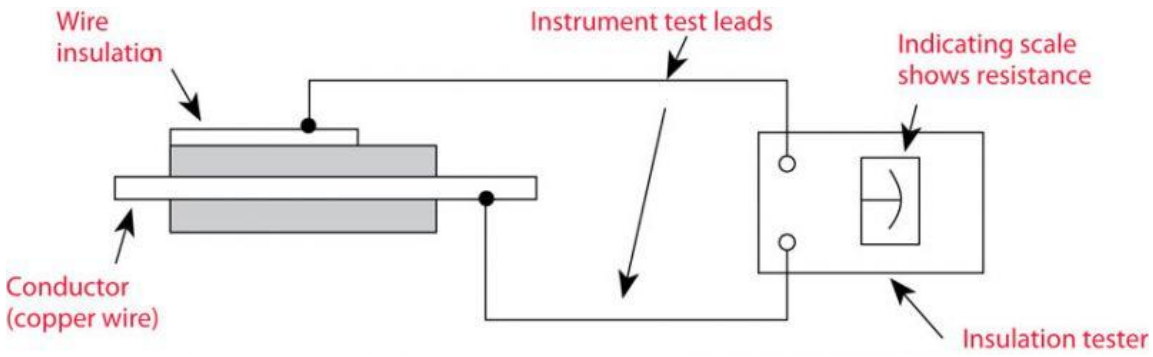
Understanding Insulation Resistance Testing Part I

Insulation starts to age as soon as it's made. As it ages, its insulating performance deteriorates. Any harsh installation environments, especially those with temperature extremes and/or chemical contamination, accelerates this process. This deterioration can result in dangerous conditions in power reliability and personnel safety. As such, it's important to identify this deterioration quickly so that corrective steps can be taken. One of the simplest tests and its required test instrument are not universally understood. To help eliminate this lack of understanding, let's discuss in detail Insulation Resistance (IR) testing and the megohmmeter.

Insulation testing components

Let's approach the subject by component.

The megohmmeter



A basic megohmmeter hook-up schematic is shown in **Fig. 1** (above). The megohmmeter is similar to a multimeter, when the latter is in its ohmmeter function. There are differences, however.

First, the megohmmeter's output is *much higher* than that of a multimeter. Voltages of 100, 250, 500, 1,000, 2500, 5,000, and even 10,000V are used (**Table 1** below). The most common voltages are 500V and 1,000V. Higher voltages are used to stress an insulation to a greater degree and thus obtain more accurate results.

Equipment AC Rating	DC Test Voltage
Up to 100V	100V and 250V
440V to 550V	500V and 1,000V
2,400V	1,000V to 2,000V and higher
4,160V and above	1,000V to 5,000V or higher

Table 1.*Recommended test voltages for routine maintenance insulation-resistance tests of equipment rated to 4,160V and above.*

Second, the range of a megohmmeter is in megohms, as its name implies, instead of ohms as in a multimeter.

