

Ground Rod Electrodes

What You Need To Know!

by Jim J. Lund

There are several misconceptions with interpretation of the *National Electrical Code* as it relates to ground rod electrode compliance. The section of the *NEC* that deals with ground rods is 250.52. The wording of this portion of the *Code* presently includes conflicting terms, dimensions and interpretations, which hopefully will be addressed in the next code proposal cycle.

The objective of this article is to clarify some of these misconceptions and provide inspectors a reliable method of inspecting ground rods to assure that they are, in fact, approving code-compliant rods. To be code-compliant, the ground rod electrodes must be compliant for the system; for either the *Code* has value or it does not. This critical decision is left up to the interpretation of the local inspector.

NEC 250.52(A)(5), which deals with rods and pipe electrodes states:

“Rod and Pipe Electrodes. Rod and pipe electrodes shall not be less than 2.5 m (8 ft.) in length and shall consist of the following materials.

“(a) Electrodes of pipe or conduit shall not be smaller than metric designator 21 (trade size $\frac{3}{4}$) and, where of iron or steel, shall have the outer surface galvanized or

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otherwise metal-coated for corrosion protection.

“(b) Electrodes of rods of iron or steel shall be at least 15.87 mm (5/8 in) in diameter. Stainless steel rods less than 16 mm (5/8 in) in diameter, nonferrous rods, or their equivalent shall be listed and shall not be less than 13 mm (1/2 in) in diameter.”

The introduction to 250.52 deals with the length of the electrode. It very clearly states that the electrode shall be no less than 8 feet in length. There are ground rods manufactured and commercially available that do not meet the minimum 8-foot requirement, although the manufacturer may claim the rod to be 8 feet nominal in length. The key issue that presents itself is, “How does an electrical inspector know once the rod is buried in the ground if the rod was manufactured to the *NEC* required minimum length?” The answer: simply look for the listing mark (e.g., UL) that is stamped on the drive or chamfer end of the rod. The listing mark must be stamped in the top 12 inches of the rod in accordance with UL 467. Another important fact is that it is stamped only within the top 12 inches.

If a contractor were to purposely cut the rod in half, the listing would appear on only one of the two pieces. Another disadvantage for the contractor is if he would choose to cut a non-fully driven rod off at ground level, the craft would be cutting off the listed marking on one of the two rod sections, not allowing one of the parts to be used. While cutting rods into two is not the norm for installers—and is a clear violation of the *NEC*—visual

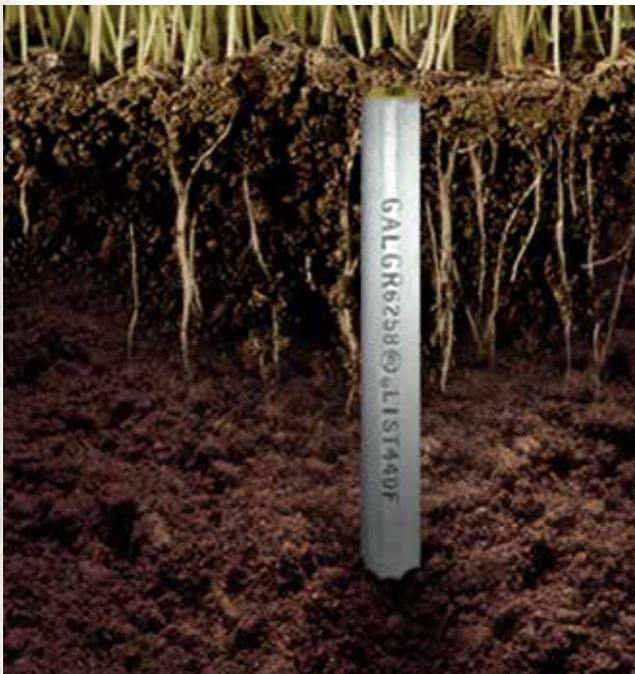


Photo 1. A rod in the ground with the UL listing marking showing and with a shovel full of dirt next to it

examination of the listing marking adds credibility to the grounding system.

This brings up one of the dilemmas faced by the electrical inspector. How does one inspect a rod once the rod is driven into the ground? Many jurisdictions have handled this by requiring the contractor to leave a shovel full of dirt away from the rod with the listed marking showing. All the inspector has to do is verify existence of the listing mark, then immediately kick the dirt back over the installed rod. The entire inspection process takes only a few moments.

In addition to being manufactured to the correct length, the listing also assures the inspector that the rod has the correct diameter and the correct amount of zinc (galvanized) or copper coating.

The next portion of the *Code* that deals with ground rods is sub-section (b). First of all, it is apparent that there are significant discrepancies in regards to the metric conversion. Even though 90.9(D) of the *NEC* allows for “soft conversions” it would make sense for the soft conversion of the same dimension to be more equal, particularly in this section of the *Code*. Within the same paragraph it states that 15.87 mm and 16 mm are both equal to 5/8 of an inch. Although it is a very slight difference, it is a discrepancy nonetheless. The two sentences in this portion of the *Code* deal with the diameter of the ground rod and whether or not the rods have to be listed.

