NATIONAL ELECTRICAL CODE®
CODE-MAKING PANEL 5
NFPA 70
Second Draft Meeting Agenda
October 25 - 27, 2018
San Diego, CA

1. Call to Order – Nathan Phillips, Chair
2. Introductions
3. Approval of Previous Meeting Minutes (Attachment A)
4. Staff Updates - NFPA Staff
    - Overview of NFPA Process
5. Review of Public Comments (Attachment B)
6. Old Business
7. New Business
8. Adjourn

Attachment A: Previous Meeting Minutes

NEC® Code-Making Panel ___5___ Chair Report
Signature:
Dates and Location of Meeting:

January 8-11, 2018
Hilton head, SC

1. List names of NEC® Code-Making Panel Members in Attendance:

   See meeting roster

2. List names of Guests in Attendance:

   See meeting roster

3. List names of Guests who addressed the Panel, the subject of their presentation and the length of time they spoke:
   - Bob Torbin of Omega Flex Spoke twice for 5 minutes each time regarding PIs 3236 and PI 3238.
   - Alpesh Bhobe of CICSO spoke for 5 minutes regarding PIs 1509 and 1510
   - Mike Holt of Mike Holt Enterprises spoke for 5 minutes regarding his PIs, 1 minute regarding PI 1842 and for 30 seconds regarding 4103.
   - Bryan Baughman spoke twice for 5 minutes each regarding PIs 3238 and 2910

4. Number of Public Inputs/Comments acted upon:

   268

5. Number of First/Second Revisions Created:

   63

6. List any Task Groups appointed to work subsequent to the First/Second Draft Meeting, along with the names of Task Group members:

   None

7. List any Public Input/Comment or First/Second Revision that may need to be referred to another Panel for information or correlation:

   - CMP 5 asks the Correlating Committee to refer FR 7819 regarding 250.184(C) to CMP 4 for correlation with Article 690.

   - CMP 5 asks the Correlating Committee to refer a series of FRs related to grounding and bonding of equipment connected to the supply side of the service disconnecting means to

CMP 4 for correlation. They are: FR 8198 that creates a new Section 250.25, FR 8196 that creates a new definition of Supply Side Disconnect, FR 8070 that revises the definition of Main Bonding Jumper, FR 7545 that revises 250.142(A), FR 7548 that revises 250.148(B) and FR 8118 that revises 250.28(2).

- CMP 5 asks the Correlating Committee to consider creating a task group of members of CMP 5, 9 and 18 to move all faceplate grounding provisions to Article 250 for consistency and correlation.

- CMP 5 asks the Correlating Committee to consider creating a task group of members of CMP 5 and 13 to consider coordinating grounding requirements proposed in PI 253 with provisions of Article 445.

- CMP 5 provides the following Table listing provisions of the NEC that are affected by FR 8114 modifying 250.122 to the Correlating Committee for its use:

Sections of 2017 NEC Affected by Changes to 250.122		
SECTION	**AFFECTED TEXT**	**PROPOSED REVISED TEXT**
215.2(A)(2)(b)(2)	(2) Grounded Conductor. The size of the feeder circuit grounded conductor shall not be smaller than that required by 250.122, except that 250.122(F) shall not apply where grounded conductors are run in parallel.	(2) Grounded Conductor. The size of the feeder circuit grounded conductor shall not be smaller than that required by 250.122.
215.2(B)	**(B) Feeders over 600 Volts.** The ampacity of conductors shall be in accordance with 310.15 and 310.60 as applicable. Where installed, the size of the feeder-circuit grounded conductor shall not be smaller than that required by 250.122, except that 250.122(F) shall not apply where grounded conductors are run in parallel. Feeder conductors over 600 volts shall be sized in accordance with 215.2(B)(1), (B)(2), or (B)(3).	**(B) Feeders over 600 Volts.** The ampacity of conductors shall be in accordance with 310.15 and 310.60 as applicable. Where installed, the size of the feeder-circuit grounded conductor shall not be smaller than that required by 250.122, except that 250.122(E) shall not apply where grounded conductors are run in parallel. Feeder conductors over 600 volts shall be sized in accordance with 215.2(B)(1), (B)(2), or (B)(3).
250.102(D) (Not addressed at FD meeting)	**(D) Size – Equipment Bonding Jumper on Load Side of an Overcurrent Device.** The equipment bonding jumper on the load side of an overcurrent device(s) shall be sized in accordance with 250.122. A single common continuous equipment bonding jumper shall be permitted to connect two or more raceways or cables if	**(D) Size – Equipment Bonding Jumper on Load Side of an Overcurrent Device.** The equipment bonding jumper on the load side of an overcurrent device(s) shall be sized in accordance with 250.122.

	the bonding jumper is sized in accordance with 250.122 for the largest overcurrent device supplying circuits therein.	A single common continuous equipment bonding jumper shall be permitted to connect two or more raceways or cables if the bonding jumper is sized in accordance with 250.122.
250.104(B) (Not addressed at FD meeting)	**(B) Other Metal Piping.** If installed in or attached to a building or structure, a metal piping system(s), including gas piping, that is likely to become energized shall be bonded to any of the following: (1) Equipment grounding conductor for the circuit that is likely to energize the piping system (2) Service equipment enclosure (3) Grounded conductor at the service (4) Grounding electrode conductor, if of sufficient size (5) One or more grounding electrodes used, if the grounding electrode conductor or bonding jumper to the grounding electrode is of sufficient size. The bonding conductor(s) or jumper(s) shall be sized in accordance with Table 250.122, and equipment grounding conductors shall be sized in accordance with Table 250.122 using the rating of the circuit that is likely to energize the piping system(s). The points of attachment of the bonding jumper(s) shall be accessible.	**(B) Other Metal Piping.** If installed in or attached to a building or structure, a metal piping system(s), including gas piping, that is likely to become energized shall be bonded to any of the following: (1) Equipment grounding conductor for the circuit that is likely to energize the piping system (2) Service equipment enclosure (3) Grounded conductor at the service (4) Grounding electrode conductor, if of sufficient size (5) One or more grounding electrodes used, if the grounding electrode conductor or bonding jumper to the grounding electrode is of sufficient size. The bonding conductor(s) or jumper(s) shall be sized in accordance with Table 250.122, and equipment grounding conductors shall be sized in accordance with Table 250.122 using the size of the circuit conductors likely to energize the piping system(s). The points of attachment of the bonding jumper(s) shall be accessible.
250.190(C)(3) (Not addressed at FD meeting)	**(3) Sizing.** Equipment grounding conductors shall be sized in accordance with Table 250.122 based on the current rating of the fuse or the overcurrent setting of the protective relay. Informational Note: The overcurrent rating for a circuit breaker is the combination of the current transformer ratio and the current pickup setting of the protective relay.	**(3) Sizing.** Equipment grounding conductors shall be sized in accordance with Table 250.122.

525.11	**525.11 Multiple Sources of Supply.** Where multiple services or separately derived systems, or both, supply portable structures, the equipment grounding conductors of all the sources of supply that serve such structures separated by less than 3.7 m (12 ft) shall be bonded together at the portable structures. The bonding conductor shall be copper and sized in accordance with Table 250.122 based on the largest overcurrent device supplying the portable structures, but not smaller than 6 AWG.	**525.11 Multiple Sources of Supply.** Where multiple services or separately derived systems, or both, supply portable structures, the equipment grounding conductors of all the sources of supply that serve such structures separated by less than 3.7 m (12 ft) shall be bonded together at the portable structures. The bonding conductor shall be copper and sized in accordance with Table 250.122, but not smaller than 6 AWG.
600.7(A)(2)	**(2) Size of Equipment Grounding Conductor.** The equipment grounding conductor size shall be in accordance with 250.122 based on the rating of the overcurrent device protecting the branch circuit or feeder conductors supplying the sign or equipment.	**(2) Size of Equipment Grounding Conductor.** The equipment grounding conductor size shall be in accordance with 250.122.
690.45	**690.45 Size of Equipment Grounding Conductors.** Equipment grounding conductors for PV source and PV output circuits shall be sized in accordance with 250.122. Where no overcurrent protective device is used in the circuit, an assumed overcurrent device rated in accordance with 690.9(B) shall be used when applying Table 250.122. Increases in equipment grounding conductor size to address voltage drop considerations shall not be required. An equipment grounding conductor shall not be smaller than 14 AWG.	**690.45 Size of Equipment Grounding Conductors.** Equipment grounding conductors for PV source and PV output circuits shall be sized in accordance with 250.122. An equipment grounding conductor shall not be smaller than 14 AWG.
Annex D Example D3(a) Industrial Feeders in a Common Raceway (Last paragraph)	**Feeder Neutral Conductor** *(see 220.61)* Because 210.11(B) does not apply to these buildings, the load cannot be assumed to be evenly distributed across phases. Therefore the maximum imbalance must be assumed to be the full lighting load in this case, or 11,600 VA. (11,600 VA / 277V = 42 amperes.) The ability of the neutral to return fault current *[see 250.32(B) Exception(2)]* is not a factor in this calculation. Because the neutral runs between the main switchboard and the building panelboard, likely terminating on a busbar at both locations, and not on	**Feeder Neutral Conductor** *(see 220.61)* Because 210.11(B) does not apply to these buildings, the load cannot be assumed to be evenly distributed across phases. Therefore the maximum imbalance must be assumed to be the full lighting load in this case, or 11,600 VA. (11,600 VA / 277V = 42 amperes.) The ability of the neutral to return fault current *[see 250.32(B) Exception(2)]* is not a factor in this calculation. Because the neutral runs

	overcurrent devices, the effects of continuous loading can be disregarded in evaluating its terminations *[see 215.2(A)(1) Exception No. 2]*. That calculation is (11,600 VA ÷ 277V) = 42 amperes, to be evaluated under the 75°C column of Table 310.15(B)(16). The minimum size of the neutral might seem to be 8 AWG, but that size would not be sufficient to be depended upon in the event of a line-to-neutral short circuit *[see 215.2(A)(1), second paragraph]*. Therefore, since the minimum size equipment grounding conductor for a 150 ampere circuit, as covered in Table 250.122, is 6 AWG, that is the minimum neutral size required for this feeder.	between the main switchboard and the building panelboard, likely terminating on a busbar at both locations, and not on overcurrent devices, the effects of continuous loading can be disregarded in evaluating its terminations *[see 215.2(A)(1) Exception No. 2]*. That calculation is (11,600 VA ÷ 277V) = 42 amperes, to be evaluated under the 75°C column of Table 310.15(B)(16). The minimum size of the neutral might seem to be 8 AWG, but that size would not be sufficient to be depended upon in the event of a line-to-neutral short circuit *[see 215.2(A)(1), second paragraph]*. Therefore, since the equipment grounding conductor size , as covered in Table 250.122, is 6 AWG, that is the minimum neutral size required for this feeder.
Index	Various references will need to be updated.	

8. List any Public Input/Comment that requires NEC® Correlating Committee attention:

CMP 5 asks the Correlating Committee to review the Resolution of PI 3236 concerning bonding of CSST gas piping. The Panel recommends that the Standards Council be asked consider providing guidance to harmonize the conflicting requirements of NFPA 70 and NFPA 54 regarding the bonding CSST.

9. List any general requests for information or assistance from the NEC® Correlating Committee:

CMP 5 notes that there are numerous grounding provisions throughout the code that conflict with requirements in Article 250 and asks that changes to grounding provisions in other articles be referred to CMP 5 for correlation.

10. List any issues that should be brought to the attention of the NFPA Research Foundation:

CMP 5 suggests that research be done into the effectiveness and durability of rebar electrodes both when encased in concrete and when exposed, particularly in coastal regions.

11. List any additional information that would be helpful to the NEC® Correlating Committee, NFPA Staff, or process in general:

The Chair and panel members note that the committee process would be greatly enhanced by making the necessary software revisions to allow the work at the panel meeting to be done directly in Terra View. In spite of our many requests, we were not given the opportunity to make a timely review of the transcriptions of the Word files into Terra View. Although we made diligent efforts to assure that the Word files that staff had at the end of the meeting contained the revisions approved by the panel, at least one FR as reported in the FD report and in Terra View does not reflect the action that was approved at the panel meeting. Considering the thousands of hours that are contributed to the code development process, it doesn't seem unreasonable to ask that NFPA provide the staff and volunteers with fully functioning and adequate tools.

Code-Making Panel 5 Attendance

NEC® First Draft Meeting A2019

Principal Members in Attendance

N. Philips, *Chair*	P. Abernathy	J. Andre
G. Beckstrand	T. Bowmer	D. Brender
P. Dobrowsky	D. Gerstetter	G. Harding
J. Harding	D. Mohla	W. Pancake
C. Porter	N. Sasso	G. Steinman
E. Gallo, *Voting Alternate*		

Alternate Members in Attendance

L. Albert	D. Atkins	K. Crawford
J. DeGregoria	R. Dunnigan	B. Gray
B. Buster	R. Horner	R. Lai
R. O'Brien	P. Simmons	

Staff Liaison

R. Roux, NFPA	J. Shapiro, NFPA	M. Earley, NFPA

Guests in Attendance

M. Johnston, NECA	T. Lindsey	D. Clements, IAEI
D. Iverson, NEMA	B. Torbin, Omega Flex	A. Bhobe, Cisco Systems, Inc.
V. Della Croce, Siemens	K. Manfredi, AFC/Cable Solutions, Atkore	B. House, Mike Holt Enterprises
M. Holt, Mike Holt Enterprises	K. Lofland, IAEI	K. Arnold, Terra XML
D. Hittinger, IEC	J. Sargent, NFPA	B. Bangham, Generac Power System
J. Novak, IBEW	P. Griffith Rose, IAEI	D. Crawford, STI

Attachment B: Public Comment Report

Public Comment No. 683-NFPA 70-2018 [Global Input]

Type your content here ...{strikethrough}physical{/strikethrough} damage

Statement of Problem and Substantiation for Public Comment

I have to respectfully disagree with the concept that the term, "Physical damage" is well understood. My basis for this is the fact that there have been many, many attempts to define the term based on the various understandings that experienced electricians and inspectors have. Based on the committee's response to PI 1781, it appears that removing the adjective will increase the consistency of interpretation of the rules that pertain to damage, while entailing no loss.

Related Item

• Based to committee statement in reponse to PI 1781

Submitter Information Verification

Submitter Full Name: David Shapiro
Organization: Safety First Electrical
Street Address:
City:
State:
Zip:
Submittal Date: Wed Aug 15 12:34:48 EDT 2018
Committee: NEC-AAC

Public Comment No. 979-NFPA 70-2018 [Global Input]

This Global Public Comment requests that each CMP review all products under their purview and determine whether reconditioning should be permitted. This public comment is submitted by a task group assigned by the NEC Correlating Committee. This task group was charged with reviewing Public Input 2935 which was resolved by CMP-1 during the first draft stage. This PI would have required that "Reconditioned Equipment" be "listed as "reconditioned" and the "original listing marks removed". This PI has ramifications that are global in nature and impacts all products referenced in the NEC under the purview of every CMP.

Additional Proposed Changes

File Name	Description	Approved
NEMA-Position_Refubishing_on_ElecEquip.pdf		

Statement of Problem and Substantiation for Public Comment

This Public Comment is submitted on behalf of a task group appointed by the NEC® Correlating Committee. This Task Group was appointed to review the use of refurbished equipment throughout the NEC®. Task Group members are Jim Dollard, Robert Osborne, Jim Pierce, and David Williams. This task group has been charged with reviewing Public Input (PI) 2935 which was resolved by CMP-1 during the first draft stage. This PI would have required that "Reconditioned Equipment" be "listed as "reconditioned" and the "original listing marks removed". This PI has ramifications that are global in nature and impacts all products referenced in the NEC under the purview of every CMP.

Task group members noted that some types of equipment are capable of being reconditioned, then re-evaluated to ensure compliance with the applicable product standards. Other types of equipment do not lend themselves to reconditioning due to the complexity of the product, the manufacturing process, or the level of knowledge the company performing the reconditioning may need, etc.

The "NEMA Policy on Reconditioned Electrical Equipment" details the following aspects of Reconditioning of Electrical Equipment:

- Fundamental Tenets for Reconditioning Electrical Equipment
- Electrical Infrastructure and Worker Safety
- Integrity of Reconditioned Equipment
- Listing or Certification Marks
- UL Guidance on the UL Mark
- Components or Assemblies Not Suitable For Reconditioning (Appendix A)
- Components or Assemblies Which May Be Reconditioned (Appendix B)

A PDF copy of this NEMA policy is attached and may also be found on the internet at the following URL:

https://www.nema.org/Policy/Documents/NEMA-Position_Refubishing%20on%20ElecEquip.pdf

NEC® section 110.21(A)(2), which was new for the 2017 Edition of the NEC®, included marking requirements for "Reconditioned Equipment". PI 2935 would have required that "Reconditioned Equipment" be "listed as "reconditioned" and the "original listing marks removed". CMP 1 resolved this PI. Due to the global nature of PI 2935 this Task Group, appointed by the NEC® Correlating Committee, has developed a number of Public Comments, based on the products identified in the referenced NEMA document, to determine whether or not equipment can be reconditioned, and if reconditioned, what additional requirements apply.

