Measurement of High Resistance (>100kΩ)

Following are few methods used for measurement of high resistance values-

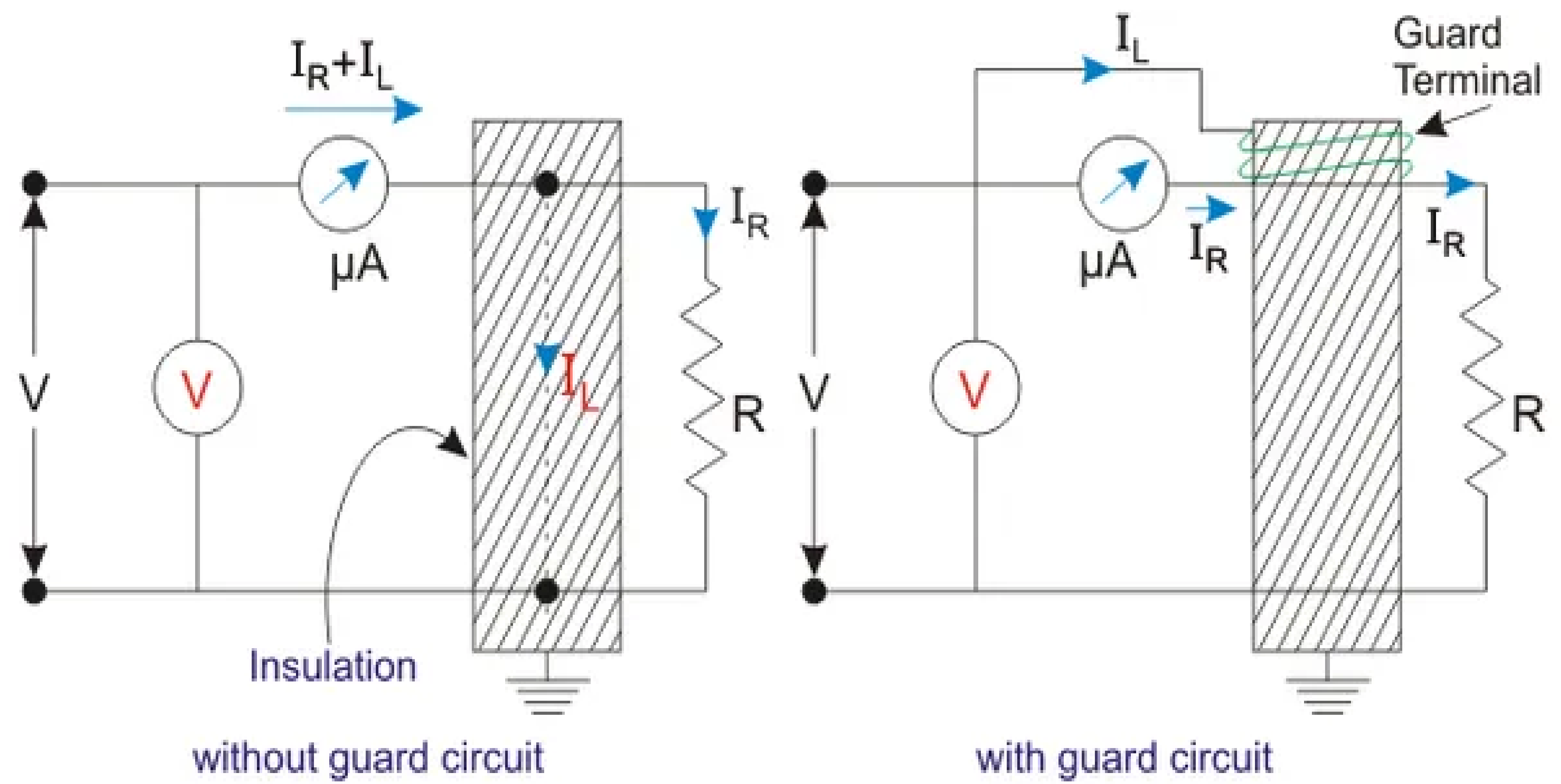
- Loss of Charge Method
- Megger
- Megohm bridge Method
- Direct Deflection Method

