

The Wenner method involves placing four probes in the earth at equal spacing. The probes are connected with wires to the ground resistance test set. The test set passes a known amount of current through the outer two probes and measures the voltage drop between the inner two probes. Using Ohm's Law, it will output a resistance value which can then be converted to a resistivity value using the equation:

$$P = 2\pi aR$$

Where:

P = soil resistivity in ohm cm

a = spacing between probes in cm

$\pi = 3.1416$

R = resistance value measured by test set

Soil resistivity values vary depending on the soil type, temperature, and moisture content. Typically, data is collected to depths of one to ten meters with additional testing required for difficult (high or widely varying resistance) sites.

Finally, testing of the grounding system is important to determine whether ground resistance targets are met. Grounding professionals should be called to perform the ground resistance tests since each test must take into account on-site conditions, and it is very easy to get erroneous data. Testing can be accomplished using clamp-on resistance testers, Fall-of-Potential methods, or by simply calculating the probable resistance. Detailed procedures for accurate testing can be found in ANSI IEEE Standard 81.

The use of a good test set is the best way to not only design and test a new grounding system, but also to test existing systems for degradation and ensure they will perform properly in the event of a nearby lightning strike. Although the cost for these sets can range upwards of \$3,000 (rentals are sometimes available for a fraction of the cost), the cost of a replacement scale system due to a noncompliant grounding system can be much more expensive, not to mention the priceless protection it provides to individuals. ■



## electro < > magnetic TAG TEAM

Electric current flow and magnetism interact and either one can induce the presence of the other.

If you take a simple bar magnet, place a piece of paper over it, and sprinkle some iron filings on the paper, it looks like the magnet above.

The lines of filings represent the magnetic field that is present.

Whenever there is a flow of electricity, there is also a magnetic field that is produced.

When an electric field is generated from any AC current flow (at any frequency), the field produced will induce a magnetic field in any magnetic (ferrous) metal that is in the field.

On the other hand, whenever a magnet is moved through a set of electrical conductors, an electric current is generated in the conductors. The larger the field, or movement, or number and size of conductors, the larger the induced magnetism or electric current.

An electromagnet can be easily made with a nail with a number of turns of wire wrapped around it. Connect the ends of the wire to a battery, and you have an electromagnet.

Take a coil of wire and move a magnet in and out of the coil, and you will generate an electrical voltage at the ends of the wire.

All of this becomes vital when dealing with a shielded cable such as a load cell cable or a "home run" cable. The shield must have a low resistance to ground connection on one end only, to act as a shield to any induced electrical current.

Grounding at both ends of the shield provides a resistance between two ground potentials, resulting in a ground loop that can carry enough current to actually damage the equipment to which it is connected.

Shield types are foil, wrapped, braided, or any combination thereof. There are advantages and disadvantages to each, although aside from the cost and flexibility issues, a combination foil and good coverage (over 90 percent) braided shield provides the best protection. All of our SURVIVOR® load cell cable offerings have both foil and more than 90 percent braided shielding.

In addition, the actual ground connection needs to be of very low resistance or the advantages are voided. Good quality connectors and grounding methods (360 degree clamp or solder) are essential.

Rice Lake offers cable with both foil and more than 90 percent braided shielding.