While several Public Comments were developed for specific equipment by this task group, not all equipment was addressed (neither was all the equipment noted in the NEMA Policy document addressed). This Global Public

Comment requests each CMP to review the products required to be listed under their purview and determine whether reconditioning should be permitted. It is recommended that the NEMA Policy document be used as one of the guidelines in making this determination. It is also recommended that one of the following options/examples be chosen for listed equipment:

Option 1 - Equipment NOT suitable for Reconditioning (EXAMPLE):

695.10 Listed Equipment. Diesel engine fire pump controllers, electric fire pump controllers, electric motors, fire pump power transfer switches, foam pump controllers, and limited service controllers shall be listed for fire pump service. [20:9.5.1.1, 10.1.2.1, 12.1.3.1]

Fire pump controllers and transfer switches shall not be permitted to be reconditioned.

Option 2 - Equipment which MAY BE suitable for Reconditioning (EXAMPLE):

408.8 Reconditioned Equipment.

(A) Panelboards. The use of reconditioned panelboards shall comply with (1) and (2):

(1) Industrial and commercial panelboards shall be permitted to be reconditioned. Reconditioned equipment shall be listed as “reconditioned” and the original listing mark removed.

(2) Panelboards installed in dwelling units shall not be permitted to be reconditioned.

(B) Switchboards and Switchgear. Low voltage switchgear, medium voltage switchgear and switchboards shall be permitted to be reconditioned. Reconditioned equipment shall be listed as “reconditioned” and the original listing mark removed.

Note that equipment where no specific guidance is provided would be permitted to be reconditioned and would only be required to meet the marking requirements in 110.21(A)(2).

Related Public Comments for This Document

Related Comment	Relationship
Public Comment No. 980-NFPA 70-2018 [New Section after 240.87(B)]	
Public Comment No. 981-NFPA 70-2018 [New Section after 240.61]	
Public Comment No. 982-NFPA 70-2018 [New Section after 240.101(B)]	
Public Comment No. 983-NFPA 70-2018 [Section No. 695.10]	
Public Comment No. 984-NFPA 70-2018 [Section No. 700.5(C)]	
Public Comment No. 985-NFPA 70-2018 [Section No. 701.5(C)]	
Public Comment No. 986-NFPA 70-2018 [Section No. 702.5]	
Public Comment No. 987-NFPA 70-2018 [New Section after 408.7]	

Related Item

• PI 2935

Submitter Information Verification

Submitter Full Name: James Dollard
Organization: IBEW Local Union 98
Street Address:
City:
State:

Zip:

Submittal Date: Tue Aug 21 08:08:39 EDT 2018

Committee: NEC-AAC

Copyright Assignment

I, James Dollard, hereby irrevocably grant and assign to the National Fire Protection Association (NFPA) all and full rights in copyright in this Public Comment (including both the Proposed Change and the Statement of Problem and Substantiation). I understand and intend that I acquire no rights, including rights as a joint author, in any publication of the NFPA in which this Public Comment in this or another similar or derivative form is used. I hereby warrant that I am the author of this Public Comment and that I have full power and authority to enter into this copyright assignment.

☑ By checking this box I affirm that I am James Dollard, and I agree to be legally bound by the above Copyright Assignment and the terms and conditions contained therein. I understand and intend that, by checking this box, I am creating an electronic signature that will, upon my submission of this form, have the same legal force and effect as a handwritten signature

NEMA Policy on Reconditioned Electrical Equipment

Executive Summary:

The option of reconditioning existing equipment (instead of purchasing new equipment) exists today. Proper electrical equipment reconditioning provides a means to extend the life of electrical products as well as an opportunity in some cases to update installed equipment with the latest performance and safety features. However, not all components of the electrical infrastructure are candidates for reconditioning.

There are a number of precautions that must be adhered to when reconditioning electrical equipment if that equipment is to operate safely and with acceptable performance. Those precautions are discussed below and include the use of design qualified parts, testing to industry-recognized safety standards, original manufacturer specification and/or recommendations, when possible, and reconditioning performed by qualified personnel. The integrity of reconditioned electrical equipment must be established by documenting and demonstrating that component replacement has not compromised the manufacturer's original specifications and accepted industry standards.

The third party certification mark must be removed or obliterated from reconditioned electrical products to indicate that an evaluation of the reconditioning process or reconditioned product has not been conducted by the original third party.

As guidance, Appendix B provides a list of electrical products and components that are considered by NEMA suitable for reconditioning and Appendix A provides a list of electrical products considered not suitable for reconditioning. Medical Imaging Equipment is specifically not addressed by this policy (reference MITA 1, Good Refurbishment Practices for Medical Imaging Equipment).

Introduction:

The U.S. electrical industry includes discussions on implementing new technologies to enhance existing electrical infrastructure. Further, sustainability and safeguarding the environment are growing in importance. In the midst of this is the option for reconditioning existing equipment. Paramount in all this is the fundamental priority that all electrical systems operate while safe-guarding personnel and infrastructure from potential hazards (electrical, mechanical, fire, etc.). This forms the basis for the NEMA position on reconditioning electrical products.

Given that electrical systems are diverse in design, function, and application, not all components of the electrical infrastructure are candidates for reconditioning.

Definition:

Reconditioning: the process of restoring electromechanical systems, equipment, apparatus or components to operating conditions as recommended by the

manufacturer's instructions, using only design qualified parts. Reverse engineered parts (designs copied from existing parts by other manufacturers) are not considered to be "design qualified parts" unless specifically design verified under applicable Standards. Electrical industry practitioners and other organizations may also use the following terms/words to describe the process of reconditioning: remanufacturing, refurbishing, recycling, repairing, restoring, rebuilding, reengineering, and reusing.

In addition to design considerations, it is often impossible to obtain the service records, application environment, and operation parameters of all electrical components. Not having access to such information could have an adverse impact on the final safety and reliability of refurbished or reconditioned equipment. While NEMA supports the reconditioning of some electrical equipment, the components listed in Appendix A are not recommended for reconditioning, unless otherwise indicated by the original manufacturer. Normal servicing of equipment that remains within a facility should not be considered reconditioning or refurbishing. For electrical components suitable for reconditioning listed in Appendix B, the following fundamental tenets have been established.

Fundamental Tenets for Reconditioning Electrical Equipment

- Reconditioning electrical equipment may be a viable option for extending operational lifetime of equipment and enhancing equipment with additional features.
- Electrical equipment reconditioning activity must be based on available guidance documentation from the Original Equipment Manufacturer, or industry-developed standards. Where any conflict in guidance is noted between the OEM and industry standards, the OEM guidance should take precedence.
- Electrical equipment must be reconditioned and qualified to an industry-developed standard that ensures equipment is in a usable and safe operating condition. An industry-developed standard is a widely agreed upon rule, set of rules, procedures or requirements for a product, assembly or process which are developed by members or organizations of an aggregate of manufacturing and technically productive enterprises in a particular field. Products deemed to be candidates for reconditioning must be reconditioned and qualified to industry standards containing the most relevant and critical design aspects, testing criteria and manufacturing specifications when the item was built.
- Reconditioning work must be performed by qualified personnel.
- Electrical equipment that has been exposed to adverse conditions, such as fire, water damage, etc., may not be suitable for reconditioning.
- A comprehensive assessment of the electrical equipment being considered for reconditioning with service records, application, environment, service life, and operating parameters is critical before deciding to pursue reconditioning of the electrical equipment and system. Trained, skilled technicians should be able to assess whether a device or system is suitable for reconditioning through physical inspection and test.
- Appendix A provides guidance on which components or assemblies of the electrical system are not suitable for reconditioning because they may pose a

hazard. Appendix B provides guidance on the components or assemblies are suitable for reconditioning.

- Reconditioning electrical equipment must utilize electrical product safety standards as they contain design aspects, testing criteria and manufacturing specifications to ensure a given product will function as intended. These requirements are established to deliver a usable and safe operating condition as a key component of intended product functionality.

Electrical Infrastructure and Worker Safety

Electrical equipment that is properly installed, tested, maintained, and operated will provide reliable power as well as protect the electrical infrastructure. The reconditioning of electrical equipment requires the electrical industry, in collaboration with manufacturers, to establish performance specifications and accepted industry standards to help ensure safe and reliable equipment that help protect our electrical infrastructure so workers and users can continue to benefit from a safe and effective electrical system. Reconditioning standards must include prescriptive actions and performance requirements that result in equipment that complies with standards that include but are not limited to CSA, IEC, IEEE, NEC, OSHA, NFPA 70E, NFPA 70B, NETA ATS, NETA MTS, and EASA AR100 for example. Qualified personnel must possess the knowledge of how to assess equipment condition, potential hazards, and specifications to accurately determine the suitability for reconditioning. A safe and reliable electrical infrastructure that can be safely maintained is dependent on compliance with manufacturers' instructions, qualified workers, proper maintenance, and accepted industry standards for reconditioning activities.

Electrical Equipment Reliability, Performance and Safety

Proper electrical equipment reconditioning provides a means to extend the life of electrical products as well as an opportunity to update installed equipment with the latest performance and safety features. Establishing well defined guidelines for those performing the reconditioning activity, based on original manufacturer's requirements, creates a solid foundation for the electrical industry and users. It is paramount that reconditioned electrical equipment be reliable in not only providing power, but also in safely performing its intended function as part of a safe operating electrical system. Understanding the environment, electrical load characteristics and historical maintenance performed on equipment being considered for reconditioning are all important parts of an assessment for reconditioning that can have a significant bearing on reliability, performance and safety. The electrical equipment manufacturer is the foremost authority on the design, performance and intended safe application of their product. Reconditioned electrical equipment must not compromise the reliability, performance, safe operation, or maintenance of the electrical system.

Integrity of Reconditioned Equipment

Reconditioned electrical equipment must comply with all applicable standards at the time the equipment was initially built as a minimum as well as the original manufacturer's performance requirements in accordance with the nameplate markings and ratings. Replacement parts shall meet the design criteria (form, fit, and function) for the device to perform its intended function and provide safe operation. Replacement parts shall not include counterfeit parts (i.e., parts that have been misrepresented to be an authorized item of the legally authorized source.) Equipment shall operate safely in its intended application after reconditioning occurs. Care must be taken to ensure specific operations such as timing, sequencing, control, transfer, etc. continue to function in the manner originally intended, unless changes are specified during the reconditioning process. The integrity of reconditioned electrical equipment must be established by documenting and demonstrating that component replacement and performance changes have not compromised the manufacturer's specifications and accepted industry standards.

Listing or Certification Marks

NEMA members manufacture products that are more than likely to be evaluated as part of a third party certification program to nationally recognized safety standards. These products can be marked with a listing or certification mark when the products are manufactured and shipped from the factory. The organization that reconditions the product is responsible for adhering to the guidelines from the issuing agency authorizing the mark to determine if the mark can remain on the product after reconditioning. The organization that reconditions is responsible for any actions necessary for the mark to remain on the product (analysis, testing, etc.). Otherwise, reconditioned electrical products must have their mark removed or obliterated to indicate that an evaluation of the reconditioning process has not been conducted by the original third party.

The organization that reconditions the product is additionally responsible for applying a mark or seal that indicates that the equipment has been reconditioned. This mark must provide traceability to the reconditioning organization in the event that it is necessary to determine the details of who reconditioned the equipment and the report on what was completed during this process.

There are a number of NEMA products that are not allowed to be reconditioned due to the inherent safety characteristics and requirements for those products to be evaluated according to a regular follow up program to evaluate the safety performance requirements as a condition of maintaining the listing or certification mark. This process cannot be applied to reconditioned electrical products since these are normally destructive tests and sample sets of reconditioned products are not possible due to limited quantities or ratings of specific devices.

UL Guidance on the UL Mark

When the manufacturer places the UL Mark on the product at the factory, it is their attestation that the product complies with the applicable requirements. Unless there is further oversight or review/inspection (field inspection) UL cannot ascertain that the

product continues to comply with all requirements should field repairs, modifications or component replacements be made to the product.

Obviously there is little control over what manufacturers will or can do to equipment which left the factory with a certification mark. UL has created rebuilt categories where the reconditioning of product is done in an organized consistent manner under the supervision of UL's FUS (Follow-Up Services) field representatives. In these cases the first action conducted with equipment being rebuilt is the removal of the initial certification mark (if provided). Upon completion of the reconditioning, in accordance with the surveillance document, the manufacturer is permitted to affix a mark which clearly identifies the product as reconditioned.

Cases where a reconditioner is instructed to NOT remove any certification mark will result in confusion. Clearly such equipment in the field, which has undergone modification or reconditioning, is ineligible to bear a mark which designates a compliance with a certification standard.

APPENDIX A

COMPONENTS OR ASSEMBLIES NOT SUITABLE FOR RECONDITIONING*

Adjustable speed drives
Arc fault circuit breakers
Ballasts
Busway (mylar wrapped)
Busway (powder coated)
Cable tray
Cast resin transformers
Components containing semiconductors and transistors
Control transformers
Dry type transformers
Electrical Connectors
Electrical submetering equipment
Electrical vehicle supply equipment
Enclosed switches
Fire detectors, smoke alarms, co detectors
Fire pump controllers
Flexible and extension cords
Flexible conduit
Ground fault circuit breakers
High performance wire and cable
Lighting controls
Liquid filled transformers
Low and medium voltage fuse holders
Low and medium voltage non-renewable fuses
Low voltage power circuit breaker electronic trip units
Luminaires
Meters (electromechanical, electronic or digital)
Meter sockets
Molded case circuit breakers
Non-Metallic conduit, tubing, raceways and fittings
Non-metallic surface raceways and fittings
Outlet and junction boxes
Overload relays
Pin and sleeve plugs receptacles and connectors
Power and control cable
Protective relays (electronic or digital)
Residential panel boards
Solid state contactors and starters
Solid state drives
Strut type channel raceway
Surface metal raceways and fittings
Surge protective devices
Transfer switches
Wire or cable
Wireway
Wiring devices

*The components or products listed above are not recommended for reconditioning, unless otherwise indicated by the original manufacturer.

APPENDIX B

COMPONENTS OR ASSEMBLIES WHICH MAY BE RECONDITIONED

Electromechanical protective relays, and current transformers
High voltage circuit breakers
Industrial and commercial panel boards
Low and medium voltage power circuit breakers
Low and medium voltage replaceable link fuses
Low voltage switchgear
Manual and magnetic controllers
Medium voltage switchgear
Metallic conduit, tubing, raceways and fittings
Motor control centers
Motors
Switchboards
Uninterruptible Power Supply Equipment

Public Comment No. 2210-NFPA 70-2018 [Global Input]

The Correlating Committee directs Panel 5 to review all references to Article 310 under their purview. Article 310 has been divided into Article 310,

Conductors for General Wiring, and Article 311, Medium Voltage Conductors and Cables for usability and clarity. Panel 5 shall appoint a task group

to review all necessary references to verify their accuracy and submit Public Comments where necessary. This action instructs Panel 5 to

submit a Public Comment(s) within the time frame required in the NEC schedule.

This action shall be considered as a public comment.

Additional Proposed Changes

File Name	Description	Approved
CN_270.pdf	CN_270	

Statement of Problem and Substantiation for Public Comment

NOTE: This Public Comment appeared as CC Note No. 270 in the First Draft Report.

The Correlating Committee directs Panel 5 to review all references to Article 310 under their purview. Article 310 has been divided into Article 310,

Conductors for General Wiring, and Article 311, Medium Voltage Conductors and Cables for usability and clarity. Panel 5 shall appoint a task group

to review all necessary references to verify their accuracy and submit Public Comments where necessary. This action instructs Panel 5 to

submit a Public Comment(s) within the time frame required in the NEC schedule.

This action shall be considered as a public comment.

Related Item

• Correlating Committee Note No. 270

Submitter Information Verification

Submitter Full Name: CC on NEC-AAC
Organization: NEC Correlating Committee
Street Address:
City:
State:
Zip:
Submittal Date: Fri Sep 07 13:52:07 EDT 2018
Committee: NEC-P05

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Correlating Committee Note No. 270-NFPA 70-2018 [Global Input]

Submitter Information Verification

Submitter Full Name: Sarah Caldwell
Committee:
Submittal Date: Fri May 11 17:54:55 EDT 2018

Committee Statement and Meeting Notes

Committee Statement: The Correlating Committee directs all panels to review all references to Article 310 under their purview. Article 310 has been divided into Article 310, Conductors for General Wiring, and Article 311, Medium Voltage Conductors and Cables for usability and clarity. Each panel shall appoint a task group to review all necessary references to verify their accuracy and submit Public Comments where necessary. This action instructs the referenced panels to submit a Public Comment(s) within the time frame required in the NEC schedule.