We normally utilize very small amount of current for such measurement, but still owing to high resistance chances of production of high voltages is not surprising. Due to this we encounter several other problems such as-

1. Electrostatic charges can get accumulated on measuring instruments
2. Leakage current becomes comparable to measuring current and can cause error

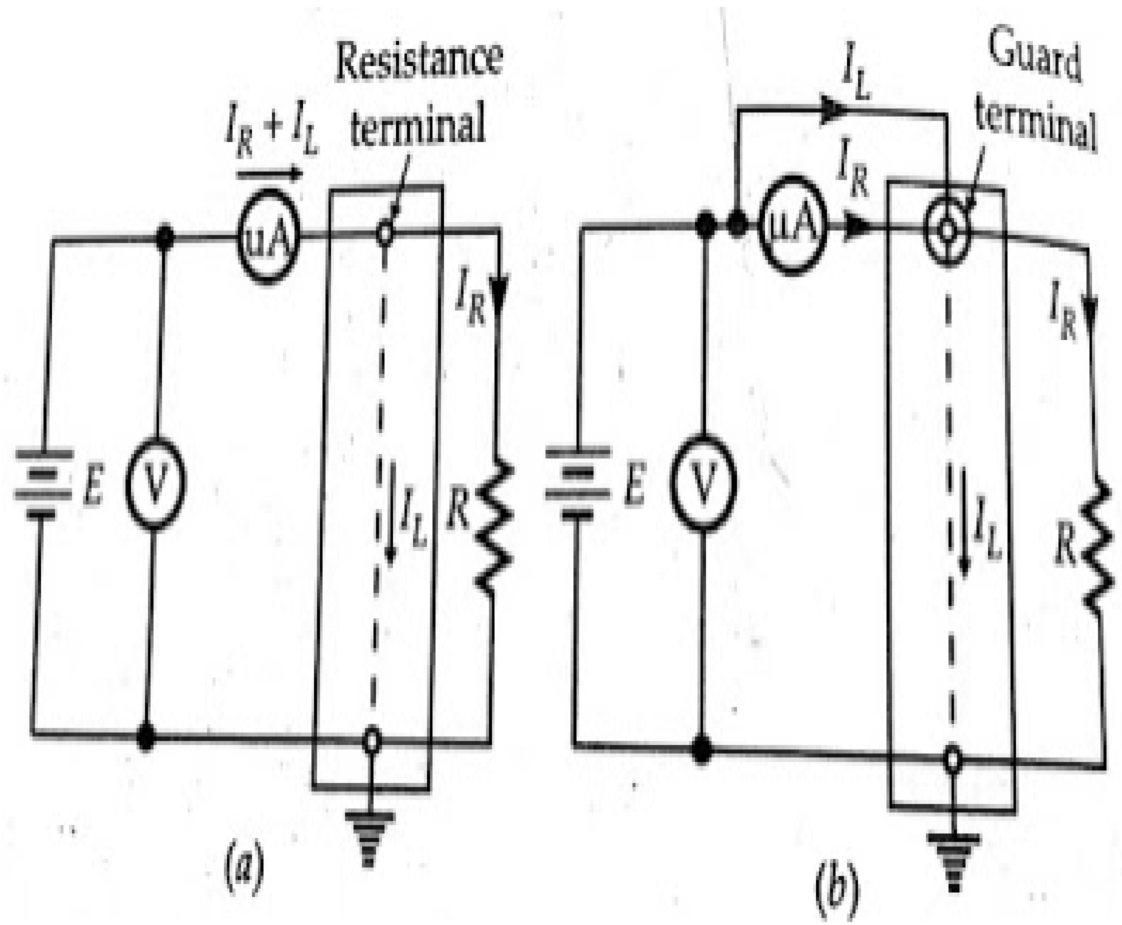
3. Insulation resistance is one of the most common in this category; however a dielectric is always modeled as a resistor and capacitor in parallel. Hence while measuring the insulation resistance (I.R.) the current includes both the component and hence true value of resistance is not obtained. The capacitive component though falls exponentially but still takes very long time to decay. Hence different values of I.R. are obtained at different times.
4. Protection of delicate instruments from high fields.

