located in electrical substations or power systems is step voltage.

**Touch/Contact voltage:** The voltage or potential difference between the connection of a person's hand to the electrified metal body of electrical systems and his feet (about one meter or three feet) is the contact voltage.
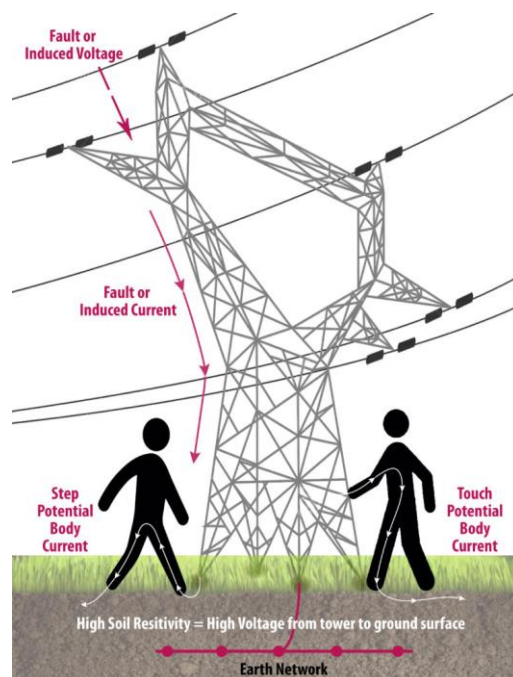
In general, the contact voltage is often more dangerous than the step voltage, because in the step voltage, the path of the fault current is between the two legs of the person, but in the contact voltage, the path of the current will be from the same hand and foot of the person, which may be the path of the current. be placed in the heart area of the person.
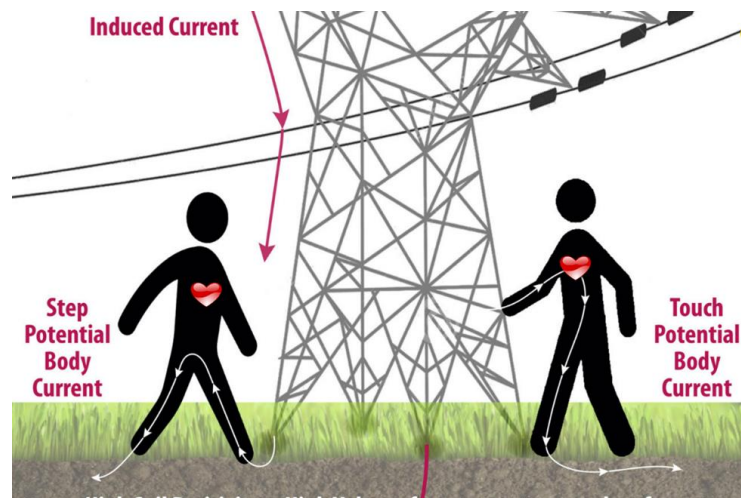


**Methods to prevent step and contact voltage risks:**

- Use insulated gloves and shoes when working with electrical systems.

- In power systems and electric substations, when there is a fault, take the steps glued together. In this case, the electrical resistance between the legs will decrease and the step voltage will be lower.

- In the power systems and electrical substations, walk and walk in the form of jumping when there is a fault.

**The method of measuring step and contact voltage**

We use the following method to measure the voltage step and contact value:

1- Indirect method (measurement of ground resistance in step and contact voltage mode by measuring device)

2- Direct method (use of fault current injection measuring device)

## 1- The method of measuring ground resistance in step and contact voltage mode

Required equipment: 4-electrode earth resistance measuring device

- Three-electrode method to calculate step voltage

Two-electrode method to calculate the contact voltage

-Using Ohm's law to calculate step and contact voltage according to the calculated resistance value and current passing through individual step and contact path (V=R.I)

### Working method in step voltage measurement

- First, close a circuit using a 4-electrode ground resistance test measuring device as shown in the figure below.



