



Grounding for Power Quality

10/12/99

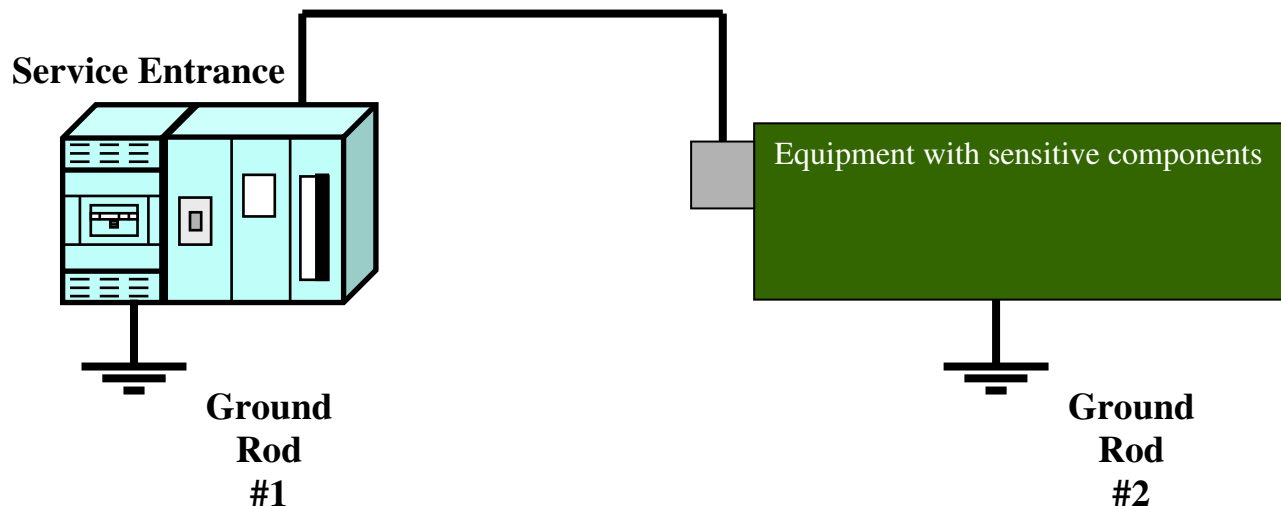
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Quite often when we speak of proper grounding in our facilities we refer to the National Electrical Code Article 250-56. Without checking the actual wording in the NEC codebook the usual response is the following "The code says ground should be less than 25 ohms" Is this true? **NO**. NEC article actually states, "A single electrode...that does not have a resistance to ground of 25 ohms or less shall be augmented by one additional electrode..." This could bring about a situation in which one electrode (ground rod) could measure 200 ohms resistance to ground and the installation of another might only bring the total down to 100 ohms. Therefore, a condition could arise where a facility may have a ground resistance higher than 25 ohms and still be in compliance with the National Electrical Code.

Is this good enough for Power quality purposes? Once again NO.

The IEEE Emerald book, which has long been accepted as the industry standard for grounding electronic and electrical equipment, states that ground resistance should be 1 ohm for substations and 2-5 ohms for commercial and industrial services. Many equipment vendors require less than 3 ohms. Why?

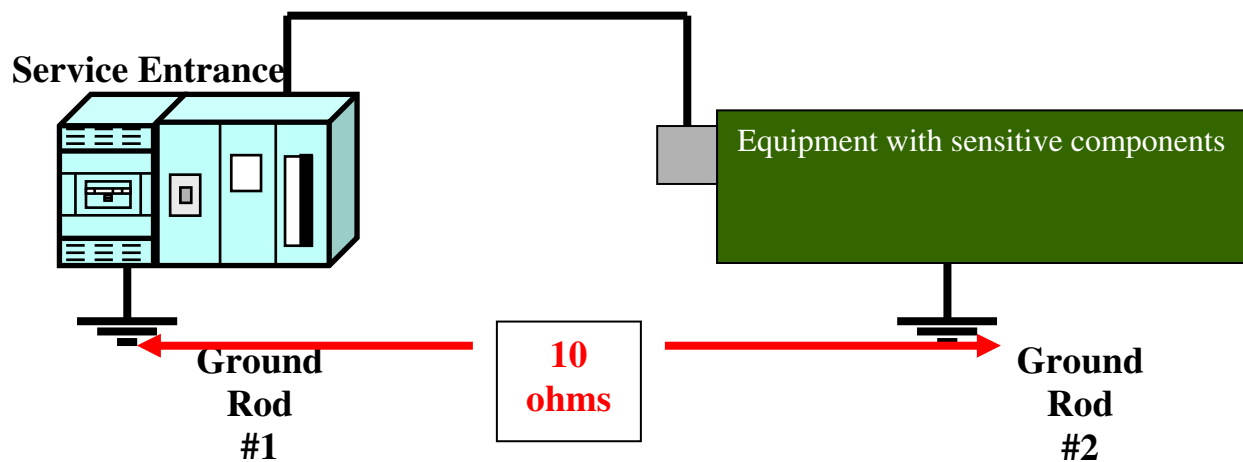
Lets examine the follow example that will illustrate the need for a low resistance ground.