This action shall be considered as a public comment.

Ballot Results

This item has passed ballot

12 Eligible Voters
0 Not Returned
12 Affirmative All
0 Affirmative with Comments
0 Negative with Comments
0 Abstention

Affirmative All

Brunssen, James E.
Dressman, Kevin L.
Hickman, Palmer L.
Hittinger, David L.
Holub, Richard A.
Johnston, Michael J.
Kovacik, John R.
Manche, Alan
McDaniel, Roger D.
Pierce, James F.
Saporita, Vincent J.
Williams, David A.

Public Comment No. 2227-NFPA 70-2018 [Global Input]

The Correlating Committee directs Panel 5 to review all Articles, within their purview, that supplement or modify (90.3) GFCI requirements in 210.8 for correlation, clarity, usability and standardized format. A Correlating Committee Task Group will be appointed and will submit comments where necessary.

This action shall be considered as a public comment.

Additional Proposed Changes

File Name	Description	Approved
CN_152.pdf	CN_152	

Statement of Problem and Substantiation for Public Comment

NOTE: This Public Comment appeared as CC Note No. 152 in the First Draft Report.

The Correlating Committee directs Panel 5 to review all Articles, within their purview, that supplement or modify (90.3) GFCI requirements in 210.8 for correlation, clarity, usability and standardized format. A Correlating Committee Task Group will be appointed and will submit comments where necessary.

This action shall be considered as a public comment.

Related Item

• Correlating Committee Note No. 152

Submitter Information Verification

Submitter Full Name: CC on NEC-AAC
Organization: NEC Correlating Committee
Street Address:
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Submittal Date: Fri Sep 07 14:42:36 EDT 2018
Committee: NEC-P05

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Correlating Committee Note No. 152-NFPA 70-2018 [Global Input]

Submitter Information Verification

Submitter Full Name: Erik Hohengasser
Committee:
Submittal Date: Thu May 10 18:00:52 EDT 2018

Committee Statement

Committee Statement: The Correlating Committee directs each panel to review all Articles, within their purview, that supplement or modify (90.3) GFCI requirements in 210.8 for correlation, clarity, usability and standardized format. A Correlating Committee Task Group will be appointed and will submit comments where necessary.

This action shall be considered as a public comment.

Ballot Results

This item has passed ballot

12 Eligible Voters
0 Not Returned
12 Affirmative All
0 Affirmative with Comments
0 Negative with Comments
0 Abstention

Affirmative All

Brunssen, James E.
Dressman, Kevin L.
Hickman, Palmer L.
Hittinger, David L.
Holub, Richard A.
Johnston, Michael J.
Kovacik, John R.
Manche, Alan
McDaniel, Roger D.
Pierce, James F.
Saporita, Vincent J.
Williams, David A.

Public Comment No. 1247-NFPA 70-2018 [Definition: Bonding Jumper, Main.]

Bonding Jumper, Main.

The ~~connection between the grounded circuit conductor and the equipment grounding conductor, or the supply-side bonding jumper, or both, at the service or at a supply-side disconnect(s)~~ part of the effective ground fault current path that connects to the grounded conductor at the service . (CMP-5)

Statement of Problem and Substantiation for Public Comment

The current definition is technically incorrect in some situations. Many times, the main bonding jumper is a green screw that connects the neutral bar to the enclosure. Since the enclosure is not in 250.118 as an Equipment Grounding Conductor, the main bonding jumper is connecting the grounded conductor to the enclosure. The enclosure, in turn, is connected to the equipment grounding conductor. The enclosure may not be an equipment grounding conductor, but it is part of the effective ground fault current path.

Related Public Comments for This Document

Related Comment	Relationship
Public Comment No. 1301-NFPA 70-2018 [Definition: Bonding Jumper, System.]	

Related Item

• 3199-NFPA 70-2017

Submitter Information Verification

Submitter Full Name: Eric Stromberg
Organization: Los Alamos National Laboratory
Affiliation: Self
Street Address:
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Submittal Date: Fri Aug 24 14:38:01 EDT 2018
Committee: NEC-P05

Public Comment No. 1301-NFPA 70-2018 [Definition: Bonding Jumper, System.]

Bonding Jumper, System.

The ~~connection between the grounded circuit conductor and the supply-side bonding jumper, or the equipment grounding conductor, or both,~~ part of the effective ground fault current path that connects to the grounded conductor at a separately derived system. (CMP-5)

Statement of Problem and Substantiation for Public Comment

The current definition isn't entirely accurate. The system bonding jumper may not, in fact, connect to the supply side bonding jumper or to the equipment grounding conductor. The system bonding jumper may only connect to the enclosure which is, in turn, connected to the SSBJ or EGC. While the enlcosure, or terminal bar inside the enclosure, is not defined as an SSBJ or EGC, it is part of the effective ground fault current path. This is a companion comment to "Bonding Jumper, Main"

Related Public Comments for This Document

Related Comment	Relationship
Public Comment No. 1247-NFPA 70-2018 [Definition: Bonding Jumper, Main.]	parallel definitions. Consistency

Related Item

- 3200-NFPA 70-2017

Submitter Information Verification

Submitter Full Name: Eric Stromberg
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Submittal Date: Sun Aug 26 12:52:26 EDT 2018
Committee: NEC-P05

Public Comment No. 604-NFPA 70-2018 [Definition: Ground Fault.]

Ground Fault.

An unintentional, electrically conductive connection between ~~an~~ one or more ungrounded conductor(s) of an electrical circuit and the normally non–current-carrying conductors, metallic enclosures, metallic raceways, metallic equipment, or earth. (CMP-5)

Statement of Problem and Substantiation for Public Comment

Ground Fault definition as stated suggests that the fault always includes only one ungrounded conductor as opposed to the possibility of multiple ungrounded conductors .

Related Item

• PI 9

Submitter Information Verification

Submitter Full Name: Jimmy Guerrero
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Submittal Date: Mon Aug 13 17:59:24 EDT 2018
Committee: NEC-P05

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Public Comment No. 1245-NFPA 70-2018 [Definition: Ground-Fault Current Path.]

~~**Ground-Fault Current Path.**~~

~~An electrically conductive path from the point of a ground fault on a wiring system through normally non–current-carrying conductors, grounded conductors, equipment, or the earth to the electrical supply source. (CMP-5)~~

~~Informational Note: Examples of ground-fault current paths are any combination of equipment grounding conductors, metallic raceways, metallic cable sheaths, electrical equipment, and any other electrically conductive material such as metal, water, and gas piping; steel framing members; stucco mesh; metal ducting; reinforcing steel; shields of communications cables; grounded conductors; and the earth itself.~~

Statement of Problem and Substantiation for Public Comment

"Ground Fault Current Path" was found in two places of the Code. One in 610.61 and the other occurrences in 250.118. All of these occurrences have been changed to "effective ground fault current path." With these changes, "Ground Fault Current Path" is no longer in the Code and this definition is not needed anymore. The recommendation is for deletion.

Related Item

• 2159-NFPA 70-2017 • 2515-NFPA 70-2017 • 2516-NFPA 70-2017

Submitter Information Verification

Submitter Full Name: Eric Stromberg
Organization: Los Alamos National Laboratory
Affiliation: Self
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Submittal Date: Fri Aug 24 14:29:47 EDT 2018
Committee: NEC-P05

Public Comment No. 599-NFPA 70-2018 [Definition: Ground-Fault Current Path.]

Ground-Fault Current Path.

An electrically conductive path from the point of a ground fault on a wiring system through normally non–current-carrying conductors, equipment, grounded service conductors, ~~equipment,~~ or the earth to the electrical supply source. (CMP-5)

Informational Note: Examples of ground-fault current paths are any combination of equipment grounding conductors, metallic raceways, metallic cable sheaths, electrical equipment, and any other electrically conductive material such as metal, water, and gas piping; steel framing members; stucco mesh; metal ducting; reinforcing steel; shields of communications cables; grounded service conductors; and the earth itself.

Statement of Problem and Substantiation for Public Comment

While this Comment is generally editorial in nature, it is important to clarify that the grounded conductor that is intended to serve as a part of the ground-fault current path is the grounded service conductor as distinguished from other grounded conductors throughout the electrical distribution system.
The order of the components is revised for clarity.

Related Item

• FR-7599

Submitter Information Verification

Submitter Full Name: Phil Simmons
Organization: Simmons Electrical Services
Street Address:
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Submittal Date: Mon Aug 13 16:09:47 EDT 2018
Committee: NEC-P05

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Public Comment No. 1507-NFPA 70-2018 [Definition: Grounded Conductor.]

Grounded Conductor.

A system or circuit conductor that is intentionally grounded, other than an equipment grounding conductor . (CMP-5)

Statement of Problem and Substantiation for Public Comment

The response to PI 3071 stated that an EGC is not a circuit or system conductor. The terms "circuit conductor" and "system conductor" are not defined in the NEC. This lack of clarity has led to a number of enforcement discussions about connection and identification rules for EGCs and neutrals that could be avoided by adding the proposed language into the definition. Alternatively, an IN explaining that an EGC is not a grounded conductor would be helpful, or a definition of circuit and/or system conductor.

Related Item

• PI 3071

Submitter Information Verification

Submitter Full Name: Christel Hunter
Organization: Cerro Wire
Street Address:
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State:
Zip:
Submittal Date: Wed Aug 29 09:32:23 EDT 2018
Committee: NEC-P05

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Public Comment No. 372-NFPA 70-2018 [Definition: Grounding Conductor, Equipment (EGC).]

Grounding/Bonding Conductor, Equipment (EGC).

A conductive path(s) that ~~provides~~ is part of an effective ground-fault current path and connects normally non–current-carrying metal parts of equipment together and to the system grounded conductor or to the grounding electrode conductor, or both. (CMP-5)

Informational Note No. 1: It is recognized that the equipment grounding conductor also performs bonding.

Informational Note No. 2: See 250.118 for a list of acceptable equipment grounding conductors.

Statement of Problem and Substantiation for Public Comment

The effective ground-fault path is comprised of the following items, that are all titled 'Bonding,' except one...
Equipment grounding conductor.
Equipment Bonding Conductor (EBC)
Equipment Bonding Jumper (EBJ)
Main 'Bonding' Jumper (MBJ)
System 'Bonding' Jumper (SBJ)
Supply Side 'Bonding' Jumper (SSBJ)

Since 2008, Code Panel 5 has done an amazing job in helping clearify the use of the terms 'ground, grounding, grounded, bond, bonded, and bonding.' I have been teaching Bonding and Grounding for over 40 years and there is no one word that is less understood than the 'equipment grounding conductor.'

1. Adding '/Bonding' to the title will help the working electrician/industry understand that this term clearly serves 'bonding' as explained in Note 1 and 250.4(A)(2).
2. Adding '/Bonding' to the title will make the NEC just a little more user friendly.

Related Item

• FR-7602

Submitter Information Verification

Submitter Full Name: Mike Holt
Organization: Mike Holt Enterprises Inc
Street Address:
City:
State:
Zip:
Submittal Date: Sat Aug 04 09:46:31 EDT 2018
Committee: NEC-P05

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Public Comment No. 378-NFPA 70-2018 [Section No. 200.3]

200.3 Connection to Grounded System.

Grounded conductors of premises wiring systems shall be ~~electrically~~ connected to the supply system grounded conductor ~~to ensure a common, continuous grounded system. For the purpose of this section, *electrically connected* shall mean making a direct electrical connection capable of carrying current, as distinguished from induced currents.~~ in accordance with 250.24(A) for services and 250.30(A) for separately derived systems.

Exception: Listed interactive inverters identified for use in distributed resource generation systems such as photovoltaic and fuel cell power systems shall be permitted to be connected to premises wiring without a grounded conductor if the connected premises wiring or utility system includes a grounded conductor.

Statement of Problem and Substantiation for Public Comment

The NEC typically uses the term 'connected' without any I discussion the theory fo the connection. I suggest that we simply tell the user of the NEC exactly what is required by giving the user reference to the rules that address this issue.

Related Item

• FR-7614

Submitter Information Verification

Submitter Full Name: Mike Holt
Organization: Mike Holt Enterprises Inc
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Submittal Date: Sat Aug 04 11:45:33 EDT 2018
Committee: NEC-P05

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Public Comment No. 1483-NFPA 70-2018 [Section No. 200.6(A)]

(A) Sizes 6 AWG or Smaller.

An insulated grounded conductor of 6 AWG or smaller shall be identified by one of the following means:

(1) A continuous white outer finish.

(2) A continuous gray outer finish.

(3) Three continuous white or gray stripes along the conductor's entire length on other than green insulation.

(4) Wires that have their outer covering finished to show a white or gray color but have colored tracer threads in the braid identifying the source of manufacture.

(5) The grounded conductor of a mineral-insulated, metal-sheathed cable (Type MI) shall be identified at the time of installation by distinctive marking at its terminations.

(6) A single-conductor, sunlight-resistant, outdoor-rated cable used as a solidly grounded conductor in photovoltaic power systems, as permitted by 690.~~31~~ 41 , shall be identified at the time of installation by markings at terminations in accordance with 200.6(A)(1) through (A)(4).

(7) Fixture wire shall comply with the requirements for grounded conductor identification as specified in 402.8.

(8) For aerial cable, the identification shall be as above, or by means of a ridge located on the exterior of the cable so as to identify it.

Statement of Problem and Substantiation for Public Comment

The correct reference for grounded conductors in PV systems is 690.41 not 690.31

Related Item

• FR7624

Submitter Information Verification

Submitter Full Name: James Rogers
Organization: Towns Of Oak Bluffs, Tisbury,
Street Address:
City:
State:
Zip:
Submittal Date: Tue Aug 28 21:13:03 EDT 2018
Committee: NEC-P05

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Public Comment No. 841-NFPA 70-2018 [Section No. 200.6(A)]

(A) Sizes 6 AWG or Smaller.

An insulated grounded conductor of 6 AWG or smaller shall be identified by one of the following means:

(1) A continuous white outer finish.

(2) A continuous gray outer finish.

(3) Three continuous white or gray stripes along the conductor's entire length on other than green insulation.

(4) Wires that have their outer covering finished to show a white or gray color but have colored tracer threads in the braid identifying the source of manufacture.

(5) The grounded conductor of a mineral-insulated, metal-sheathed cable (Type MI) shall be identified at the time of installation by distinctive marking at its terminations.

(6) A single-conductor, sunlight-resistant, outdoor-rated cable used as a solidly grounded conductor in photovoltaic power systems, as permitted by 690.31, shall be identified at the time of installation by markings at terminations in accordance with 200.6(A)(1) through (A)(4).

(7) Fixture wire shall comply with the requirements for grounded conductor identification as specified in 402.8.

(8) For aerial cable, the identification shall be as above, or by means of a ridge located on the exterior of the cable so as to identify it.

Additional Proposed Changes

File Name	Description	Approved
CN_238.pdf	70_CN 238	

Statement of Problem and Substantiation for Public Comment

NOTE: This Public Comment appeared as CC Note No. 238 in the First Draft Report on First Revision No. 7624.

The Correlating Committee directs that this first revision be rewritten to comply with the NEC Style Manual. The section uses an inconsistent list format. Some list items are phrases, while others are complete sentences.

This action will be considered as a public comment.

Related Item

• FR 7624

Submitter Information Verification

Submitter Full Name: CC on NEC-AAC
Organization: NEC Correlating Committee
Street Address:
City:
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Submittal Date: Mon Aug 20 11:47:43 EDT 2018
Committee: NEC-P05

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Correlating Committee Note No. 238-NFPA 70-2018 [Section No. 200.6(A)]

Submitter Information Verification

Submitter Full Name: Sarah Caldwell
Committee:
Submittal Date: Fri May 11 16:13:33 EDT 2018

Committee Statement and Meeting Notes

Committee Statement: The Correlating Committee directs that this first revision be rewritten to comply with the NEC Style Manual. The section uses an inconsistent list format. Some list items are phrases, while others are complete sentences. This action will be considered as a public comment.

First Revision No. 7624-NFPA 70-2018 [Section No. 200.6(A)]

Ballot Results

This item has passed ballot

12 Eligible Voters
0 Not Returned
12 Affirmative All
0 Affirmative with Comments
0 Negative with Comments
0 Abstention

Affirmative All

Brunssen, James E.
Dressman, Kevin L.
Hickman, Palmer L.
Hittinger, David L.
Holub, Richard A.
Johnston, Michael J.
Kovacik, John R.
Manche, Alan
McDaniel, Roger D.
Pierce, James F.
Saporita, Vincent J.
Williams, David A.

Public Comment No. 281-NFPA 70-2018 [Section No. 200.6(E)]

(E) Grounded Conductors of Multiconductor Cables.