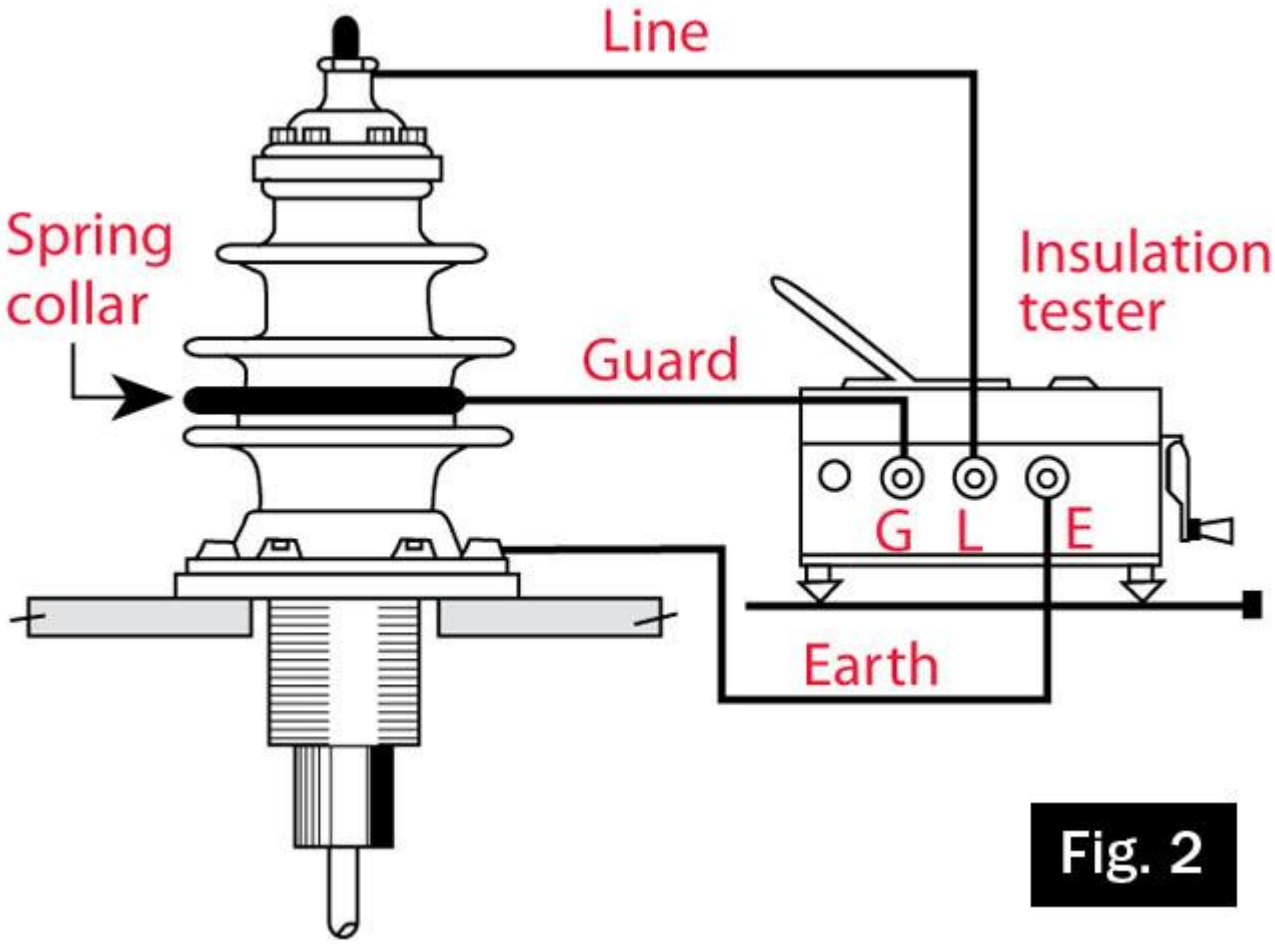
Third, a megohmmeter has a relatively high internal resistance, making the instrument less hazardous to use in spite of the higher voltages.

Testing connections

A megohmmeter usually is equipped with three terminals. The "LINE" (or "L") terminal is the so-called "hot" terminal and is connected to the conductor whose insulation resistance you are measuring. **Remember: These tests are performed with the circuit deenergized.**

The "EARTH" (or "E") terminal is connected to the other side of the insulation, the ground conductor.

The "GUARD" (or "G") terminal provides a return circuit that *bypasses* the meter. For example, if you are measuring a circuit having a current that you do not want to include, you connect that part of the circuit to the "GUARD" terminal.



Figs. 2, 3, and 4 show connections for testing three common types of equipment. Fig. 2 shows a connection for testing a transformer bushing, without measuring the surface leakage. Only the current through the insulation is measured, since any surface current will be returned on the "GUARD" lead.