The example above illustrates a typical equipment installation of a piece of equipment that has internal sensitive electronic and electrical components. Quite often the manufacturer of this



equipment will insist on a ground rod driven at the piece of equipment or the warranty will be void. The manufacturer of this equipment may have good intentions in regard to establishing a good ground, however, this is a direct violation of the National Electrical Code article 250-50 stating that "any ...electrodes (grounds)...shall be bonded together" The establishment of this separate ground is both a safety hazard and a Power Quality problem. The next illustration shows the dangers of a separate ground rod.



Lets say that ground rod #1 has a ground resistance of 10 ohms and ground rod #2 has a ground resistance of 20 ohms. Note both are less than the NEC 250-56 of 25 ohms. The difference in resistance between both ground rods is:

Ground rod #2 20 ohms minus Ground rod #1 10 ohms equals a 10 ohm difference.

Now we have to use a little math and an old favorite OHMS LAW. One way of stating ohms law is: Ohms x Amps = Volts. For demonstration purposes in the above example lets say a lightning strike occurred close to this facility and it induced only 1000 amps into the earth under our facility. This number of 1000 amps is not out of line as induced current flow from lightning has been measured at much higher values. Using Ohms Law we can deduct the following:

10 ohms difference between ground rods times 1000 amps of current flow from the lightning strike equals 10,000 volts of potential between the electrical service and our machine with sensitive components.

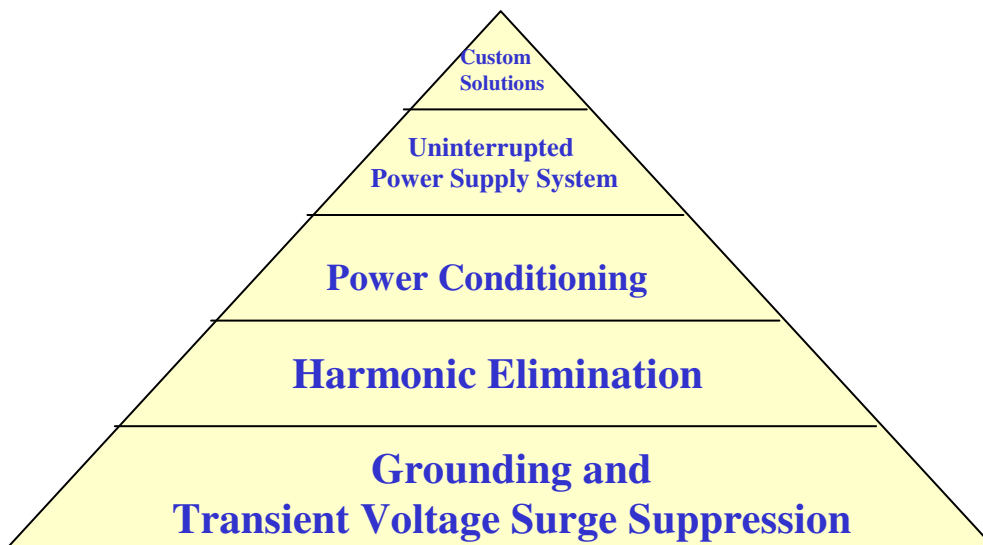
10 ohms x 1000 amps = 10,000 volts.



This large voltage is both a safety hazard and a Power Quality hazard as both can and do cause problems in your facility. One way to solve this problem is to bond the two ground rods together as per NEC code. This will lower the difference between the two ground rods, thus, lowering the voltage between the same.

Good grounding is essential for electrical equipment and distribution systems. Good grounding provides the level of safety required to protect personnel and equipment from shock hazards. Every solution to a power quality problem in your facility should start with a thorough ground study.

The following pyramid illustrates the need for a good ground to build the solid base in a program to solve power quality problems in your facility. After establishing a good base you then can address the other equipment that can help solve problems in your facility.



An effective grounding system:

- Provides a more stable system with a minimum of transient voltages and electrical noise. (Using TVSS units)
- Provides a path to ground in fault conditions to insure proper operation of ground fault protection equipment.
- Provides grounding of all conductive enclosures that may be touched by personnel, thereby reducing shock hazards.



- Reduces static electricity that may be generated within facilities.
- Provides protection from large electrical disturbances (such as lightning) by creating a low resistive path to earth.
- Should be built so that it can be EASILY measured on a REGULAR basis to make sure it is still functioning properly.

This last statement is so important I will mention it again. An effective grounding system ...should be built so that it can be EASILY measured on a REGULAR basis to make sure it is still functioning properly. This may at first sound like a simple matter. In reality it can be a very long and detailed task. The establishment of an electrical ground to meet the IEEE standard of less than 5 ohms and the ability to measure this 5 ohm resistance varies with each installation.

Your facility should have a detailed ground study to help you determine and establish effective grounding systems within your facility. Remember the lower the ground resistance the more effective it will be.