The insulated grounded ~~conductors~~ conductor(s) in a multiconductor cable shall be identified by a continuous white or gray outer finish or by three continuous white or gray stripes on other than green insulation along its entire length. For ~~cables~~ conductors that are 4 AWG or larger in cables , identification of the grounded conductor(s) shall be permitted to comply with 200.6(B). ~~Multiconductor~~ For multiconductor flat cable with conductors that are 4 AWG or larger, an external ridge shall be permitted to ~~employ an external ridge on~~ identify the grounded conductor.

Exception No. 1: ~~Where the conditions of maintenance and supervision ensure that only qualified persons service the installation, grounded conductors in multiconductor cables~~ A grounded conductor(s) that is in addition to that provided by the manufacturer shall be permitted to be permanently identified at their terminations at the time of installation ~~by a distinctive white marking or other equally effective means~~ in accordance with 200.6(A) or (B) .

Exception No. 2: The grounded conductor of a multiconductor varnished-cloth-insulated cable shall be permitted to be identified at its terminations at the time of installation by a distinctive white marking or other equally effective means.

Informational Note: The color gray may have been used in the past as an ungrounded conductor. Care should be taken when working on existing systems.

Statement of Problem and Substantiation for Public Comment

This Comment intends to make several improvements to the requirements in the Section as well as to Exception No. 1.
• The word “conductor” is revised to be both singular and plural.
• Revisions are made to improve the sentence structure in the second sentence. The cables are not 4 AWG. The rule intends to apply when the conductors in the cable are 4 AWG or larger.
• Revisions are made to the third sentence to clarify that an external ridge is permitted to be used to identify the grounded conductor that is 4 AWG or larger in multiconductor flat cable.
• Revisions are proposed for the first Exception to remove the unnecessary requirement that identification of the grounded conductor in multiconductor cable be performed by only qualified persons.
• No similar requirement can be found for identification of grounded or ungrounded conductors in 200.6(A) or in 200.6(B).
• No such requirement exists in 200.6(D) for reidentifying conductors of different systems that are installed in a raceway, cable, box, auxiliary gutter, or other type of enclosure.
• Section 200.7(C)(1), which covers the use of conductors in (multiconductor) cables with insulation that identifies them as grounded conductors, permits conductor insulations to be reidentified to indicate their use as a “hot” or ungrounded conductor. This reidentification of conductor insulation is permitted without a requirement for qualified persons in qualified occupancies.
• No such requirement exists in 210.5(C) for branch circuits
• Identification requirement for grounded conductors in feeders in 215.12 simply refers back to 200.6 without additional requirement. No requirement exists for such tasks to be performed by only qualified persons in qualifying facilities.
• General requirements for identification of conductors is found in 310.110. There is no requirement for identification to be performed by qualified persons.
Changes as proposed in the Comment need to be made to this rule is not in conflict with the many other identification requirements in the Code.

Related Item

• 2775

Submitter Information Verification

Submitter Full Name: Phil Simmons
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Submittal Date: Mon Jul 23 19:04:08 EDT 2018
Committee: NEC-P05

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Public Comment No. 2104-NFPA 70-2018 [Section No. 200.9]

200.9 Means of Identification of Terminals.

In devices or utilization equipment with polarized connections, identification of terminals to which a grounded conductor is to be connected shall be substantially white or silver in color. The identification of other terminals shall be of a readily distinguishable different color.

Exception: Where the conditions of maintenance and supervision ensure that only qualified persons service the installations, terminals for grounded conductors shall be permitted to be permanently identified at the time of installation by a distinctive white marking or other equally effective means.

Statement of Problem and Substantiation for Public Comment

It seems that words "or silver" should be added here to be consistent with the action taken in 200.10 based on PI 2658 and FR 7631.

Related Item

• Public Input No. 2658

Submitter Information Verification

Submitter Full Name: Paul Dobrowsky
Organization: Innovative Technology Services
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Submittal Date: Thu Aug 30 17:57:01 EDT 2018
Committee: NEC-P05

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Public Comment No. 2144-NFPA 70-2018 [Section No. 250.2]

250.2 Definition. The definition in this section shall apply only within this article.

Disconnect, Supply-Side.

~~As used in this article, a~~ A disconnecting means, other than a meter disconnect, that is connected to the serving utility and is on the supply-side of the service disconnecting means. The supply-side disconnect is used for connection of equipment not supplied by a service and is intended to constitute the main control and cutoff of the supply.

Informational Note: Examples of supply-side disconnects are solar, fuel cell, wind, energy storage, or interconnected power production system disconnecting means for equipment permitted to be connected ahead of the service disconnecting means in accordance with the connection requirements of 230.82.

Statement of Problem and Substantiation for Public Comment

The proposed language will provide clear direction to the code user and correlate with actions taken elsewhere in the code. The proposed language is based on recommendations submitted in the Public Input stage by a Correlating Committee Task Group.

Related Item

• PI 1207

Submitter Information Verification

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Submittal Date: Thu Aug 30 20:27:41 EDT 2018
Committee: NEC-P05

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Public Comment No. 851-NFPA 70-2018 [Section No. 250.2]

250.2 Definition.

Disconnect, Supply-Side.

As used in this article, a disconnecting means, other than a meter disconnect, that is connected to the serving utility and is on the supply-side of the service disconnecting means. The supply-side disconnect is used for connection of equipment not supplied by a service and is intended to constitute the main control and cutoff of the supply.

Informational Note: Examples of supply-side disconnects are solar, fuel cell, wind, energy storage, or interconnected power production system disconnecting means for equipment permitted to be connected ahead of the service disconnecting means in accordance with the connection requirements of 230.82.

Additional Proposed Changes

File Name	Description	Approved
CN_165.pdf	70_CN165	

Statement of Problem and Substantiation for Public Comment

NOTE: This Public Comment appeared as CC Note No. 165 in the First Draft Report on First Revision No. 9007.

The Correlating Committee directs the panel to revise the action on FR 9007 to correlate with other actions taken throughout the code with respect
to the application of definitions in the XXX.2 sections. This action will be considered as a public comment.

Related Item

• First Revision No. 9007

Submitter Information Verification

Submitter Full Name: CC on NEC-AAC
Organization: NEC Correlating Committee
Street Address:
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Submittal Date: Mon Aug 20 12:00:07 EDT 2018
Committee: NEC-P05

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Correlating Committee Note No. 165-NFPA 70-2018 [Detail]

Submitter Information Verification

Submitter Full Name: Sarah Caldwell
Committee:
Submittal Date: Fri May 11 09:35:22 EDT 2018

Committee Statement and Meeting Notes

Committee Statement: The Correlating Committee directs the panel to revise the action on FR 9007 to correlate with other actions taken throughout the code with respect to the application of definitions in the XXX.2 sections. This action will be considered as a public comment.

First Revision No. 9007-NFPA 70-2018 [Detail]

Ballot Results

This item has passed ballot

12 Eligible Voters
0 Not Returned
12 Affirmative All
0 Affirmative with Comments
0 Negative with Comments
0 Abstention

Affirmative All

Brunssen, James E.
Dressman, Kevin L.
Hickman, Palmer L.
Hittinger, David L.
Holub, Richard A.
Johnston, Michael J.
Kovacik, John R.
Manche, Alan
McDaniel, Roger D.
Pierce, James F.
Saporita, Vincent J.
Williams, David A.

Public Comment No. 2015-NFPA 70-2018 [Definition: Disconnect, Supply-Side.]

~~**Disconnect, Supply-Side.**~~

~~As used in this article, a disconnecting means, other than a meter disconnect, that is connected to the serving utility and is on the supply-side of the service disconnecting means. The supply-side disconnect is used for connection of equipment not supplied by a service and is intended to constitute the main control and cutoff of the supply.~~

~~Informational Note: Examples of supply-side disconnects are solar, fuel cell, wind, energy storage, or interconnected power production system disconnecting means for equipment permitted to be connected ahead of the service disconnecting means in accordance with the connection requirements of 230.82 .~~

Statement of Problem and Substantiation for Public Comment

The new definition in 250.2 should be deleted. The purview of CMP-5 is grounding and bonding and definitions for CMP-5 need to relate to terms used for grounding and bonding. If CMP-5 believes this term is needed then a public input should be made to the appropriate panel whose responsibility is disconnect for services or other sources such as CMP-10 or as a general definition in Article 100 under CMP-1.

Related Item

• FR 8196

Submitter Information Verification

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Committee: NEC-P05

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Public Comment No. 910-NFPA 70-2018 [Definition: Disconnect, Supply-Side.]

~~**Disconnect, Supply-Side.**~~

~~As used in this article, a disconnecting means, other than a meter disconnect, that is connected to the serving utility and is on the supply-side of the service disconnecting means. The supply-side disconnect is used for connection of equipment not supplied by a service and is intended to constitute the main control and cutoff of the supply.~~

~~Informational Note: Examples of supply-side disconnects are solar, fuel cell, wind, energy storage, or interconnected power production system disconnecting means for equipment permitted to be connected ahead of the service disconnecting means in accordance with the connection requirements of 230.82 .~~

Statement of Problem and Substantiation for Public Comment

Substantiation: The definition is unnecessary. No technical substantiation was provided to add this definition other than a new section has been added in Part II of Article 250, which is titled System Grounding. Bonding on the line side and load side of equipment or a disconnecting means is already covered in Part V of Article 250, where the bonding rules have traditionally been provided. Defining what a supply side disconnect is not necessary and adds confusion. Line side bonding happens in more types of equipment than just disconnects. See the substantiation to another comment submitted to Global FR 8198 that strongly recommends deletion of new Section 250.25.

Related Item

• FR 8196

Submitter Information Verification

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Committee: NEC-P05

Public Comment No. 125-NFPA 70-2018 [Section No. 250.3]

250.3 Application of Other Articles.

For other articles applying to particular cases of installation of conductors and equipment, grounding and bonding requirements are identified in Table 250.3 that are in addition to, or modifications of, those of this article.

Table 250.3 Additional Grounding and Bonding Requirements

Conductor/Equipment	Article	Section	
Agricultural buildings	-		547.9 and 547.10
Audio signal processing, amplification, and reproduction equipment	-		640.7
Branch circuits	-		210.5, 210.6, 406.3
Cablebus	-		370.9
Cable trays	392	392.60	
Capacitors	-		460.10, 460.27
Circuits and equipment operating at less than 50 volts	720	-	
Communications circuits	~~800~~ 805	-	
Community antenna television and radio distribution systems	-		820.93, 820.100, 820.103, 820.106
Conductors for general wiring	310	-	
Cranes and hoists	610	-	
Electrically driven or controlled irrigation machines	-		675.11(C), 675.12, 675.13, 675.14, 675.15
Electric signs and outline lighting	600	-	
Electrolytic cells	668	-	
Elevators, dumbwaiters, escalators, moving walks, wheelchair lifts, and stairway chairlifts	620	-	
Fixed electric heating equipment for pipelines and vessels	-		427.29, 427.48
Fixed outdoor electric deicing and snow-melting equipment	-		426.27
Flexible cords and cables	-		400.22, 400.23
Floating buildings	-		553.8, 553.10, 553.11
Grounding-type receptacles, adapters, cord connectors, and attachment plugs	-		406.9
Hazardous (classified) locations	500–517	-	
Health care facilities	517	-	
Induction and dielectric heating equipment	665	-	
Industrial machinery	670	-	
Information technology equipment	-		645.15
Intrinsically safe systems	-		504.50
Luminaires and lighting equipment	-		410.40, 410.42, 410.46, 410.155(B)
Luminaires, lampholders, and lamps	410	-	
Marinas and boatyards	-		555.15
Mobile homes and mobile home park	550	-	
Motion picture and television studios and similar locations	-		530.20, 530.64(B)
Motors, motor circuits, and controllers	430	-	
Natural and artificially made bodies of water	682	682.30, 682.31, 682.32, 682.33	
Network powered broadband communications circuits	-		830.93, 830.100, 830.106

Conductor/Equipment	Article	Section	
Optical fiber cables	-		770.100
Outlet, device, pull, and junction boxes; conduit bodies; and fittings	-		314.4, 314.25
Over 600 volts, nominal, underground wiring methods	-		300.50(C)
Panelboards	-		408.40
Pipe organs	650	-	
Radio and television equipment	810	-	
Receptacles and cord connectors	-		406.3
Recreational vehicles and recreational vehicle parks	551	-	
Services	230	-	
Solar photovoltaic systems	-		690.41, 690.42, 690.43, 690.45, 690.47
Swimming pools, fountains, and similar installations	680	-	
Switchboards and panelboards	-		408.3(D)
Switches	-		404.12
Theaters, audience areas of motion picture and television studios, and similar locations	-		520.81
Transformers and transformer vaults	-		450.10
Use and identification of grounded conductors	200	-	
X-ray equipment	660	517.78	

Statement of Problem and Substantiation for Public Comment

FR 7512 created a new general article, Article 800, for Chapter 8. The old Article 800 was renumbered to Article 805.

Related Item

• FR 7512

Submitter Information Verification

Submitter Full Name: Terry Peters
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Submittal Date: Sun Jul 01 09:15:18 EDT 2018
Committee: NEC-P05

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Public Comment No. 2132-NFPA 70-2018 [Section No. 250.6(D)]

(D) Limitations to Permissible Alterations.

Electronic equipment shall not be permitted to be operated on ac systems or branch circuits that are not connected to an equipment grounding conductor as required by this article. Currents that introduce ~~noise~~ electromagnetic interference or data errors in electronic equipment shall not be considered the objectionable currents addressed in this section.

Statement of Problem and Substantiation for Public Comment

Change the term "noise" to "electromagnetic interference" because it is a better understood term. This change will be consistent with Actions in Article 406 such as in 406.3(D).

Related Item

• PI 1508, FR 8257

Submitter Information Verification

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Submittal Date: Thu Aug 30 19:53:59 EDT 2018
Committee: NEC-P05

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Public Comment No. 878-NFPA 70-2018 [Section No. 250.6(D)]

(D) Limitations to Permissible Alterations.

Electronic equipment shall not be permitted to be operated on ac systems or branch circuits that are not connected to an equipment grounding conductor as required by this article. Currents that introduce noise or data errors in electronic equipment shall not be considered the objectionable currents addressed in this section.

Additional Proposed Changes

File Name	Description	Approved
CN_239.pdf	70_CN 239	

Statement of Problem and Substantiation for Public Comment

NOTE: This Public Comment appeared as CC Note No. 239 in the First Draft Report on First Revision No. 8107.

The Correlating Committee directs that the panel consider rewording the text of FR 8107 to improve clarity.

This action will be considered as a public comment.

Related Item

• FR 8107

Submitter Information Verification

Submitter Full Name: CC on NEC-AAC
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Submittal Date: Mon Aug 20 14:16:02 EDT 2018
Committee: NEC-P05

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Correlating Committee Note No. 239-NFPA 70-2018 [Section No. 250.6(D)]

Submitter Information Verification

Submitter Full Name: Sarah Caldwell
Committee:
Submittal Date: Fri May 11 16:14:33 EDT 2018

Committee Statement and Meeting Notes

Committee Statement: The Correlating Committee directs that the panel consider rewording the text of FR 8107 to improve clarity. This action will be considered as a public comment.

First Revision No. 8107-NFPA 70-2018 [Section No. 250.6(D)]

Ballot Results

This item has passed ballot

12 Eligible Voters
0 Not Returned
12 Affirmative All
0 Affirmative with Comments
0 Negative with Comments
0 Abstention

Affirmative All

Brunssen, James E.

Dressman, Kevin L.

Hickman, Palmer L.

Hittinger, David L.

Holub, Richard A.

Johnston, Michael J.

Kovacik, John R.

Manche, Alan

McDaniel, Roger D.

Pierce, James F.

Saporita, Vincent J.

Williams, David A.

Public Comment No. 2023-NFPA 70-2018 [Section No. 250.24]

250.24 Grounding and Bonding of Service-Supplied Alternating-Current Systems.

(A) Grounded System.

If an ac system operating at 1000 volts or less is grounded at any point, it shall comply with 250.24(A)(1) through (A)(3).

(1) Grounded Conductor Brought to Service Equipment.

A grounded conductor(s) shall be routed with the ungrounded conductors to each service disconnecting means. The grounded conductor(s) shall be connected to each disconnecting means grounded conductor(s) terminal or bus. The grounded conductor on a high impedance grounded neutral system shall be installed in accordance with 250.36 .

Exception: If two or more service disconnecting means are in a single assembly listed for use as service equipment, it shall be permitted to connect the grounded conductor(s) to the assembly common grounded conductor(s) terminal or bus. The assembly shall include a main bonding jumper for connecting the grounded conductor(s) to the assembly enclosure.

(a) *Sizing of Grounding Conductor.*

(2) The grounded service conductor(s) shall be sized not smaller than given in 250.102(C)(1) or (C)(2).

(3) The grounded conductor of a 3-phase, 3-wire delta service shall have an ampacity not less than that of the ungrounded conductors.