“(b) Electrodes of iron or steel shall be at least 15.87 mm (5/8 in) in diameter.”

It is interesting to note that all nonferrous coated ground rods, whether copper or zinc, have a ferrous steel core. From this sentence we may conclude that if a rod is 5/8 (0.625) inch in diameter, it satisfies the diameter issue in this section of the *NEC*, and is compliant without the additional need for a listing. Five-eighths of an inch is 0.625. Few 5/8-inch nominal diameter ground rods are manufactured to a 0.625-inch diameter specification. Most “5/8 inch” rods are nominally 5/8 inch, which means they are actually less than the required 0.625 inches and do not meet *Code*. Reference to nominal dimensions also applies to other rod diameters including 1/2, 3/4 and 1 inch, all commercially available for years.

The second sentence in (b) deals with rods that are less than 0.625 inch in diameter.

“Stainless steel rods less than 16 mm (5/8 inch.) in diameter, nonferrous rods or their equivalent shall be listed and shall not be less than 13 mm (1/2 inch.) in diameter.”

One area of misunderstanding relates to the term *nonferrous*. Nonferrous is defined as “not containing iron.” Both copper- and zinc-coated ground rods have steel



Figure 1. Galvan ground rod gage

cores. Both of the coatings are nonferrous, yet the term *nonferrous* refers to the copper-coated steel rod. Hopefully, this will be clarified in the next code change cycle.

From the above statement of the *Code*, it can be ascertained that a rod that is less than 0.625 inch can meet code but only if it is greater than ½ inch and listed.

With regard to diameter, the *Code* allows for two ways a ground rod can meet the requirements: (1) It can be 0.625 or larger in diameter, or (2) it must be listed and not less than ½ inch (0.500).

In order for a copper ground rod to meet the requirements of the product standard and be listed, it must also have a protective coating of 10 mils minimum of copper. If a rod does not have at least 10 mils of copper and is less than 0.625, the rod does not meet *Code*. In New York, Pennsylvania and Delaware, 3-mil copper-coated rods are being installed which are well under 0.625 in diameter. Is this occurring in your jurisdiction? These rods cannot be listed since they do not maintain the 10 mil minimum requirement specified by certification agencies. They do not meet the *Code* and must be rejected by local inspectors.

In other areas of the country, it is not uncommon to see ground rods being installed and passing inspection that are less than the required ½ inch minimum in diameter. They are also produced with less than the listed requirement of 10 mils minimum of protective copper coating. While local codes do vary, the *NEC* is very explicit in the definition of a code-compliant ground rod electrode.

Again, the challenge facing inspectors is how to inspect a ground rod once it is in the ground. The inspector, according to the *Code*, must check for diameter, length, whether the diameter is under 0.625 inch, and verify the listing mark.

There is a means of verifying that the diameter of a ground rod adheres to the *Code*. The inspector may use

a micrometer to verify diameter, but would not be able to assure the exact rod length once the electrode was installed. A free ground rod gage is available to be used to see if the rod has to be listed or not. Listing certification also provides assurance that the ground rod electrode fulfills the *NEC* length requirements, and is therefore code-compliant. To order the gage, simply go to www.galvanelectrical.com and request your personnel gage. Click on the picture of the gage, fill in the address information and a gage will be mailed to you.

A ground rod may have a diameter of 0.625 inch as examined during the review process with a micrometer; but how does an inspector know, without a visual examination of the listed mark, that the rod was produced to a code-compliant length of 8 feet and that it has the proper amount of protective coating?

The most effective way is to look for the listing marking, which as we described earlier, is located within the top 12 inches of the rod. By examination of this listing mark, the inspector is assured that the ground rod was produced to all of the important criteria necessary to meet the *NEC* requirements. At this point the inspector can proceed to the next step in the process.

A simple and creative technique to inspect the ground rod after it has been installed in the ground, as other inspectors have done in many areas, is to require the contractor to leave a shovel full of dirt away from the rod with the listed marking showing. This is the most effective process for the inspector to be assured that the rod was produced to the criteria to make the rod compliant to 250.52(A)(5) of the *NEC*. This can be viewed photo 1.

In conclusion once the rod is installed in the ground, it is impossible for the inspector to verify beyond a reasonable doubt that the rod was manufactured to all of the code-compliant parameters. Having the installer leave a shovel full of dirt away from the rod with the listing mark visible allows for a quick, easy and effective inspection. The only way for the inspector to verify that an installed ground rod was manufactured to the correct diameter, length, and protective coating thickness, is to assure existence of the listing mark.

With the listing mark verified, there is now a high degree of assurance that the ground rod electrode installed meets the *National Electrical Code*, and that the entire system is code-compliant.■

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