Hence to solve the problem of leakage currents or capacitive currents we use a guard circuit. The concept of guard circuit is to bypass the leakage current from the ammeter so as to measure the true resistive current. Figure below shows two connections on voltmeter and micro ammeter to measure R, one without guard circuit and one with guard circuit.



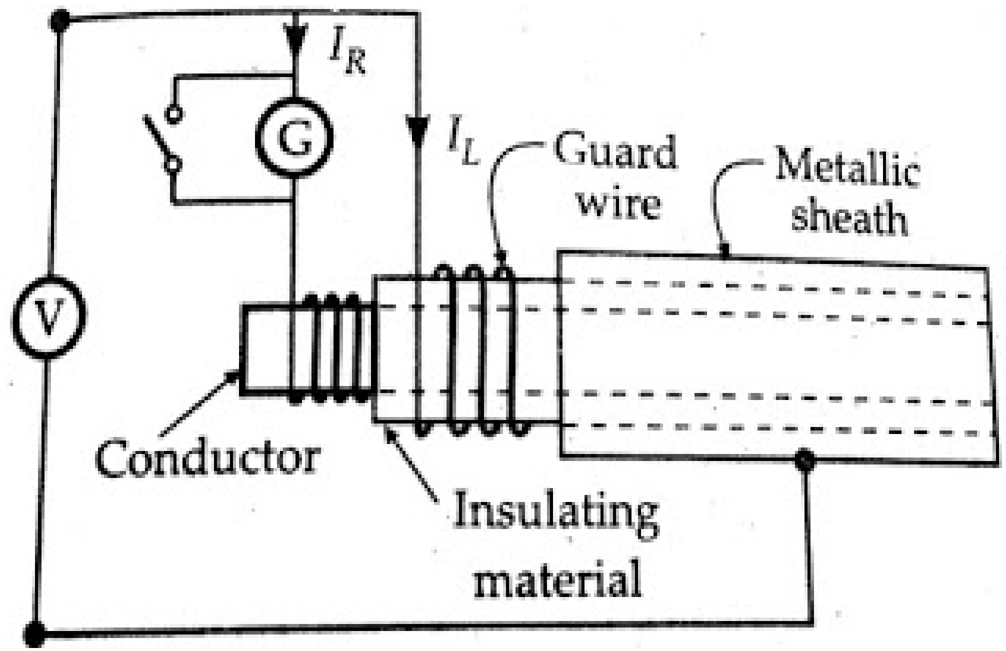
In the first circuit the micro ammeter measures both capacitive and the resistive current leading to error in value of R, while in the other circuit the micro ammeter reads only the resistive current.

Direct deflection method for measuring high resistance:



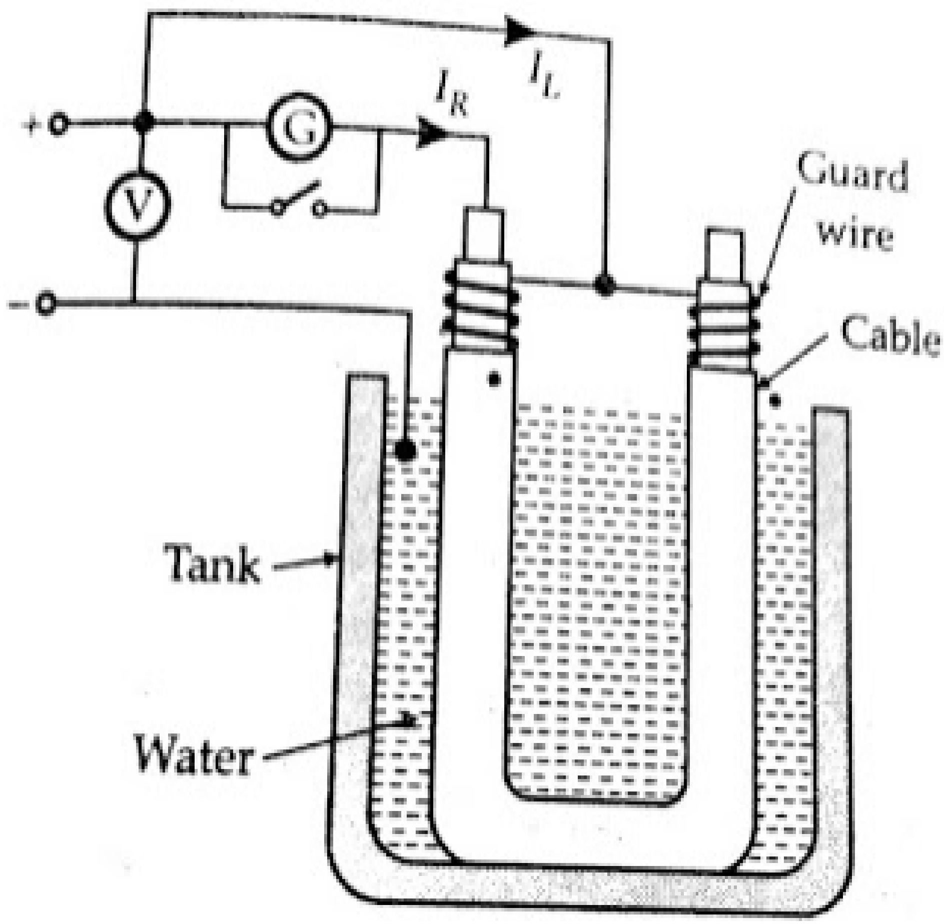
The **direct deflection method** is that of the figure-(b) above. For high resistance, such as insulation resistance of cables, a sensitive galvanometer of d'Arsonval type (usually having a current sensitivity of at 1000 mm/μA at a scale distance of 1 metre) is used in place of the microammeter. In fact, many sensitive types of galvanometers can detect currents from 0.1 - 1 nA. Therefore, with an applied voltage of 1 kV, resistances as high as 10^12 to 10*10^12 can be measured.

An illustration of the **direct deflection method used for measuring the** insulation **resistance** of a cable is shown in the figure below. The galvanometer G measures the current IR between the conductor and the metal Sheath. The leakage current IL, over the insulating material, is carried by the guard wire wound on the insulation and therefore does not flow through the galvanometer.



Cables without metal sheaths can be tested in a similar way if cable, except the end or ends on which corrections are made, is immersed in water in a tank. The water and the tank then form the return path for the current. The cable is immersed in slightly saline water for about 24 hours, and the temperature is kept constant (at about 20°C) and then the measurement is taken as in the figure below.

The insulation resistance of the cable $R = V / I_R$.



In some cases, the deflection of the galvanometer is observed, and its scale is afterwards calibrated by replacing the insulation by a standard high resistance (usually 1 MO), the galvanometer shunt being varied, as required to give a deflection of the same order as before.

In tests on cables, the galvanometer should be short-circuited before applying the voltage. The short-circuited connection is removed only after sufficient time has elapsed so that charging and absorption currents cease to flow. The galvanometer should be well shunted during the early stages of measurement, and it is normally desirable to include a protective series resistance (of several MΩ) in the galvanometer circuit.

The value of this resistance should be subtracted from the observed resistance value to determine the true resistance. A high voltage battery of 500 V emf is required and its emf should remain constant throughout the test.