(d) *Load-Side Connections.* A grounded conductor shall not be connected to normally non–current-carrying metal parts of equipment, ground, or equipment grounding conductors on the load side of the service disconnecting means except as follows:

(5) Separately derived systems as permitted in 250.30

(6) Separate buildings or structures as permitted in 250.32

(7) Electric ranges and clothes dryers as permitted in 250.140

(8) Grounding of equipment as permitted in 250.142

Informational Note: See 310.10(H) for grounded conductors connected in parallel.

(2) Main Bonding Jumper.

For a solidly grounded system, an unspliced main bonding jumper shall be used to connect all of the following:

(1) The grounded service conductor to the equipment grounding conductor(s)

(2) The service-disconnect within the enclosure for each service disconnect

.

Exception No. 1: If more than one service disconnecting means is located in an assembly listed for use as service equipment, an unspliced main bonding jumper shall bond the grounded conductor(s) to the assembly enclosure.

Exception No. 2: Impedance grounded neutral systems shall be permitted to be connected as provided in 250.36 and 250.187 .

(3) Grounding Electrode Conductor.

~~A premises wiring system supplied by a solidly grounded ac service shall have the grounded service conductor connected to all of the following:~~

(1) ~~The grounding electrode system in accordance with Part III~~

(2) ~~The equipment grounding conductors~~

(3) ~~The service equipment enclosures~~

~~**(a)** Grounding Electrode Conductor Connection.~~

~~The grounding electrode conductor connection shall be made at any accessible point from the load end of the overhead service conductors, service drop, underground service conductors, or service lateral to, including the terminal or bus to which the grounded service conductor is connected at the service disconnecting means.~~

~~Informational Note: See definitions of *Service Conductors, Overhead; Service Conductors, Underground; Service Drop;* and *Service Lateral* in Article 100.~~

~~**(b)** Outdoor Transformer.~~

~~If the transformer supplying the service is located outside the building, at least one additional grounding connection shall be made from the grounded service conductor to a grounding electrode, either at the transformer or elsewhere outside the building.~~

~~**(c)** Dual-Fed Services.~~

~~For services that are dual fed (double ended) in a common enclosure or grouped together in separate enclosures and employing a secondary tie, a single grounding electrode conductor connection to the tie point of the grounded conductor(s) from each power source shall be permitted.~~

~~**(d)** Main Bonding Jumper as Wire or Busbar.~~

~~If the main bonding jumper specified in 250.28 is a wire or busbar and is installed from the grounded conductor terminal bar or bus to the equipment grounding terminal bar or bus in the service equipment, the grounding electrode conductor shall be permitted to be connected to the equipment grounding terminal, bar, or bus to which the main bonding jumper is connected.~~

~~**(B)** Ungrounded System Grounding Connections.~~

~~A premises wiring system that is supplied by an ac service that is ungrounded shall have, at each service, a grounding electrode conductor connected in accordance with both of the following:~~

(1) ~~To the grounding electrode(s) required by Part III of this article~~

(2) ~~To a metal enclosure of the service conductors at any accessible point from the load end of the overhead service conductors, service drop, underground service conductors, or service lateral to the service disconnecting means~~

Statement of Problem and Substantiation for Public Comment

Delete the proposed changes and revert back to the text of the 2017 NEC with any other technical changes from this cycle included, but leave the structure as before.

I understand the intent of the panel, and agree that with work some reorganization may improve clarity and usability. Unfortunately, what was created in the first draft creates many issues that cannot be easily fixed in the comment without potentially introducing new material.

Adding “bonding” to the title is not substantiated and does not belong in Part II sections. Figure 250.1 sets the structure and clearly shows that “bonding” from Part V in interlaced with Parts II, III, IV, VI, VII, VIII, and X. See comment substantiation for the FR on the Part II title change. While there are connection points identified in 250.24 for system grounding with specific bonding conductors, there are many other requirements for service bonding found in Part V and with the title change it could lead a reader to misapply the Code thinking that all the grounding and bonding is stated in 250.24.

The new structure of lists at 3 or 4 levels deep is hard to follow what the requirements are. In some cased there was clarity added, but in others not.

The title of the list item for sizing indicates sizing for the “grounding conductor” a term CMP-5 removed from the code in 2008. It appears the intent was for the “grounded conductor”.

The sizing of the grounded system conductor (neutral) now references 250.102(C)(1) and (2) but that section has not had any correlating change to the title from “Size -- Supply Side Bonding Jumper”.

Also, the similar grounded conductor (neutral) sizing requirements remaining in 250.30(A)(3) have not been changed and opens the question why the pointer in 250.24 but not 250.30.

The new requirements for the main bonding jumper, list item 2 indicate the main bonding jumper is to be connected to the service disconnect, within the service enclosure. Where in the service disconnect is the bonding jumper to be attached?

The deletion of the exception for the outdoor transformer not to have a grounding electrode conductor installed to the Xo terminal where there is a high impedance grounded system installed at the service creates a very hazardous condition where the high impedance grounded system in the building is now defeated by the connection required at the transformer outside.

As stated in the panel substantiation, there are no intended technical changes, just reorganization, but it appears some technical changes have inadvertently been made. If the panel believes the concept is good, I suggest reverting for one more cycle, as that does not impact users, and work on the reorganization in the time to submit the public inputs for the 2023 NEC.

Related Public Comments for This Document

Related Comment	Relationship
Public Comment No. 1706-NFPA 70-2018 [Part II.]	

Related Item

• FR 8061

Submitter Information Verification

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Committee: NEC-P05

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Public Comment No. 441-NFPA 70-2018 [Section No. 250.24]

250.24 Grounding and Bonding of Service-Supplied Alternating-Current Systems.

(A) Grounded System.

If an ac system operating at 1000 volts or less is grounded at any point, it shall comply with 250.24(A)(1) through (A)(3 9).

(1) Grounded Conductor Brought to Service Equipment.

A grounded conductor(s) shall be routed with the ungrounded conductors to each service disconnecting means. The grounded conductor(s) shall be connected to each disconnecting means grounded conductor(s) terminal or bus. The grounded conductor on a high impedance grounded neutral system shall be installed in accordance with 250.36.

Exception: If two or more service disconnecting means are in a single assembly listed for use as service equipment, it shall be permitted to connect the grounded conductor(s) to the assembly common grounded conductor(s) terminal or bus. The assembly shall include a main bonding jumper for connecting the grounded conductor(s) to the assembly enclosure.

(a) *Sizing of Grounding Conductor (2) Size of Grounded Conductor* .

(1) (a) The grounded service conductor(s) shall be sized not be not smaller than given in 250.102(C)(1) or (C)(2).

(2) (b) The grounded conductor of a 3-phase, 3-wire delta service shall have an ampacity not less than that of the ungrounded conductors.

(b) *(3) Load-Side Connections.* A grounded conductor shall not be connected to normally non–current-carrying metal parts of equipment, ground, or equipment grounding conductors on the load side of the service disconnecting means except as follows:

(3) (a) Separately derived systems as permitted in 250.30 (A)

(4) (b) Separate buildings or structures as permitted in 250.32 (B)(1) Exception No. 1

(5) (c) Electric ranges and clothes dryers as permitted in 250.140

(6) (d) Grounding of equipment as permitted in 250.142

Informational Note: See 310.10(H) for grounded conductors connected in parallel.

(2 4) Main Bonding Jumper.

For a solidly grounded system, an unspliced main bonding jumper shall be used to connect all of the following:The grounded service conductor to the following:

(1) (a) The equipment grounding conductor(s)

(2) (b) The service-disconnect disconnecting means within the enclosure for each service disconnect

.

Exception No. 1: If more than one service disconnecting means is located in an assembly listed for use as service equipment, an unspliced main bonding jumper shall bond connect the grounded conductor(s) to the assembly enclosure.

Exception No. 2: Impedance grounded neutral systems shall be permitted to be connected as provided in 250.36 and 250.187.

(3 5) Grounding Electrode Conductor.

A ~~premises wiring system supplied by a~~ solidly grounded ac service shall have the ~~grounded service~~ grounding electrode conductor connected to all of the following:

(1) (a) The grounded service conductor

(2) (b) The grounding electrode system in accordance with Part III

(3) (c) The equipment grounding conductors

(4) (d) The service equipment enclosures

(~~a~~ 6) Grounding Electrode Conductor Connection.

The grounding electrode conductor connection shall be made at any accessible point from the load end of the overhead service conductors, service drop, underground service conductors, or service lateral to, and including the terminal or bus to which the grounded service conductor is connected at the service disconnecting means.

Informational Note: See definitions of *Service Conductors, Overhead; Service Conductors, Underground; Service Drop;* and *Service Lateral* in Article 100.

(~~b~~ 7) Outdoor Transformer.

If the transformer supplying the service is located outside the building, at least one additional ~~grounding~~ connection shall be made from the grounded service conductor to a grounding electrode, either at the transformer or elsewhere outside the building.

(~~c~~ 8) Dual-Fed Services.

For services that are dual fed (double ended) in a common enclosure or grouped together in separate enclosures and employing a secondary tie, a single grounding electrode conductor connection to the tie point of the grounded conductor(s) from each power source shall be permitted.

(~~d~~ 9) Main Bonding Jumper as Wire or Busbar.

If the main bonding jumper specified in 250.28 is a wire or busbar and is installed from the grounded conductor terminal bar or bus to the equipment grounding terminal bar or bus in the service equipment, the grounding electrode conductor shall be permitted to be connected to the equipment grounding terminal, bar, or bus to which the main bonding jumper is connected.

(B) Ungrounded System Grounding Connections.

A premises wiring system that is supplied by an ac service that is ungrounded shall have, at each service, a grounding electrode conductor connected in accordance with both of the following:

(1) To the grounding electrode(s) required by Part III of this article

(2) To a metal enclosure of the service conductors at any accessible point from the load end of the overhead service conductors, service drop, underground service conductors, or service lateral to the service disconnecting means

Additional Proposed Changes

File Name	Description	Approved
250.24_for_Comment.pdf	250.24 for Comment	

Statement of Problem and Substantiation for Public Comment

Please see the attached PDF file rather than the TerraView version.
Changes are proposed to make editorial improvement, and, in other cases, correction.
Under (A), it is proposed that the major paragraphs be numbered so they will be pore prominent.
The title of (A)(2) is to correct the wording to refer to the noun "Size" and not a verb "Sizing" s that seems to be correct.
Under (4), the reference to applicable sections is improved.
Under (5), editorial corrections are made and the grounded service conductor is added to the list because it must be connected to the grounding electrode conductor.
Other recommendations are for numbering.

Related Item

• FR 8061

Submitter Information Verification

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Committee: NEC-P05

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250.24 Grounding and Bonding of Service-Supplied Alternating-Current Systems.

(A) Grounded System.
If an ac system operating at 1000 volts or less is grounded at any point, it shall comply with 250.24(A)(1) through (A)(9~~3~~).

(1) Grounded Conductor Brought to Service Equipment.
A grounded conductor(s) shall be routed with the ungrounded conductors to each service disconnecting means. The grounded conductor(s) shall be connected to each disconnecting means grounded conductor(s) terminal or bus. The grounded conductor on a high impedance grounded neutral system shall be installed in accordance with 250.36.

Exception: If two or more service disconnecting means are in a single assembly listed for use as service equipment, it shall be permitted to connect the grounded conductor(s) to the assembly common grounded conductor(s) terminal or bus. The assembly shall include a main bonding jumper for connecting the grounded conductor(s) to the assembly enclosure.

(2~~a~~) ~~Sizing~~ Size of ~~Grounding~~ Grounded Conductor.

(1) The grounded service conductor(s) shall be ~~sized~~ not smaller than given in 250.102(C)(1) or (C)(2).

(2) The grounded conductor of a 3-phase, 3-wire delta service shall have an ampacity not less than that of the ungrounded conductors.

(3~~b~~) Load-Side Connections. A grounded conductor shall not be connected to normally non–current-carrying metal parts of equipment, ground, or equipment grounding conductors on the load side of the service disconnecting means except as follows:

(a~~1~~) Separately derived systems as permitted in 250.30(A)

(b~~2~~) Separate buildings or structures as permitted in 250.32(B)(1) Exception No. 1

(c~~3~~) Electric ranges and clothes dryers as permitted in 250.140

(d~~4~~) Grounding of equipment as permitted in 250.142

Informational Note: See 310.10(H) for grounded conductors connected in parallel.

(4~~2~~) Main Bonding Jumper.

For a solidly grounded system, an unspliced main bonding jumper shall be used to connect ~~all of~~ the grounded service conductor to the following:

(a~~1~~) The ~~grounded service conductor to the~~ equipment grounding conductor(s)

(b~~2~~) The service-disconnecting means within the enclosure ~~for each service disconnect~~

.
Exception No. 1: If more than one service disconnecting means is located in an assembly listed for use as service equipment, an unspliced main bonding jumper shall ~~bond~~ connect the grounded conductor(s) to the assembly enclosure.

Exception No. 2: Impedance grounded neutral systems shall be permitted to be connected as provided in 250.36 and 250.187.

(5~~3~~) Grounding Electrode Conductor.
A ~~premises wiring system supplied by a~~ solidly grounded ac service shall have the ~~grounded service~~grounding electrode conductor connected to all of the following:

(a~~1~~) The grounded service conductor

(b) The grounding electrode system in accordance with Part III

(c2) The equipment grounding conductors

(d3) The service equipment enclosures

(6a) Grounding Electrode Conductor Connection.
The grounding electrode conductor connection shall be made at any accessible point from the load end of the overhead service conductors, service drop, underground service conductors, or service lateral to, and including the terminal or bus to which the grounded service conductor is connected at the service disconnecting means.
Informational Note: See definitions of *Service Conductors, Overhead; Service Conductors, Underground; Service Drop;* and *Service Lateral* in Article 100.

(7b) Outdoor Transformer.
If the transformer supplying the service is located outside the building, at least one additional grounding connection shall be made from the grounded service conductor to a grounding electrode, either at the transformer or elsewhere outside the building.

(8c) Dual-Fed Services.
For services that are dual fed (double ended) in a common enclosure or grouped together in separate enclosures and employing a secondary tie, a single grounding electrode conductor connection to the tie point of the grounded conductor(s) from each power source shall be permitted.

(9d) Main Bonding Jumper as Wire or Busbar.
If the main bonding jumper specified in 250.28 is a wire or busbar and is installed from the grounded conductor terminal bar or bus to the equipment grounding terminal bar or bus in the service equipment, the grounding electrode conductor shall be permitted to be connected to the equipment grounding terminal, bar, or bus to which the main bonding jumper is connected.

(B) Ungrounded System Grounding Connections.
A premises wiring system that is supplied by an ac service that is ungrounded shall have, at each service, a grounding electrode conductor connected in accordance with both of the following:

(1) To the grounding electrode(s) required by Part III of this article

(2) To a metal enclosure of the service conductors at any accessible point from the load end of the overhead service conductors, service drop, underground service conductors, or service lateral to the service disconnecting means

Public Comment No. 2110-NFPA 70-2018 [Section No. 250.24(A)(1)]

(1) Grounded Conductor Brought to Service Equipment.

A grounded conductor(s) shall be routed with the ungrounded conductors to each service disconnecting means. The grounded conductor(s) shall be connected to each disconnecting means grounded conductor(s) terminal or bus. The grounded conductor on a high impedance grounded neutral system shall be installed in accordance with 250.36.

Exception: If two or more service disconnecting means are in a single assembly listed for use as service equipment, it shall be permitted to connect the grounded conductor(s) to the assembly common grounded conductor(s) terminal or bus. The assembly shall include a main bonding jumper for connecting the grounded conductor(s) to the assembly enclosure.

(a) *Sizing ~~of Grounding Conductor~~ Grounded Conductors* .

(1) The grounded service conductor(s) shall be sized not smaller than given in 250.102(C)(1) or (C)(2).

(2) The grounded conductor of a 3-phase, 3-wire delta service shall have an ampacity not less than that of the ungrounded conductors.

(b) *Load-Side Connections.* A grounded conductor shall not be connected to normally non–current-carrying metal parts of equipment, ground, or equipment grounding conductors on the load side of the service disconnecting means except as follows:

(3) Separately derived systems as permitted in 250.30

(4) Separate buildings or structures as permitted in 250.32

(5) Electric ranges and clothes dryers as permitted in 250.140

(6) Grounding of equipment as permitted in 250.142

Informational Note: See 310.10(H) for grounded conductors connected in parallel.

Statement of Problem and Substantiation for Public Comment

It seems the term "Grounded Conductor" is consistent with the use of that term throughout this section. The word Conductor" was changed to "Conductors" because there are probably more than one grounded conductors in existence and to be consistent with the NEC Style Manual for using plural language.

Related Item

• FR 8061

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Public Comment No. 1111-NFPA 70-2018 [Section No. 250.25]

Delete Entire Section

250.25 Grounding and Bonding Supply-Side Disconnects.

A supply-side disconnect shall be grounded and bonded in accordance with 250.25(A) through (C).

(A) Bonding.

The normally non–current-carrying metal parts of equipment containing conductors from the supply-side disconnect to the serving utility shall be bonded together in accordance with 250.92.