**1 Meter (3 Ft)**



*Step Voltage example*
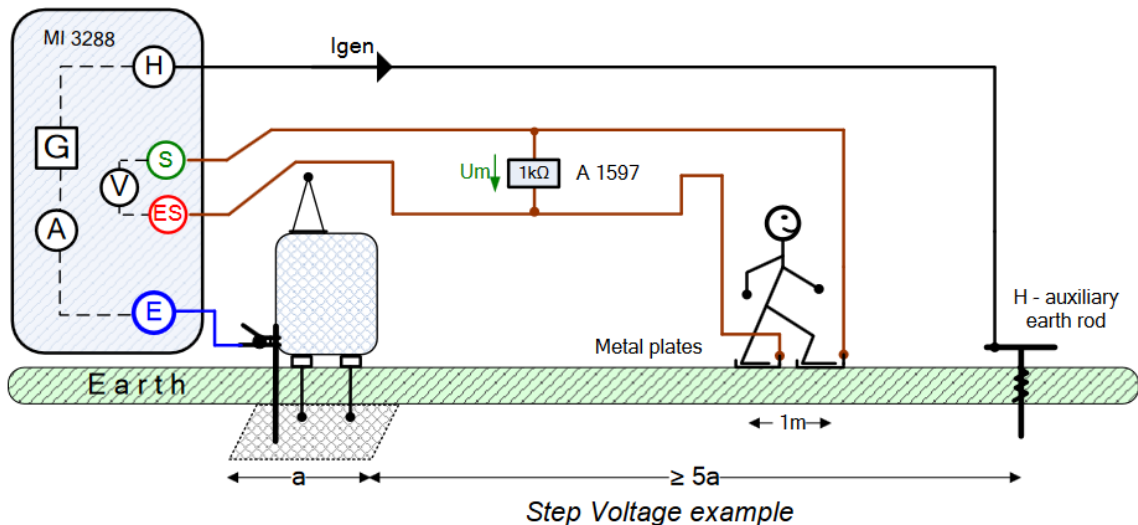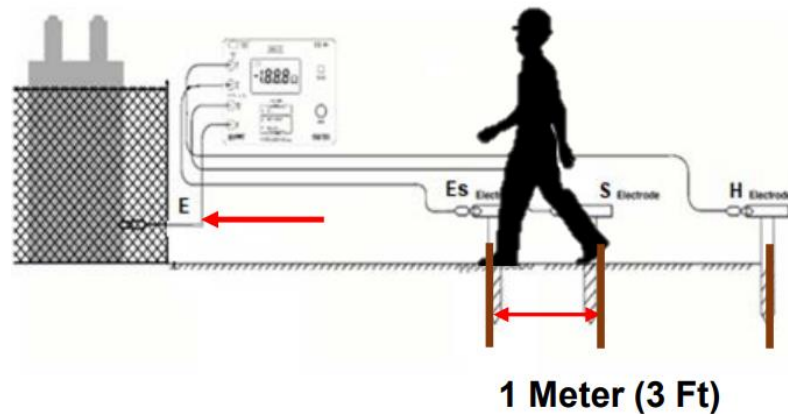
- Measure the electrical resistance value between the two feet of the person using the earth resistance test measuring device.

Using Ohm's law, you can easily get the step voltage value.

