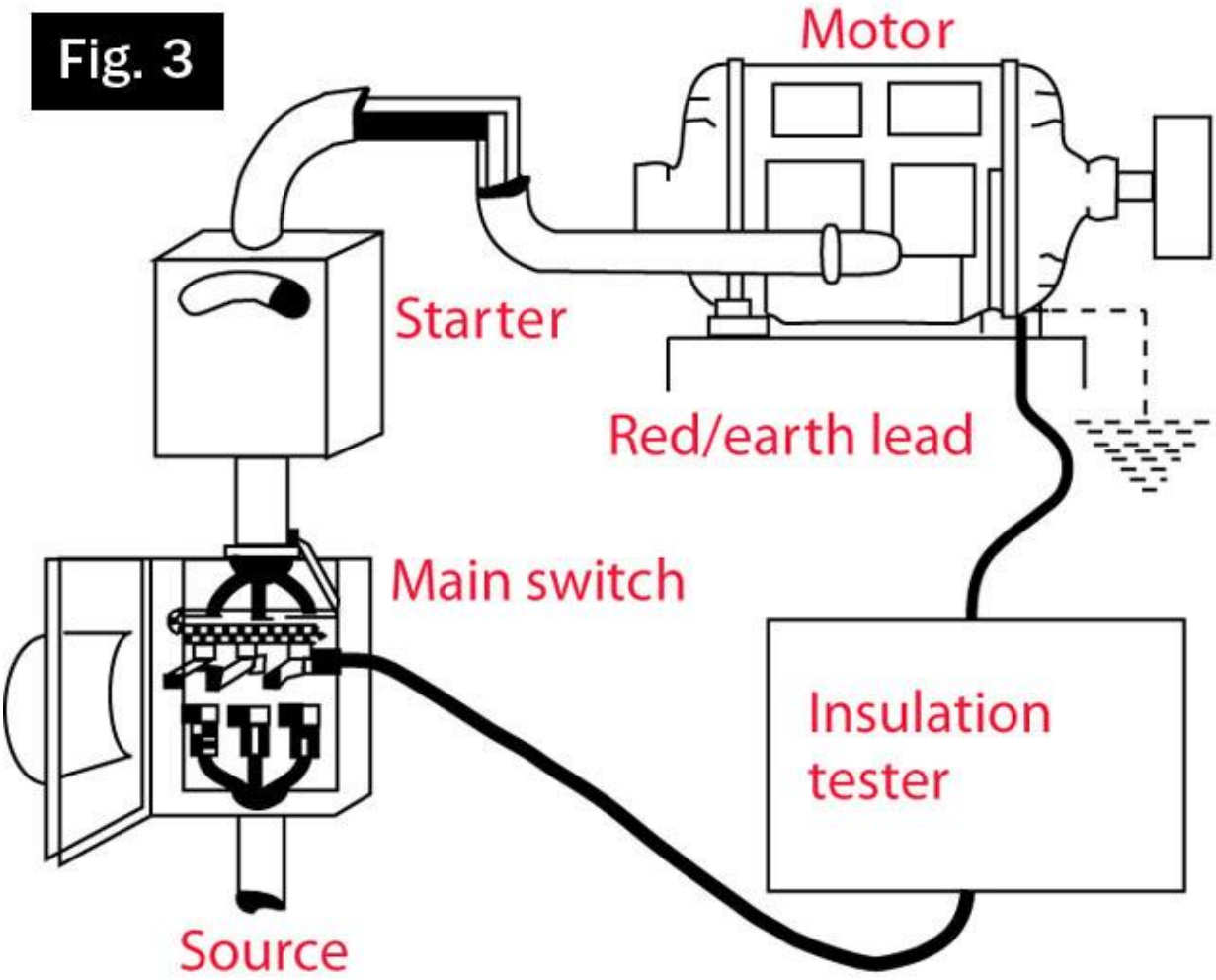
Understanding Insulation Resistance Testing Part II

Various insulation tests

Basically, there are three different tests that can be done using a megohmmeter.

1) Insulation resistance (IR)



This is the simplest of the tests. After the required connections are made, you apply the test voltage for a period of one min. (The one-min interval is an industry practice that allows everyone to take the reading at the same time. In this way, comparison of readings will be of value because, although taken by different people, the test methods are consistent.) During this interval, the resistance should drop or remain relatively steady.
Larger insulation systems will show a steady decrease, while smaller systems will remain steady because the capacitive and absorption currents drop to zero faster on smaller insulation systems. After one min, read and record the resistance value.