(B) Grounded AC Systems.

A supply-side disconnect, supplied by an ac system operating at 1000 volts or less that is grounded at any point, shall comply with 250.25(B)(1) through (4).

(1) Main Bonding Jumper.

An unspliced main bonding jumper shall be used to connect the equipment grounding conductor(s) and the supply-side disconnect enclosure to the grounded conductor(s) within each supply-side disconnect enclosure in accordance with 250.28.

Exception: If more than one supply-side disconnect is located in an assembly listed for use as service equipment, an unspliced main bonding jumper shall bond the grounded conductor(s) to the assembly enclosure.

(2) Grounded Conductor.

The grounded conductor(s) shall be installed and routed with the ungrounded supply conductors from the point of connection to the serving utility to the supply-side disconnect and terminated to the supply-side disconnects grounded conductor(s) terminal or bus. The grounded conductor(s) shall comply with 250.25(B)(2)(a), (B)(2)(b), or (B)(2)(c).

(a) *Sizing.*

The grounded conductor(s) shall be sized in accordance with 250.25(B)(2)(a)(1), (2), or (3).

(1) Single Raceway or Cable.

The grounded conductor shall not be smaller than specified in 250.102(C)(1) based upon the ungrounded supply conductors.

(2) Parallel Conductors in Two or More Raceways or Cables.

If ungrounded supply conductors are installed in parallel in two or more raceways or cables, the grounded conductor shall also be installed in parallel. The size of the grounded conductor in each raceway or cable shall be based on the total circular mil area of the parallel ungrounded conductors in the raceway or cable, as required in 250.25(B)(2)(a)(1), but shall not be smaller than 1/0 AWG.

Informational Note to (2): See 310.10(H) for grounded conductors connected in parallel.

(3) Delta Connected Supply-Side Disconnect.

The grounded conductor of a 3-phase, 3-wire delta supply-side disconnect shall have an ampacity not less than that of the ungrounded conductors.

(b) *Load-Side Grounding Connections.*

A grounded conductor shall not be connected to normally non–current-carrying metal parts of equipment, be connected to equipment grounding conductor(s), or be reconnected to ground on the load side of the supply-side disconnect except as otherwise permitted in this article.

Informational Note: See 250.30 for separately derived systems, 250.32 for connections at separate buildings or structures, and 250.142 for use of the grounded circuit conductor for grounding equipment.

(c) *High Impedance.*

The grounded conductor for a high impedance system supplying a supply-side disconnect shall be installed in accordance with 250.36.

(3) Grounding Electrode Connection.

The grounded conductor supplying a supply-side disconnect shall be connected to the grounding electrode conductor(s) in accordance with 250.25(B)(3)(a) through (B)(3)(c).

(a) *General.*

The grounding electrode conductor connection shall be made either within the supply-side disconnect or at any accessible point up to the supply conductor’s connection to the serving utility.

(b) *Main Bonding Jumper as Wire or Busbar.*

If the supply-side disconnect bonding jumper is a wire or busbar and is installed from the grounded conductor terminal bar or bus to the equipment grounding terminal bar or bus in the supply-side disconnect, the grounding electrode conductor shall be permitted to be connected to the equipment grounding terminal, bar, or bus to which the supply-side disconnect bonding jumper is connected.

(c) *Outdoor Transformer.*

If the transformer supplying the supply-side disconnect is located outside the building, at least one additional grounding connection shall be made from the grounded supply conductor to a grounding electrode, either at the transformer or elsewhere outside the building.

(4) Grounding Electrode Conductor.

A grounding electrode conductor shall be used to connect the equipment grounding conductor(s), the supply-side disconnect enclosure, and the grounded conductor(s) to the grounding electrode(s) required by Part III of this article. The grounding electrode conductor shall be sized in accordance with 250.66 based upon the ungrounded supply conductors.

(C) Ungrounded AC Systems.

A supply-side disconnect that is supplied by an ungrounded ac system operating at 1000 volts or less shall comply with 250.25(C)(1) and (C)(2).

(1) Grounding Electrode Connection.

The supply-side disconnect shall be connected to the grounding electrode(s) as required by Part III of this article. The grounding electrode conductor connection shall be made either within the supply-side disconnect or at any accessible point up to the supply conductor's connection to the serving utility. If the grounding electrode connection is made at any point outside of the supply-side disconnect, the grounding electrode conductor shall be connected to the supply-side disconnect by a supply-side bonding jumper.

(2) Grounding Electrode Conductor.

A grounding electrode conductor shall be used to connect the equipment grounding conductor(s), the supply-side disconnect enclosure, and the supply-side bonding jumper(s) to the grounding electrode(s) required by Part III of this article. The grounding electrode conductor shall be sized in accordance with 250.66 based upon the ungrounded supply conductors.

Statement of Problem and Substantiation for Public Comment

Delete proposed new section 250.25. Bonding is covered in Part V of Article 250. Adding this new section alters the structure of this chapter and will lead to confusion. If the intent is to add language about supply / line-side bonding, it should be accomplished by changing the language in the appropriate parts of Part V. As an instructor of electrical trainees, my goal is to help educate future electricians on code structure so that they may properly and efficiently apply it when they are on the job now and as journey level installers in the future. Adding the new section will set an example for future code cycles that it is acceptable to add sections in questionable places - something that ultimately weakens the code and makes it harder to use. Deleting the proposed new section 250.25 and re-wording parts of Part V in Article 250 would be a much more logical choice to accomplish the addition of language regarding line/supply - side bonding.

Related Item

• Global FR 8198

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Public Comment No. 1966-NFPA 70-2018 [Section No. 250.25]

250.25 Grounding and Bonding Supply-Side Disconnects.

A supply-side disconnect shall be grounded and bonded in accordance with 250.25(A) through (C).

(A) Bonding.

The normally non–current-carrying metal parts of equipment containing conductors from the supply-side disconnect to the serving utility shall be bonded together in accordance with 250.92 .

(B) Grounded AC Systems.

A supply-side disconnect, supplied by an ac system operating at 1000 volts or less that is grounded at any point, shall comply with 250.25(B)(1) through (4).

(1) Main Bonding Jumper.

An unspliced main bonding jumper shall be used to connect the equipment grounding conductor(s) and the supply-side disconnect enclosure to the grounded conductor(s) within each supply-side disconnect enclosure in accordance with 250.28 .

Exception: If more than one supply-side disconnect is located in an assembly listed for use as service equipment, an unspliced main bonding jumper shall bond the grounded conductor(s) to the assembly enclosure.

(2) Grounded Conductor.

The grounded conductor(s) shall be installed and routed with the ungrounded supply conductors from the point of connection to the serving utility to the supply-side disconnect and terminated to the supply-side disconnects grounded conductor(s) terminal or bus. The grounded conductor(s) shall comply with 250.25(B)(2)(a), (B)(2)(b), or (B)(2)(c).

(a) *Sizing.*

The grounded conductor(s) shall be sized in accordance with 250.25(B)(2)(a)(1), (2), or (3).

(1) Single Raceway or Cable.

The grounded conductor shall not be smaller than specified in 250.102(C)(1) based upon the ungrounded supply conductors.

(2) Parallel Conductors in Two or More Raceways or Cables.

If ungrounded supply conductors are installed in parallel in two or more raceways or cables, the grounded conductor shall also be installed in parallel. The size of the grounded conductor in each raceway or cable shall be based on the total circular mil area of the parallel ungrounded conductors in the raceway or cable, as required in 250.25(B)(2)(a)(1), but shall not be smaller than 1/0 AWG.

Informational Note to (2): See 310.10(H) for grounded conductors connected in parallel.

(3) Delta Connected Supply-Side Disconnect.

The grounded conductor of a 3-phase, 3-wire delta supply-side disconnect shall have an ampacity not less than that of the ungrounded conductors.

(b) *Load-Side Grounding Connections.*

A grounded conductor shall not be connected to normally non–current-carrying metal parts of equipment, be connected to equipment grounding conductor(s), or be reconnected to ground on the load side of the supply-side disconnect except as otherwise permitted in this article.

Informational Note: See 250.30 for separately derived systems, 250.32 for connections at separate buildings or structures, and 250.142 for use of the grounded circuit conductor for grounding equipment.

(c) *High Impedance.*

The grounded conductor for a high impedance system supplying a supply-side disconnect shall be installed in accordance with 250.36 .

~~**(3)** Grounding Electrode Connection.~~

~~The grounded conductor supplying a supply-side disconnect shall be connected to the grounding electrode conductor(s) in accordance with 250.25(B)(3)(a) through (B)(3)(c).~~

(1) ~~*General.*~~

~~The grounding electrode conductor connection shall be made either within the supply-side disconnect or at any accessible point up to the supply conductor's connection to the serving utility.~~

(2) ~~*Main Bonding Jumper as Wire or Busbar.*~~

~~If the supply-side disconnect bonding jumper is a wire or busbar and is installed from the grounded conductor terminal bar or bus to the equipment grounding terminal bar or bus in the supply-side disconnect, the grounding electrode conductor shall be permitted to be connected to the equipment grounding terminal, bar, or bus to which the supply-side disconnect bonding jumper is connected.~~

(3) ~~*Outdoor Transformer.*~~

~~If the transformer supplying the supply-side disconnect is located outside the building, at least one additional grounding connection shall be made from the grounded supply conductor to a grounding electrode, either at the transformer or elsewhere outside the building.~~

~~**(4)** Grounding Electrode Conductor.~~

~~A grounding electrode conductor shall be used to connect the equipment grounding conductor(s), the supply-side disconnect enclosure, and the grounded conductor(s) to the grounding electrode(s) required by Part III of this article. The grounding electrode conductor shall be sized in accordance with 250.66 based upon the ungrounded supply conductors.~~

~~**(C)** Ungrounded AC Systems.~~

~~A supply-side disconnect that is supplied by an ungrounded ac system operating at 1000 volts or less shall comply with 250.25(C)(1) and (C)(2).~~

~~**(1)** Grounding Electrode Connection.~~

~~The supply-side disconnect shall be connected to the grounding electrode(s) as required by Part III of this article. The grounding electrode conductor connection shall be made either within the supply-side disconnect or at any accessible point up to the supply conductor's connection to the serving utility. If the grounding electrode connection is made at any point outside of the supply-side disconnect, the grounding electrode conductor shall be connected to the supply-side disconnect by a supply-side bonding jumper.~~

~~**(2)** Grounding Electrode Conductor.~~

~~A grounding electrode conductor shall be used to connect the equipment grounding conductor(s), the supply-side disconnect enclosure, and the supply-side bonding jumper(s) to the grounding electrode(s) required by Part III of this article. The grounding electrode conductor shall be sized in accordance with 250.66 based upon the ungrounded supply conductors.~~

Statement of Problem and Substantiation for Public Comment

There were numerous PIs submitted to CMP4, CMP5, and CMP10 on this issue and the foundational concern was Interconnected Electric Power Production Sources (Article 705) connected on the supply side of the service disconnect. It is obvious that a tremendous amount of work went in to producing the language in 250.25. However, there was a plea for CMP4, CMP5, and CMP10 to work together on this issue. That coordination never happened so now is the time to fix the overlapping requirements that have been developed in Articles 230, 250, and 705. The set of requirements belong in Article 705 and references should be made to 705.11 if related to power production sources (non-utility). CMP4 is more than willing to coordinate with CMP5 to get this correct. It does, however, require coordination.

Lastly, the concept of having a new section 250.25 is highly debatable. The physics of the issues, related to fault clearing, is identical for many applications, so it is hard to believe that a whole new section is the answer to the confusion on this issue. Perhaps better pointers to the appropriate sections is a better solution.

Related Item

• FR 8608

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Public Comment No. 2057-NFPA 70-2018 [Section No. 250.25]

250.

~~25 Grounding and Bonding Supply-Side Disconnects.~~

~~A supply-side disconnect shall be grounded and bonded in accordance with 250.25(A) through (C).~~

~~**(A)** Bonding.~~

~~The normally non–current-carrying metal parts of equipment containing conductors from the supply-side disconnect to the serving utility shall be bonded together in accordance with 250.92 .~~

~~**(B)** Grounded AC Systems.~~

~~A supply-side disconnect, supplied by an ac system operating at 1000 volts or less that is grounded at any point, shall comply with 250.25(B)(1) through (4).~~

~~**(1)** Main Bonding Jumper.~~

~~An unspliced main bonding jumper shall be used to connect the equipment grounding conductor(s) and the supply-side disconnect enclosure to the grounded conductor(s) within each supply-side disconnect enclosure in accordance with 250.28 .~~

~~*Exception: If more than one supply-side disconnect is located in an assembly listed for use as service equipment, an unspliced main bonding jumper shall bond the grounded conductor(s) to the assembly enclosure.*~~

(2) Grounded Conductor.

The grounded conductor(s) shall be installed and routed with the ungrounded supply conductors from the point of connection to the serving utility to the supply-side disconnect and terminated to the supply-side disconnects grounded conductor(s) terminal or bus. The grounded conductor(s) shall comply with 250.25(B)(2)(a), (B)(2)(b), or (B)(2)(c).

(a) *Sizing.*

The grounded conductor(s) shall be sized in accordance with 250.25(B)(2)(a)(1), (2), or (3).

(1) Single Raceway or Cable.

The grounded conductor shall not be smaller than specified in 250.102(C)(1) based upon the ungrounded supply conductors.

(2) Parallel Conductors in Two or More Raceways or Cables.

If ungrounded supply conductors are installed in parallel in two or more raceways or cables, the grounded conductor shall also be installed in parallel. The size of the grounded conductor in each raceway or cable shall be based on the total circular mil area of the parallel ungrounded conductors in the raceway or cable, as required in 250.25(B)(2)(a)(1), but shall not be smaller than 1/0 AWG.

Informational Note to (2): See 310.10(H) for grounded conductors connected in parallel.

(3) Delta Connected Supply-Side Disconnect.

The grounded conductor of a 3-phase, 3-wire delta supply-side disconnect shall have an ampacity not less than that of the ungrounded conductors.

(b) *Load-Side Grounding Connections.*

A grounded conductor shall not be connected to normally non–current-carrying metal parts of equipment, be connected to equipment grounding conductor(s), or be reconnected to ground on the load side of the supply-side disconnect except as otherwise permitted in this article.

Informational Note: See 250.30 for separately derived systems, 250.32 for connections at separate buildings or structures, and 250.142 for use of the grounded circuit conductor for grounding equipment.

(c) *High Impedance.*

The grounded conductor for a high impedance system supplying a supply-side disconnect shall be installed in accordance with 250.36 .

(3) Grounding Electrode Connection.

The grounded conductor supplying a supply-side disconnect shall be connected to the grounding electrode conductor(s) in accordance with 250.25(B)(3)(a) through (B)(3)(c).

(1) *General.*

The grounding electrode conductor connection shall be made either within the supply-side disconnect or at any accessible point up to the supply conductor's connection to the serving utility.

(2) *Main Bonding Jumper as Wire or Busbar.*

If the supply-side disconnect bonding jumper is a wire or busbar and is installed from the grounded conductor terminal bar or bus to the equipment grounding terminal bar or bus in the supply-side disconnect, the grounding electrode conductor shall be permitted to be connected to the equipment grounding terminal, bar, or bus to which the supply-side disconnect bonding jumper is connected.

(3) *Outdoor Transformer.*

If the transformer supplying the supply-side disconnect is located outside the building, at least one additional grounding connection shall be made from the grounded supply conductor to a grounding electrode, either at the transformer or elsewhere outside the building.

(4) Grounding Electrode Conductor.

A grounding electrode conductor shall be used to connect the equipment grounding conductor(s), the supply-side disconnect enclosure, and the grounded conductor(s) to the grounding electrode(s) required by Part III of this article. The grounding electrode conductor shall be sized in accordance with 250.66 based upon the ungrounded supply conductors.

~~**(C)** Ungrounded AC Systems.~~

~~A supply-side disconnect that is supplied by an ungrounded ac system operating at 1000 volts or less shall comply with 250.25(C)(1) and (C)(2).~~

~~**(1)** Grounding Electrode Connection.~~

~~The supply-side disconnect shall be connected to the grounding electrode(s) as required by Part III of this article. The grounding electrode conductor connection shall be made either within the supply-side disconnect or at any accessible point up to the supply conductor's connection to the serving utility. If the grounding electrode connection is made at any point outside of the supply-side disconnect, the grounding electrode conductor shall be connected to the supply-side disconnect by a supply-side bonding jumper.~~

~~**(2)** Grounding Electrode Conductor.~~

~~A grounding electrode conductor shall be used to connect the equipment grounding conductor(s), the supply-side disconnect enclosure, and the supply-side bonding jumper(s) to the grounding electrode(s) required by Part III of this article. The grounding electrode conductor shall be sized in accordance with 250.66 based upon the ungrounded supply conductors.~~

25 Grounding Systems Permitted to be Connected on the Supply Side of the Service.

The grounding of systems connected on the supply side of the service disconnect, as permitted in 230.82, that are in enclosures separate from the service equipment enclosure shall comply with (A) or (B).

