Hood-Patterson & Dewar, Inc. Electrical Engineering and Testing
Spring 1997

# Testing Times

A newsletter for the electrical construction and maintenance industry
Volume 4 No. 2

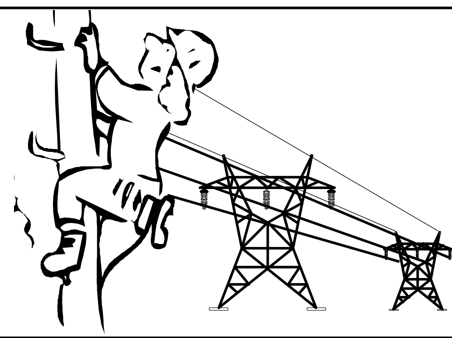
## Grounding: Why ground? Testing grounding

Basic principle #1: current follows the path of least resistance **+** Basic principle #2: current will exist in undesirable forms **=** the need to ground. The purpose of grounding is to control where this undesirable current goes. Undesirable current includes lightning discharge, power system neutral return, ground fault currents, and noise currents. The earth is an obvious natural electrical conductor because of its sheer size

***We ground for three reasons: personnel safety, equipment protection, and electrical noise reduction.***

and accessibility. The connection to the earth can be achieved with bare metallic conductors, copper plates, steel pipes, and ground rods.

Ideally, we would like to have zero resistance at any point in the grounding system. Unfortunately, this not possible, so our goal is to minimize the resistance to earth at all points in the system. The total resistance in the system will vary with the grounding conductor size, type and size of electrical connectors, contact resistance between the conductors and the soil, the resistivity of the soil, the area of the grounding system, the temperature, and more.
We ground for three reasons: personnel safety, equipment protection, and electrical noise reduction. Personnel safety should be the top priority of a grounding system and is best achieved by equalizing the potentials of all conductive objects that are within reach. Another safety objective is to provide a low impedance path back to the power source in the event of an electrical fault to ground.



***Personnel safety should be the top priority in the design of any grounding system.***

Equipment protection involves providing an alternate path for lightning and faults to avoid damaging equipment. Electrical noise reduction is accomplished by ensuring that the impedance to earth or the ground impedance between interfacing equipment is kept to a minimum value. ❖

## Testing grounding systems

After a grounding system is designed and installed, the grounding system resistance should be measured to make sure it conforms to design values. Testing needs to be performed after the grounding system is completely installed but prior to connection to the utility neutral or any other system (cold water, building steel, etc.).

In cases where the measured resistance is too high, the cause can be poor installation or incorrect assumptions on soil resistivity during design. To avoid high resistance due to incorrect assumptions, soil resistivity measurements should be made and incorporated into a site specific design. This additional step will eliminate the need for a specification that reads “the contractor shall install the grounding system as specified. If the measured resistance is greater than 25 ohms, the contractor shall install additional ground rods until reaching 25 ohms or less, at no additional cost to the owner”!

Testing specifications typically call

(continued on page 2)

HOOD - PATTERSON & DEWAR INCORPORATED
ELECTRICAL ENGINEERING AND TESTING
POST OFFICE BOX 1048 DECATUR, GA 30031
TELEPHONE (404)296-5990 FAX (404) 299-3542

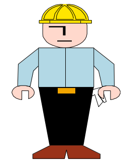
*(continued from page 1)*

for the fall-of-potential or three point test method. This method requires the test engineer to be able to access "remote" earth; that is, earth outside the area of influence of the grounding system under test. Unfortunately, in heavily populated areas, access to remote earth can be difficult. In this case, an alternative test method is the direct or two point method. The test probes are shorted together and connected to a reference ground. The reference ground should be a ground system with a fairly low resistance (i.e., the utility system neutral). The resistance of the ground system under test will be measured relative to the reference ground, assuming the reference ground to be true earth. In a few instances like a downtown metro area, even the two point method may be impossible. In this particular case, there is no existing test equipment or test procedure that will accurately measure the grounding system resistance.

***In a downtown area, there is no existing test equipment or procedure that will accurately measure grounding system resistance.***

If the system is a complex electrical system that is already tied to the electrical utility system, tied to underground water, or is extremely large, then the best test method available is the EPRI Smart Ground Multimeter (SGM). The SGM was developed for use by electric utilities to measure the impedance of large electric utility substations that are connected to transmission and distribution systems. The SGM is a computer-based device that takes numerous measurements of voltages produced by current injected by the SGM, and from these measurements, complex computer algorithms calculate the ground impedance of the system under test. The SGM is relatively immune to noise from AC power systems because it injects current and measures voltages at random frequencies which allows the software to digitally filter out external noise. ❖

## Grounding Terms...



### Chemical Ground Rods

When trying to obtain a low resistance ground connection, one of the key limiting factors is the soil resistivity. Chemically treating the soil can be an effective method for lowering soil resistivity. Chemical ground rods can provide a permanent soil treatment solution. A two inch hollow copper rod is installed which is filled with a special salt mixture. The rod can be refilled as needed to provide long term soil treatment. ❖

## FaxBack

If you would like additional information about the following:

______Grounding System Design
______Grounding System Audit
______Grounding System Testing
______HiCon® Chemical Rods
______Smart Ground Multimeter®

Fax this page to: **404-299-3542**. Your name and address will appear on the label below.

HOOD - PATTERSON & DEWAR INCORPORATED
ELECTRICAL ENGINEERING AND TESTING
POST OFFICE BOX 1048 DECATUR, GEORGIA 30031

**inside:**