HOW SLIGHT CHANGES IN THE NEC CODE CAN HAVE A BIG IMPACT

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The power of the written word is great, especially if you're an electrician or a contractor working under the guidelines set in the National Electric Code (NEC).

When you're working with the 1,069 page NEC, the most detailed of any National Fire Protection Association (NFPA) code or standard, even the switch-out of one word can dramatically affect the way you perform your job.

As equipment has become more complex and varied, the NEC has been revised to meet new technologies and challenges. The 2002 version of the NEC featured some of the most significant changes in the Code's history. The 2005 NEC, the 50th edition, builds on those changes, and affects everything from load calculation to zone classification of hazardous locations to arc fault circuit interrupter requirements.

In particular, section 250.50 of the NEC covers the topic of grounding electrodes. A grounding electrode, defined as a conducting element that connects electrical systems and/or equipment to the earth, is an inherent component of all building construction.

The 2005 NEC has slightly revised this article in a way that greatly alters its meaning and consequences.

The article now reads:

"All grounding electrodes as described in 250.52 (A)(1) through (A)(6) that are present at each building or structure served shall be bonded together to form the grounding electrode system. Where none of these grounding electrodes exists, one or more of the grounding electrodes specified in 250.52 (A)(4) through (A)(7) shall be installed or used."

The new term "are present" replaces the previous term "if available", which was deemed too difficult to enforce and too vague. The updated language serves to clarify the original intent of the article. It also puts the onus on the general contractor or electrician in a residential construction job to ensure that the grounding electrode — in most cases a reinforcing bar in the concrete foundation — is accessible after the concrete has been poured.

Timing is everything in this situation. When a local authority chooses to enforce the rebar option for residential grounding, both the general contractor and electrician must be prepared to have a piece of rebar installed in the concrete, a step that must be performed far in advance of the majority of the electrical work to be done on site.

SETTING THE BAR

Grounding to a reinforcing bar, or rebar, is a relatively new idea in residential applications. Commonly known as a UFER ground, this method now offers an alternative to the traditional methods historically used in residential jobs of grounding to a copper ground rod or cold water pipe. With proper planning, rebar grounding offers an inexpensive grounding electrode that also provides a low resistance connection.

When local authorities choose to require this new grounding method, Article 250.50 mandates that either the electrician has to be involved while the concrete is getting poured or, more likely, the general contractor has to make the connection to the rebar using a pigtail wire that attaches to the rebar and sticks out from the concrete. Another option is to have a section of the rebar itself left exposed by the contractor, but this is a method that may not meet the approval of some electrical inspectors.

GOING TO GREATER LENGTHS

There are practical problems inherent to the application of the pigtail wire, specifically in regards to its length. The recent code change has presented the dilemma of having a local inspector ask for a pigtail to be installed, but does not give a guideline as to the exact length that should be left exposed outside the foundation for future use by an electrician.

The standard length for a pigtail wire, as set by some local inspectors and/or ordinances, is 20 feet. But this length, for most practical purposes, falls short. Electrical boxes can be located anywhere in a building, perhaps a hundred feet or more from the rebar. Electricians have to be prepared to make a connection to the pigtail in order to extend the wire to reach a distant meter or service location.

The extension of a grounding electrode is restricted by the NEC and must be made by either a compression or exothermic ground. A third type, the mechanical connection, does not meet NEC standards for extending a grounding electrode, as it allows variation in the resulting connection. In the case of grounding to rebar, mechanical grounding is an option, but not for extending the electrode if the pre-installed pigtail is too short.

There are advantages to both compression and exothermic connections. Exothermic is accepted by 80% of the country's specifying engineers and doesn't require the procurement of any expensive tools.

Additionally, exothermic connections create a strong molecular bond between the two conductors.

Compression connections, also appropriate for extending the grounding electrode, are better suited for adverse weather or environmental conditions and offer users the ability to make a compression connection almost anywhere, including underwater or in a muddy

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ditch. Additionally, compression doesn't create heat build-up, eliminating the need for a special "hot" permit that is sometimes required.

Mechanical connections are inexpensive, readily available and easy to install, making them a reasonable solution to consider for some grounding applications, including attaching the pigtail to rebar — but not the extension of a pigtail that cannot reach the service location.

CONNECT WITH ONE SOURCE

When specifying a grounding connection, it is helpful to seek out companies that offer all three methods of grounding. For example, certain applications require an exothermic method for one connection and a mechanical connection for another. Having a one-source supplier saves a considerable amount of time.

Also, companies that offer all three options can offer an unbiased opinion about which method best suits your ultimate needs that extend beyond the job in question without strong-arming you into selecting an option that doesn't exactly fit.

The phrase change in Article 250.50 of the NEC code has made phrases like "grounding to rebar" a more prominent part of a contractor's vocabulary, but this change doesn't have to be grounds for great concern. Once the ramifications of the change are clear, half the battle is won. The rest of the solution can be narrowed down to simply making the right connections.

Arc Flash Safety

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eral compliance. Specifically:

- Safety program with defined responsibilities
- Calculations for the degree of arc flash hazard
- Personal protective equipment (PPE) for workers
- Training for workers
- Tools for safe work
- Warning labels on equipment

IEEE STANDARD 1584-2002, GUIDE FOR ARC FLASH HAZARD ANALYSIS

In order for the warning labels to carry enough information to show the danger zone for arc flash conditions, companies must determine that area within which only qualified workers should enter — the flash protection boundary. IEEE 1584 provides a method to calculate the incident energy in order to specify the level of PPE required for workers.

REQUIREMENTS FOR SAFETY PROGRAM UNDER NFPA 70E

OSHA and NFPA 70E require equipment be in an electrically safe work condition before employees work on or near it. Equipment, therefore, should be de-energized before any work is done. In some cases, however, work cannot be done on de-energized systems, such as in a hospital or a 24 hr continuous operation.

There are specific steps NFPA 70E dictates to ensure an electrically safe working condition exists:

- Determine all possible sources of supply
- Open disconnecting device(s) for each source
- Where possible, visually verify device is open
- Apply lockout/tagout devices
- Test voltage on each conductor to verify that it is de-energized
- Apply grounding devices where stored energy or induced voltage could exist or where de-energized conductors could contact live parts.

Establishing these safety procedures is part of the company safety plan that must be in effect for each facility:

- Employers must formalize procedures and practices such as the qualification of employees to work in hazardous areas, tasks they may perform, steps needed to secure management approval for work to be done, and audits.
- Employers must provide training for employees in the skills and techniques needed to work with electrical equipment, equipment details, and emergency procedures.
- Employees must implement the practices according to the training.
- Companies must perform a flash hazard analysis before work is done on any energized equipment.