(A) Grounded System . If the utility supply system is grounded, the grounding of systems permitted to be connected on the supply side of the service disconnect and are installed in one or more separate enclosures from the service equipment enclosure shall comply with the requirements of 250.24(A) through (D)

(B) Ungrounded System . If the utility supply system is ungrounded, the grounding of systems permitted to be connected on the supply side of the service disconnect and are installed in one or more separate enclosures from the service equipment enclosure shall comply with the requirements of 250.24(E).

Additional Proposed Changes

File Name	Description	Approved
250.25_Comment.docx	250.25 revised text clean copy.	

Statement of Problem and Substantiation for Public Comment

The proposed text for 250.25 should be deleted and replaced with the proposed text. This does not introduce any new material as all the requirements are existing and this new section points to that text.

The proposed text creates a lot of redundancy in requirements where the the same thing can be more easily accomplished by pointing the user to where the desired requirements are already in Article 250. The issue is where equipment is installed and connected on the line side of the service disconnect. If that equipment is installed within the service equipment enclosure, the system grounding requirements are generally already covered by the existing 250.24. When the equipment is installed in another enclosure, identified as not being "service", then requirements need to be provided to direct the user on how to properly accomplish the installation. Since the idea is to generally treat the installation like a service, but not call it a service, then pointing the installer and AHJ to the same requirements as used for the service equipment, provides the direction and a consistent installation. The proposed text accomplishes this, but opens a number of issue whereby any future changes could cause inconsistency to be introduced between these installations.

Please see the related comment on adding the term bonding to the title of the First Draft text for 250.25.

Related Public Comments for This Document

Related Comment	Relationship
Public Comment No. 1706-NFPA 70-2018 [Part II.]	

Related Item

• Global FR 8198

Submitter Information Verification

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Submittal Date: Thu Aug 30 15:48:00 EDT 2018
Committee: NEC-P05

250.25 Clean copy proposed text

250.25 Grounding Systems Permitted to be Connected on the Supply Side of the Service.

The grounding of systems connected on the supply side of the service disconnect, as permitted in 230.82, that are in enclosures separate from the service equipment enclosure shall comply with (A) or (B).

(A) Grounded System. If the utility supply system is grounded, the grounding of systems permitted to be connected on the supply side of the service disconnect and are installed in one or more separate enclosures from the service equipment enclosure shall comply with the requirements of 250.24(A) through (D)

(B) Ungrounded System. If the utility supply system is ungrounded, the grounding of systems permitted to be connected on the supply side of the service disconnect and are installed in one or more separate enclosures from the service equipment enclosure shall comply with the requirements of 250.24(E).

Public Comment No. 2126-NFPA 70-2018 [Section No. 250.25]

250.25 Grounding and Bonding Supply-Side Disconnects.

A supply-side disconnect shall be grounded and bonded in accordance with 250.25(A) through (C).

(A) Bonding.

The normally non–current-carrying metal parts of equipment containing conductors from the supply-side disconnect to the serving utility shall be bonded together in accordance with 250.92 .

(B) Grounded AC Systems.

A supply-side disconnect, supplied by an ac system operating at 1000 volts or less that is grounded at any point, shall comply with 250.25(B)(1) through (4).

(1) Main Bonding Jumper.

An unspliced main bonding jumper shall be used to connect the equipment grounding conductor(s) and the supply-side disconnect enclosure to the grounded conductor(s) within each supply-side disconnect enclosure in accordance with 250.28 .

Exception: If more than one supply-side disconnect is located in an assembly listed for use as service equipment, an unspliced main bonding jumper shall bond the grounded conductor(s) to the assembly enclosure.

(2) Grounded Conductor.

The grounded conductor(s) shall be installed and routed with the ungrounded supply conductors from the point of connection to the serving utility to the supply-side disconnect and terminated to the supply-side disconnects grounded conductor(s) terminal or bus. The grounded conductor(s) shall comply with 250.25(B)(2)(a), (B)(2)(b), or (B)(2)(c).

(a) *Sizing.*

The grounded conductor(s) shall be sized in accordance with 250.25(B)(2)(a)(1), (2), or (3).

(1) Single Raceway or Cable.

The grounded conductor shall not be smaller than specified in 250.102(C)(1) based upon the ungrounded supply conductors.

(2) Parallel Conductors in Two or More Raceways or Cables.

If ungrounded supply conductors are installed in parallel in two or more raceways or cables, the grounded conductor shall also be installed in parallel. The size of the grounded conductor in each raceway or cable shall be based on the total circular mil area of the parallel ungrounded conductors in the raceway or cable, as required in 250.25(B)(2)(a)(1), but shall not be smaller than 1/0 AWG.

Informational Note to (2): See 310.10(H) for grounded conductors connected in parallel.

(3) Delta Connected Supply-Side Disconnect.

The grounded conductor of a 3-phase, 3-wire delta supply-side disconnect shall have an ampacity not less than that of the ungrounded conductors.

(b) *Load-Side Grounding Connections.*

A grounded conductor shall not be connected to normally non–current-carrying metal parts of equipment, be connected to equipment grounding conductor(s), or be reconnected to ground on the load side of the supply-side disconnect except as otherwise permitted in this article.

Informational Note: See 250.30 for separately derived systems, 250.32 for connections at separate buildings or structures, and 250.142 for use of the grounded circuit conductor for grounding equipment.

(c) *High Impedance.*

The grounded conductor for a high impedance system supplying a supply-side disconnect shall be installed in accordance with 250.36 .

~~**(3)** Grounding Electrode Connection.~~

~~The grounded conductor supplying a supply-side disconnect shall be connected to the grounding electrode conductor(s) in accordance with 250.25(B)(3)(a) through (B)(3)(c).~~

(1) ~~*General.*~~

~~The grounding electrode conductor connection shall be made either within the supply-side disconnect or at any accessible point up to the supply conductor's connection to the serving utility.~~

(2) ~~*Main Bonding Jumper as Wire or Busbar.*~~

~~If the supply-side disconnect bonding jumper is a wire or busbar and is installed from the grounded conductor terminal bar or bus to the equipment grounding terminal bar or bus in the supply-side disconnect, the grounding electrode conductor shall be permitted to be connected to the equipment grounding terminal, bar, or bus to which the supply-side disconnect bonding jumper is connected.~~

(3) ~~*Outdoor Transformer.*~~

~~If the transformer supplying the supply-side disconnect is located outside the building, at least one additional grounding connection shall be made from the grounded supply conductor to a grounding electrode, either at the transformer or elsewhere outside the building.~~

~~**(4)** Grounding Electrode Conductor.~~

~~A grounding electrode conductor shall be used to connect the equipment grounding conductor(s), the supply-side disconnect enclosure, and the grounded conductor(s) to the grounding electrode(s) required by Part III of this article. The grounding electrode conductor shall be sized in accordance with 250.66 based upon the ungrounded supply conductors.~~

~~**(C)** Ungrounded AC Systems.~~

~~A supply-side disconnect that is supplied by an ungrounded ac system operating at 1000 volts or less shall comply with 250.25(C)(1) and (C)(2).~~

~~**(1)** Grounding Electrode Connection.~~

~~The supply-side disconnect shall be connected to the grounding electrode(s) as required by Part III of this article. The grounding electrode conductor connection shall be made either within the supply-side disconnect or at any accessible point up to the supply conductor's connection to the serving utility. If the grounding electrode connection is made at any point outside of the supply-side disconnect, the grounding electrode conductor shall be connected to the supply-side disconnect by a supply-side bonding jumper.~~

~~**(2)** Grounding Electrode Conductor.~~

~~A grounding electrode conductor shall be used to connect the equipment grounding conductor(s), the supply-side disconnect enclosure, and the supply-side bonding jumper(s) to the grounding electrode(s) required by Part III of this article. The grounding electrode conductor shall be sized in accordance with 250.66 based upon the ungrounded supply conductors.~~

Statement of Problem and Substantiation for Public Comment

The majority of these systems would fall under the category of 250.25(A) and (C) and the main issue would be to provide adequate bonding of metal enclosures and raceways in the event of a fault condition. The need to take a grounding electrode conductor to these disconnects is unnecessary as the service equipment already is required to have a grounding electrode system and as long as this equipment is properly bonded that would be the reference to ground. CMP 4 has developed a new Section 705.11 that addresses many of these issues I would ask CMP 5 to establish a task group with CMP 4 to review both Sections. Having information in bots Sections that is conflicting in some ways is not good for the users of the NEC. The requirements for sizing grounded conductors already exist in Article 250 and there is no need to repeat them here. In addition most of these systems do not utilize grounded conductors they use grounding conductors for a reference only to facilitate ground fault protective devices.

Related Item

• FR8198

Submitter Information Verification

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Committee: NEC-P05

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Public Comment No. 911-NFPA 70-2018 [Section No. 250.25]

250.25 Grounding and Bonding Supply-Side Disconnects.

A supply-side disconnect shall be grounded and bonded in accordance with 250.25(A) through (C).

(A) Bonding.

The normally non–current-carrying metal parts of equipment containing conductors from the supply-side disconnect to the serving utility shall be bonded together in accordance with 250.92 .

(B) Grounded AC Systems.

A supply-side disconnect, supplied by an ac system operating at 1000 volts or less that is grounded at any point, shall comply with 250.25(B)(1) through (4).

(1) Main Bonding Jumper.

An unspliced main bonding jumper shall be used to connect the equipment grounding conductor(s) and the supply-side disconnect enclosure to the grounded conductor(s) within each supply-side disconnect enclosure in accordance with 250.28 .

Exception: If more than one supply-side disconnect is located in an assembly listed for use as service equipment, an unspliced main bonding jumper shall bond the grounded conductor(s) to the assembly enclosure.

(2) Grounded Conductor.

The grounded conductor(s) shall be installed and routed with the ungrounded supply conductors from the point of connection to the serving utility to the supply-side disconnect and terminated to the supply-side disconnects grounded conductor(s) terminal or bus. The grounded conductor(s) shall comply with 250.25(B)(2)(a), (B)(2)(b), or (B)(2)(c).

(a) *Sizing.*

The grounded conductor(s) shall be sized in accordance with 250.25(B)(2)(a)(1), (2), or (3).

(1) Single Raceway or Cable.

The grounded conductor shall not be smaller than specified in 250.102(C)(1) based upon the ungrounded supply conductors.

(2) Parallel Conductors in Two or More Raceways or Cables.

If ungrounded supply conductors are installed in parallel in two or more raceways or cables, the grounded conductor shall also be installed in parallel. The size of the grounded conductor in each raceway or cable shall be based on the total circular mil area of the parallel ungrounded conductors in the raceway or cable, as required in 250.25(B)(2)(a)(1), but shall not be smaller than 1/0 AWG.

Informational Note to (2): See 310.10(H) for grounded conductors connected in parallel.

(3) Delta Connected Supply-Side Disconnect.

The grounded conductor of a 3-phase, 3-wire delta supply-side disconnect shall have an ampacity not less than that of the ungrounded conductors.

(b) *Load-Side Grounding Connections.*

A grounded conductor shall not be connected to normally non–current-carrying metal parts of equipment, be connected to equipment grounding conductor(s), or be reconnected to ground on the load side of the supply-side disconnect except as otherwise permitted in this article.

Informational Note: See 250.30 for separately derived systems, 250.32 for connections at separate buildings or structures, and 250.142 for use of the grounded circuit conductor for grounding equipment.

(c) *High Impedance.*

The grounded conductor for a high impedance system supplying a supply-side disconnect shall be installed in accordance with 250.36 .

~~**(3)** Grounding Electrode Connection.~~

~~The grounded conductor supplying a supply-side disconnect shall be connected to the grounding electrode conductor(s) in accordance with 250.25(B)(3)(a) through (B)(3)(c).~~

(1) ~~*General.*~~

~~The grounding electrode conductor connection shall be made either within the supply-side disconnect or at any accessible point up to the supply conductor's connection to the serving utility.~~

(2) ~~*Main Bonding Jumper as Wire or Busbar.*~~

~~If the supply-side disconnect bonding jumper is a wire or busbar and is installed from the grounded conductor terminal bar or bus to the equipment grounding terminal bar or bus in the supply-side disconnect, the grounding electrode conductor shall be permitted to be connected to the equipment grounding terminal, bar, or bus to which the supply-side disconnect bonding jumper is connected.~~

(3) ~~*Outdoor Transformer.*~~

~~If the transformer supplying the supply-side disconnect is located outside the building, at least one additional grounding connection shall be made from the grounded supply conductor to a grounding electrode, either at the transformer or elsewhere outside the building.~~

~~**(4)** Grounding Electrode Conductor.~~

~~A grounding electrode conductor shall be used to connect the equipment grounding conductor(s), the supply-side disconnect enclosure, and the grounded conductor(s) to the grounding electrode(s) required by Part III of this article. The grounding electrode conductor shall be sized in accordance with 250.66 based upon the ungrounded supply conductors.~~

~~**(C)** Ungrounded AC Systems.~~

~~A supply-side disconnect that is supplied by an ungrounded ac system operating at 1000 volts or less shall comply with 250.25(C)(1) and (C)(2).~~

~~**(1)** Grounding Electrode Connection.~~

~~The supply-side disconnect shall be connected to the grounding electrode(s) as required by Part III of this article. The grounding electrode conductor connection shall be made either within the supply-side disconnect or at any accessible point up to the supply conductor's connection to the serving utility. If the grounding electrode connection is made at any point outside of the supply-side disconnect, the grounding electrode conductor shall be connected to the supply-side disconnect by a supply-side bonding jumper.~~

~~**(2)** Grounding Electrode Conductor.~~

~~A grounding electrode conductor shall be used to connect the equipment grounding conductor(s), the supply-side disconnect enclosure, and the supply-side bonding jumper(s) to the grounding electrode(s) required by Part III of this article. The grounding electrode conductor shall be sized in accordance with 250.66 based upon the ungrounded supply conductors.~~

Statement of Problem and Substantiation for Public Comment

Substantiation: The new section is not needed, and as revised, Part II and the rest of Article 250 have been impacted by mixing grounding and bonding rules within a Part of the Article primarily designated for, and titled, "System Grounding." This FR is flawed fundamentally for a few basic reasons. Part V of Article 250 already contains the bonding requirements and slight adjustments to the titles (and text in some instances) of Sections 250.92, 250.102, 250.28 and so forth will address any concerns about the Code being silent on bonding requirements on the supply side of service equipment and bonding and on the line side of other equipment fed by other than a utility service. It would be far better for user, and in the interest in maintaining the current Article 250 structure, to make slight revisions in those sections to clarify how the requirements apply in a line side (supply side) bonding arrangement whether on the line side of the service or on the line side of another source.

Changing the title of Part II of Article 250 from "System Grounding" to "System Grounding and Bonding" is unsubstantiated and affects the structure of the Article and the users of the Code. Part V of the article is where the bonding rules have traditionally been located. Part III of Article 250 contains the rules for grounding electrode conductors. It makes no sense at all to start populating Part II of the Article with rules related to grounding electrode conductors when they already exist in Part III. Part II includes primarily system grounding rules (to ground or not to ground systems) The bonding rules contained in Section 250.30 are example of where bonding rules are needed because they are specific to achieving grounding for separately derived systems. The roadmap conveyed in Figure 250.1 is an example of the relationship between the function of bonding as it appears in Part II, for separately derived systems.

Delete the new section 250.25 and return the title of Part II to its 2017 title. Also delete the associated definition in 250.2 as it is unnecessary. It is strongly suggested that slight revisions in 250.28, 250.92 250.102 be made to accomplish the same goal without adding this confusion and additional cross referencing for users. Heading down this road is not only going to result in increased confusion, it sets a new precedent that it's okay to include duplicate requirements for both grounding and bonding in any part of Article 250, especially seeing that rules already exist that can and currently are being applied to bonding installations on the supply side of service equipment and on the supply side of equipment fed by sources other than a service. It is strongly recommended that this action be reversed, and the appropriate revisions take place in rules that are already in place and can apply to supply side bonding arrangements. Maintain the current structure of Article 250 and build upon that arrangement without introducing this scrambling of rules.

Related Item

• FR 8198

Submitter Information Verification

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Submittal Date: Mon Aug 20 15:43:09 EDT 2018
Committee: NEC-P05

Public Comment No. 948-NFPA 70-2018 [New Section after 250.25(B)(1)]

TITLE OF NEW CONTENT

250.24(B)(2) Main Bonding Jumper at Non-Service Meter Disconnect Enclosure(s), Supply Side

This may become 250.25 _ _ with others new code proposals.

Where a meter disconnect switch is installed on the line side of a meter, as allowed by 230.82(3), an un-spliced main bonding jumper shall be used to connect the equipment grounding conductor(s) and the meter disconnecting means enclosure to the grounded conductor within the enclosure in accordance with 250.28.