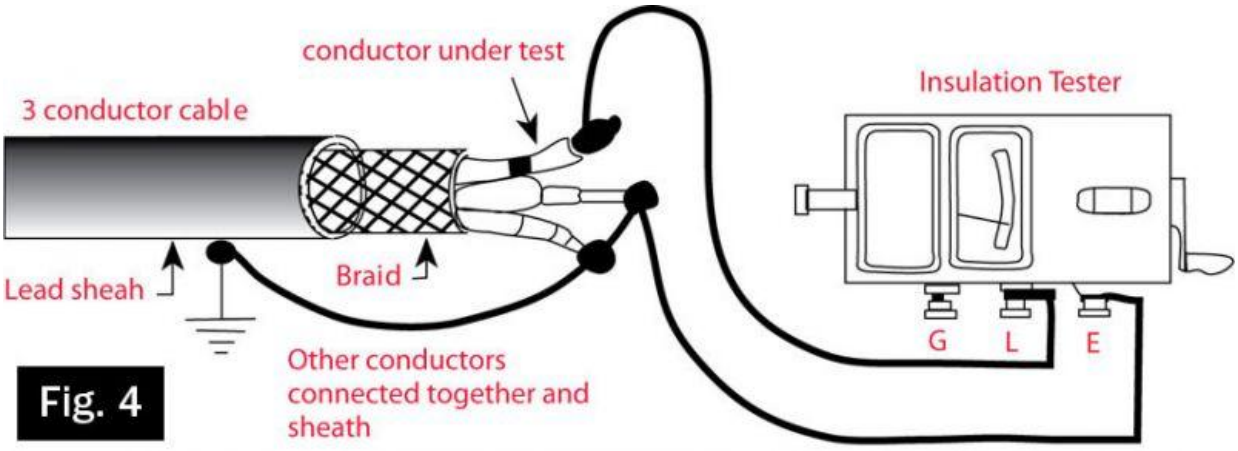


Fig. 4

Note that IR is temperature sensitive. When the temperature goes up, IR goes down, and vice versa. Therefore, to compare new readings with previous readings, you need to correct the readings to some base temperature. Usually, 20°C or 40°C are used as comparison temperatures; tables are available for any correction. However, a common rule of thumb is that IR changes by a factor of two for each 10°C change.

For example, suppose we obtained an IR reading of 100 megohms with an insulation temperature of 30°C. The corrected IR (at 20°C) would be 100 megohms times 2, or 200 megohms.

Also note that acceptable values of IR will depend upon the equipment. Historically, field personnel have used the questionable standard of one megohm per kV plus one. The international Electrical Testing Assoc. (NETA) specification NETA MTS-1993,*Maintenance Testing Specifications for Electrical Power Distribution Equipment and Systems*, provides much more realistic and useful values.

Test results should be compared with previous readings and with readings taken for similar equipment. Any values below the NETA standard minimums or sudden departures from previous values should be investigated.

2) Dielectric absorption ratio

This test recognizes the fact that "good" insulation will show a gradually increasing IR after the test voltage is applied. After the connections are made, the test voltage is applied, and the IR is read at two different times: Usually either 30 and 60 sec, or 60 sec and 10 min. The later reading is divided by the earlier reading, the result being the dielectric absorption ratio. The 10 min./60 sec. ratio is called the polarization index (PI).

For example, let's assume we apply the megohmmeter as described earlier with the appropriate test voltage impressed. The one min. IR reading is 50 megohms, and the 10 min. IR reading is 125 megohms. Thus, the PI is 125 megohms divided by 50 megohms, or 2.5.

Various sources have tables of acceptable values of dielectric absorption ratios (see **Table 2** below).

Insulation Condition	**60/30-sec Ratio**	**10/1-min Ratio (Polarization Index)**
Dangerous	-	Less than 1
Questionable	1.0 to 1.25	1.0 to 2*
Good	1.4 to 1.6	2 to 4
Excellent	Above 1.6**	Above 4**

Table 2. *Listing of conditions of insulation as indicated by Dielectric Absorption Ratios. These values must be considered tentative and relative, subject to experience with the time-resistance method over a period of time.*

*These results would be satisfactory for equipment with very low capacitance, such as short runs of house wiring.

**In some cases with motors, values approximately 20% higher than shown here indicate a dry, brittle winding that may fail under shock conditions or during starts. For preventative maintenance, the motor winding should be cleaned, treated, and dried to restore winding flexibility.