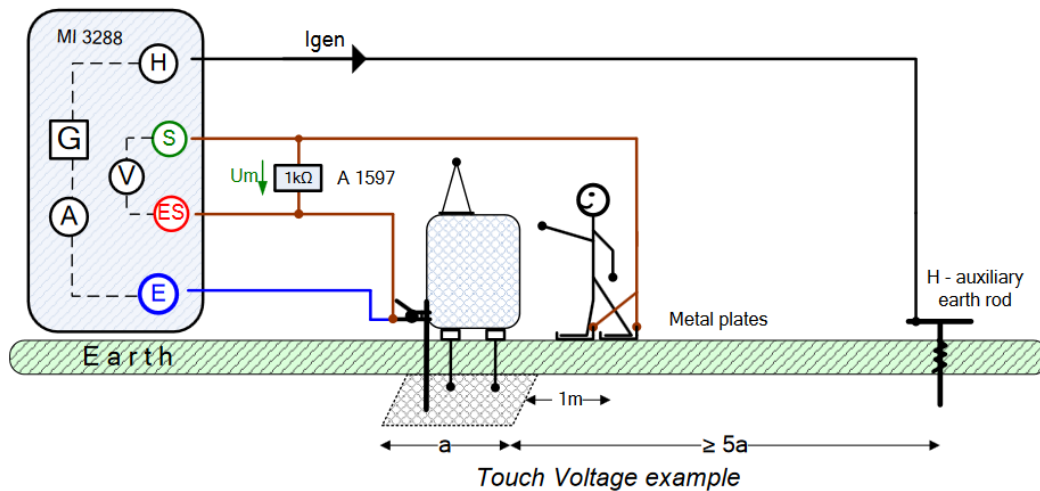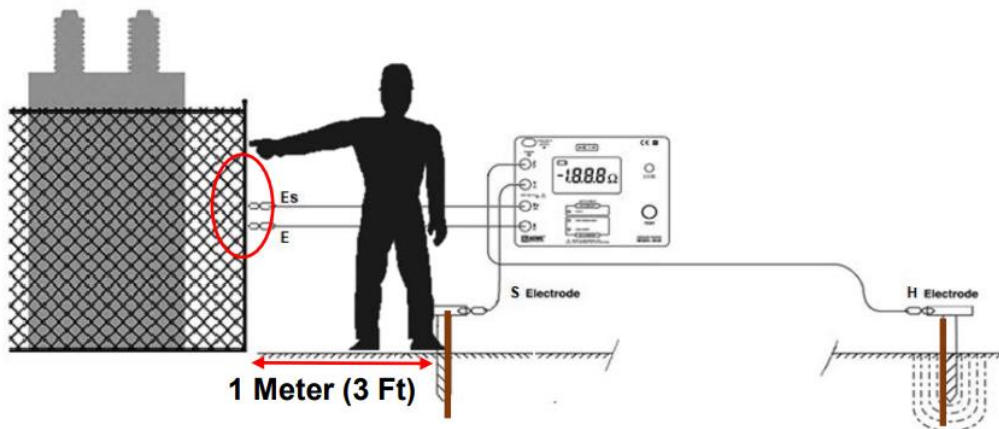$$\boxed{V_{step} = R_{step} \times I_{fualt}}$$

Example:

$$R_{step} = 0.35\Omega$$
$$I_{fualt} = 800\,A$$
$$V_{step} = R_{step} \times I_{fualt} = 0.35 \times 800 = 280v$$

### *Working method in contact voltage measurement*

- First, close a circuit using a 4-electrode ground resistance test measuring device as shown in the figure below.





Touch Voltage example

- Measure the electrical resistance value between the touch of hand and foot by the ground resistance test measuring device.

-Using Ohm's law, you can easily get the value of the contact voltage.

$$V_{touch} = R_{touch} \times I_{fualt}$$

Example:

$$R_{touch} = 0.15\Omega$$
$$I_{fualt} = 1000\,A$$
$$V_{touch} = R_{touch} \times I_{fualt} = 0.15 \times 1000 = 150v$$

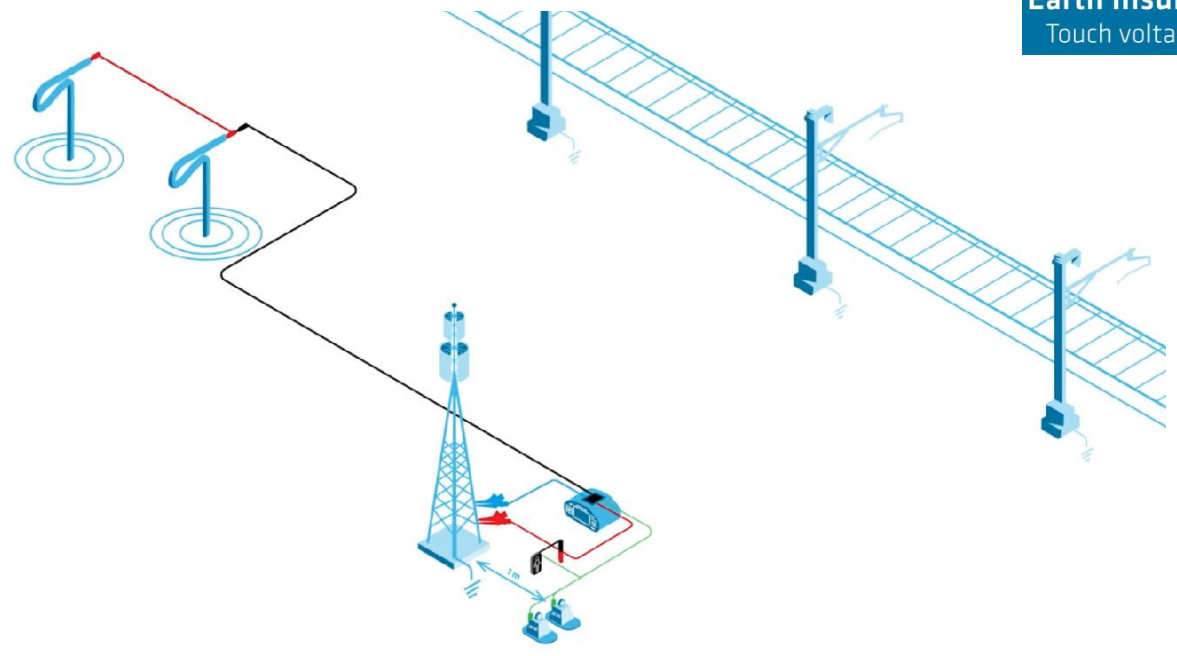## 2- Direct method (use of fault current injection measuring device)
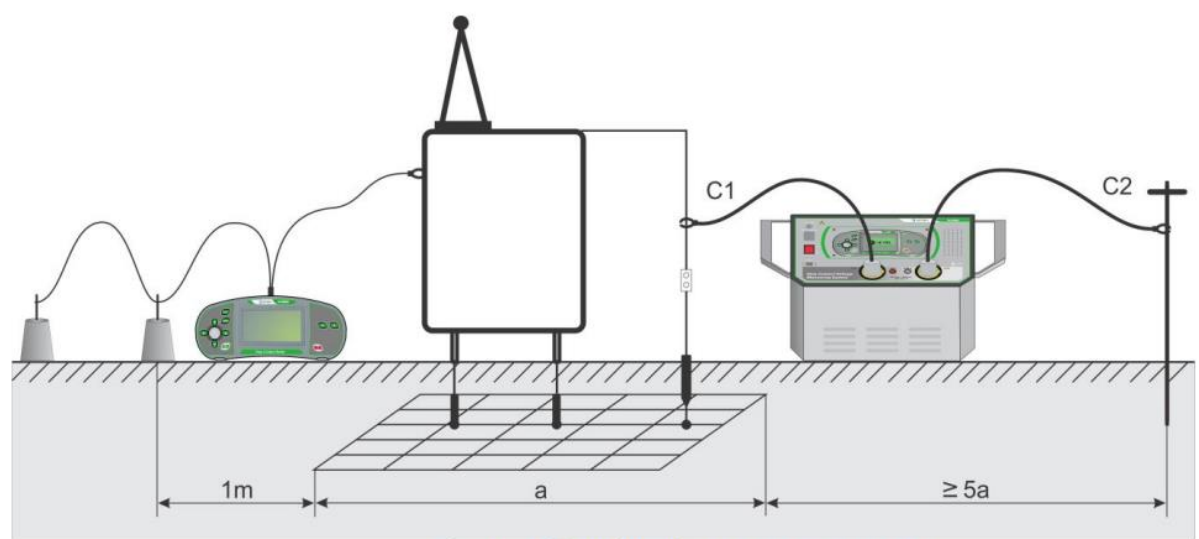


**METREL®**
**EI Tester**
MI 3288



**METREL®**
**Step Contact Voltage Measuring System**
MI 3295

MI 3295

Contact/Touch voltage measurement

1 meter

**MI 3295**

C1

C2

1m

a

≥ 5a

*Step voltage measurement*