Statement of Problem and Substantiation for Public Comment

Utility companies sometimes require a cold sequence disconnecting means, allowable by 230.82(3). Attention is needed for the grounding of NEC service and utility company required disconnects where installed together.

This new code entry follows the direction of 250.24(B) and 250.24(C). While 230.82(3) has made it abundantly clear that this disconnect is not a service disconnecting means, the intent of the code is clear on this needed connection and it needs to be pointed out in this proposed new code location. 250.24(B) and 250.24(C) mandate that the equipment grounding conductor(s), grounded conductor, enclosure connection be made for 'each disconnect'. This connection is necessary due to the disconnecting means physical and electrical location in the service and fault current characteristics that come with it.

Presently, the AHJ could enforce this connection one way or the other with little ground to stand on without a clear passage in the NEC, meaning if the main bonding jumper shouldn't be installed in a line side cold sequence meter disconnect, the NEC should provide that new language in 2020, if I'm found to be incorrect with this proposal.

Related Item

• Cold Sequence Disconnect Main Bonding Jumper

Submitter Information Verification

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Committee: NEC-P05

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Public Comment No. 947-NFPA 70-2018 [Section No. 250.25(B)(1)]

(1) Main Bonding Jumper at Service Disconnect Enclosure(s) .

An unspliced main bonding jumper shall be used to connect the equipment grounding conductor(s) and the supply-side disconnect enclosure to the grounded conductor(s) within each supply-side disconnect enclosure in accordance with 250.28.

Exception: If more than one supply-side disconnect is located in an assembly listed for use as service equipment, an unspliced main bonding jumper shall bond the grounded conductor(s) to the assembly enclosure.

Statement of Problem and Substantiation for Public Comment

Adding to this title differentiates and prepares for the next code entry which is the new Main Bonding Jumper at Non-Service Meter Disconnect Enclosure(s), Supply Side

Related Item

• Main Bonding Jumper

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Public Comment No. 462-NFPA 70-2018 [Section No. 250.28(D)(2)]

(2) Main Bonding Jumper for Service with More Than One Enclosure.

If a service consists of ~~more than a single enclosure as permitted in~~ ~~230.71(A)~~ ~~, or if there are~~ two or more ~~supply~~ enclosures including service disconnecting means or supply -side disconnect ~~enclosures~~ enclosure , the main bonding jumper for each enclosure shall be sized in accordance with 250.28(D)(1) based on the largest ungrounded service or supply conductor serving that enclosure.

Statement of Problem and Substantiation for Public Comment

This Comment is intended to make editorial improvements to the revisions that added "two or more supply-side disconnects". It seems that each supply-side disconnecting means must have a main bonding jumper not only when there are two or more of them.

Related Item

• FR 8118

Submitter Information Verification

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Committee: NEC-P05

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Public Comment No. 2113-NFPA 70-2018 [Section No. 250.30(A)(2)]

(2) Supply-Side Bonding Jumper.

If the source of a separately derived system and the ~~source of the~~ first disconnecting means are located in separate enclosures, a supply-side bonding jumper shall be installed with the circuit conductors from the source enclosure to the first disconnecting means enclosure. A supply-side bonding jumper shall not be required to be larger than the derived ungrounded conductors. The supply-side bonding jumper shall be permitted to be of nonflexible metal raceway type or of the wire or bus type as follows:

(1) A supply-side bonding jumper of the wire type shall comply with 250.102(C), based on the size of the derived ungrounded conductors.

(2) A supply-side bonding jumper of the bus type shall have a cross-sectional area not smaller than a supply-side bonding jumper of the wire type as determined in 250.102(C).

Exception: A supply-side bonding jumper shall not be required between enclosures for installations made in compliance with 250.30(A)(1), Exception No. 2.

Statement of Problem and Substantiation for Public Comment

It seems like the word "source" is used too many times and it is confusing which source it is referring to. Deleting this instance seems to make the wording clearer.

Related Item

• FR 8097

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Committee: NEC-P05

Public Comment No. 466-NFPA 70-2018 [Section No. 250.30(A)(2)]

(2) Supply-Side Bonding Jumper.

If the source of a separately derived system and the ~~source of the~~ first disconnecting means are located in separate enclosures, a supply-side bonding jumper shall be installed with the circuit conductors from the source enclosure to the first disconnecting means enclosure. A supply-side bonding jumper shall not be required to be larger than the derived ungrounded conductors. The supply-side bonding jumper shall be permitted to be of nonflexible metal raceway type or of the wire or bus type as follows:

(1) A supply-side bonding jumper of the wire type shall comply with 250.102(C), based on the size of the derived ungrounded conductors.

(2) A supply-side bonding jumper of the bus type shall have a cross-sectional area not smaller than a supply-side bonding jumper of the wire type as determined in 250.102(C).

Exception: A supply-side bonding jumper shall not be required between enclosures for installations made in compliance with 250.30(A)(1), Exception No. 2.

Statement of Problem and Substantiation for Public Comment

Adding the second "the source of" creates a confusing statement. The source, such as a generator or transformer will typically be in a different enclosure than the first disconnecting means. If the first disconnecting means is a part of a generator, for example, a supply-side bonding jumper is not provided or required.

Related Item

• FR 8097

Submitter Information Verification

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Public Comment No. 950-NFPA 70-2018 [Section No. 250.30(A)(6)]

(6) Grounding Electrode Conductor, Multiple Separately Derived Systems.

A common grounding electrode conductor for multiple separately derived systems shall be permitted. If installed, the common grounding electrode conductor shall be used to connect the grounded conductor of each separately derived system to the grounding electrode as specified in 250.30(A)(4). A grounding electrode conductor tap shall then be installed from each separately derived system to the common grounding electrode conductor. Each tap conductor shall connect the grounded conductor of the separately derived system to the common grounding electrode conductor. This connection shall be made at the same point on the separately derived system where the system bonding jumper is connected.

Exception No. 1: If the system bonding jumper specified in 250.30(A)(1) is a wire or busbar, it shall be permitted to connect the grounding electrode conductor tap to the equipment grounding terminal, bar, or bus, provided the equipment grounding terminal, bar, or bus is of sufficient size for the separately derived system.

Exception No. 2: A grounding electrode conductor shall not be required for a system that supplies a Class 1, Class 2, or Class 3 circuit and is derived from a transformer rated not more than 1000 volt-amperes, provided the system grounded conductor is bonded to the transformer frame or enclosure by a jumper sized in accordance with 250.30(A)(1), Exception No. 3, and the transformer frame or enclosure is grounded by one of the means specified in 250.134.

Exception No. 3: If the source of a separately derived system is located within equipment listed and identified as suitable for use as service equipment, the grounding electrode conductor from the service or feeder equipment to the grounding electrode shall be permitted as the grounding electrode conductor for the separately derived system, if the grounding electrode conductor is of sufficient size for the separately derived system. If the equipment grounding bus internal to the equipment is not smaller than the required grounding electrode conductor for the separately derived system, the grounding electrode connection for the separately derived system shall be permitted to be made to the bus.

(a) *Common Grounding Electrode Conductor.* The common grounding electrode conductor shall be permitted to be one of the following:

(2) A conductor of the wire type not smaller than 3/0 AWG copper or 250 kcmil aluminum

(3) A metal water pipe that complies with 250.68(C)(1)

(4) The metal structural frame of the building or structure that complies with 250.68(C)(2) or is connected to the grounding electrode system by a conductor not smaller than 3/0 AWG copper or 250 kcmil aluminum

(e) *Tap Conductor Size.* Each tap conductor shall be sized in accordance with 250.66 based on the derived ungrounded conductors of the separately derived system it serves.

Exception to (a)(1) and (b): If the only electrodes that are present are of the types in 250.66(A), (B), or (C), the size of the common grounding electrode conductor shall not be required to be larger than the largest conductor required by 250.66(A), (B), or (C) for the type of electrode that is present.

(f) *Connections.* All tap connections to the common grounding electrode conductor shall be made at an accessible location by one of the following methods:

(7) A connector listed as grounding and bonding equipment made for the purpose of connecting and bonding multiple service equipment or separately derived system's grounding electrode conductors .

(8) Listed connections to aluminum or copper busbars not smaller than 6 mm thick × 50 mm wide (**1**⁄**4** in. thick × 2 in. wide) and of sufficient length to accommodate the number of terminations necessary for the installation. If aluminum busbars are used, the installation shall also comply with 250.64(A) .

(9) The exothermic welding process.

Tap conductors shall be connected to the common grounding electrode conductor in such a manner that the common grounding electrode conductor remains without a splice or joint.

Statement of Problem and Substantiation for Public Comment

I believe, this should be elaborated on as proposed. A 250.94 Intersystem Bond Terminal Device meets the description as stated in the 2017 NEC other than its' title "Bonding for Communication Systems". The new language helps prevent a misapplication of an intersystem bonding terminal device.

Related Item

- 250.30A6c1

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Committee: NEC-P05

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Public Comment No. 405-NFPA 70-2018 [Section No. 250.32(A)]

(A) Grounding.

(1) Grounding Electrode System .

~~A building(s) or structure(s) supplied by a feeder(s) or branch circuit(s) shall have a grounding electrode or grounding electrode system installed in accordance with Part III of Article 250. Where there is no existing grounding electrode, the grounding electrode(s) required in 250.50 shall be installed.~~

~~*Exception:* A grounding electrode shall not be required where only a single branch circuit, including a multiwire branch circuit, supplies the building or structure and the branch circuit includes an equipment grounding conductor for grounding the normally non-current-carrying metal parts of equipment.~~

~~(2) Grounding Electrode Conductor. A grounding electrode conductor A grounding electrode conductor shall be used to connect the equipment grounding conductors to the grounding electrode(s) , where required in 250.32(A)(1) .~~

Statement of Problem and Substantiation for Public Comment

Add text to actually require a grounding electrode conductor and how to size it. Right now all that is required is a grounding electrode system. This text was extracted from 250.24(D) for services and 250.30 for separately derived systems.

Related Item

• FR-7759

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Committee: NEC-P05

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Public Comment No. 1790-NFPA 70-2018 [Section No. 250.32(B)(1)]

(1) Supplied by a Feeder or Branch Circuit.

An equipment grounding conductor, as described in 250.118, shall be run with the supply conductors and be connected to the building or structure disconnecting means and bonded to the grounding electrode ~~(s)~~ conductor. The equipment grounding conductor shall be used for grounding or bonding of equipment, structures, or frames required to be grounded or bonded. The equipment grounding conductor shall be sized in accordance with 250.122. Any installed grounded conductor shall not be connected to the equipment grounding conductor or to the grounding electrode(s).

Exception No. 1: For installations made in compliance with previous editions of this Code that permitted such connection, the grounded conductor run with the supply to the building or structure shall be permitted to serve as the ground-fault return path if all of the following requirements continue to be met:

(1) An equipment grounding conductor is not run with the supply to the building or structure.

(2) There are no continuous metallic paths bonded to the grounding system in each building or structure involved.

(3) Ground-fault protection of equipment has not been installed on the supply side of the feeder(s).

If the grounded conductor is used for grounding in accordance with the provision of this exception, the size of the grounded conductor shall not be smaller than the larger of either of the following:

(1) That required by 220.61

(2) That required by 250.122

Exception No. 2: If system bonding jumpers are installed in accordance with 250.30(A)(1), Exception No. 2, the feeder grounded circuit conductor at the building or structure served shall be connected to the equipment grounding conductors, grounding electrode conductor, and the enclosure for the first disconnecting means.

Statement of Problem and Substantiation for Public Comment

I agree with the Panel statement that the grounding electrode conductor is often connected to the equipment grounding terminal bar. The present wording of this section could be interpreted as requiring the equipment grounding conductor to function as the grounding electrode conductor. The Panel should reconsider the proposed change to this section, as it clarifies that the equipment grounding conductor is not functioning as a grounding electrode conductor.

Related Item

• Public Input No. 4117

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Committee: NEC-P05

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Public Comment No. 288-NFPA 70-2018 [Section No. 250.34(B)]

(B) Vehicle-Mounted and Trailer-Mounted Generators.

The frame of a vehicle or trailer shall not be required to be connected to a grounding electrode as defined in 250.52 for a system supplied by a generator located on this vehicle or trailer under all of the following conditions:

(1) The frame of the generator is bonded to the vehicle or trailer frame.

(2) The generator supplies only equipment located on the vehicle or trailer; cord-and-plug-connected equipment through receptacles mounted on the vehicle; or both equipment located on the vehicle or trailer and cord-and-plug-connected equipment through receptacles mounted on the vehicle, trailer, or on the generator. or receptacles mounted remotely from the generator that supply portable equipment as specified in Article 530.6.

(3) The normally non–current-carrying metal parts of equipment and the equipment grounding conductor terminals of the receptacles are connected to the generator frame.

Statement of Problem and Substantiation for Public Comment

The motion picture industry frequently utilizes portable lighting equipment for temporary use. This equipment is monitored by professionals while energized, the voltage is under 150 volts to ground. The generator may change locations several times within a single day. The ground return path to the source (generator) is via an equipment grounding conductor. When parked on concrete, temporary earth connection can be problematic. When parked in an isolated field, earth connection is not necessary for safety. If lighting equipment is plugged directly into a receptacle located "on" the generator, the generator is not required to be connected to the earth. A receptacle located 100 feet away (or 200 or 300) and cabled directly back to the generator, is equally safe.

Related Item

• Article 530

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Public Comment No. 371-NFPA 70-2018 [Section No. 250.34(C)]

(C) Grounded Conductor Bonding.

A system conductor that is required to be grounded by 250.26 shall be connected to the generator frame ~~where the~~ under all of the following conditions:

(1) if the generator is a component of a separately derived system.

(2) if a grounding-type receptacle(s) is mounted on the generator or is supplied by the generator

(3) if a receptacle mounted on the generator or is supplied by the generator has ground-fault circuit interrupter protection

Informational Note: For grounding portable generators supplying fixed wiring systems, see 250.30.

Additional Proposed Changes

File Name	Description	Approved
445-20_GFCI_Unbonded.jpg	Unbonded generator	
445-20_GFCI_Unbonded-2.jpg	GFCI Receptacles from unbonded generator	

Statement of Problem and Substantiation for Public Comment

This section is really in need of revision for safety. In the NEC, Article 250 IS expected to provide the general rules for grounding and bonding for safety. See the Scope of Article 250 in 250.1 as well as 90.3. Several other articles refer to Article 250 for the general rules for safety.
One of those references is 406.4(B). This section generally requires the installation of grounding-type receptacles. This section refers to 250.34 for portable generators. 250.34(A)(2) and (B)(3) requires that the equipment grounding conductor terminals of receptacles are connected to the generator frame. This connection is completely ineffective if the neutral of the generator is not bonded to the frame because there is no path for ground-fault current to flow. See the supplied drawing that illustrates this point. It seems like a subterfuge to install a grounding type receptacle on a portable or vehicle-mounted generator when it is not grounded or bonded in an effective manner.
A similar though perhaps a more serious violation of electrical safety principles is permitting GFCI receptacles to be installed on portable-type generators without a bonded neutral. In this configuration, the GFCI device cannot function. Once again, a false sense of having GFCI protection is created when the neutral is unbonded. This also violates the requirements in UL 943, the UL Standard on GFCI protection. It requires that GFCI devices be used only on systems with one conductor grounded. For portable and vehicle-mounted generaters, the equivalent is bonding the neutral conductor to the frame of the generator. Without such connection, there is no complete circuit and GFCI protection cannot function. Once again, please refer to the drawings submitted with this Comment.
Accept this Comment to provide the level of electrical safety that is needed.

Related Item

• PI 2824

Submitter Information Verification

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Committee: NEC-P05

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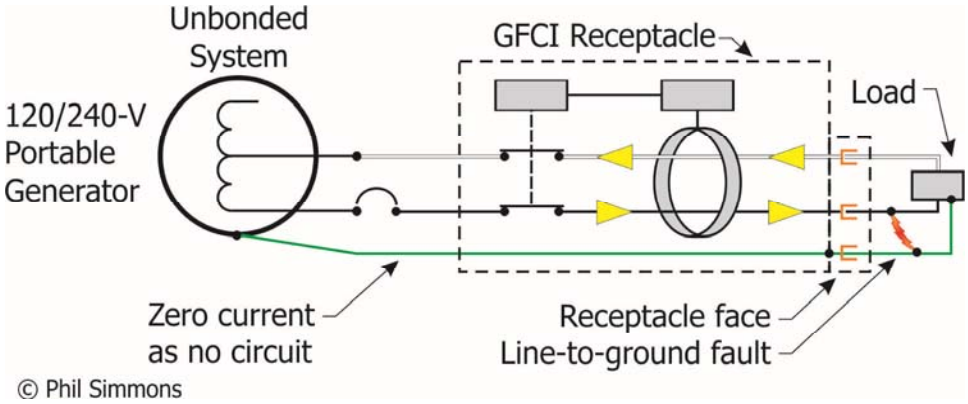
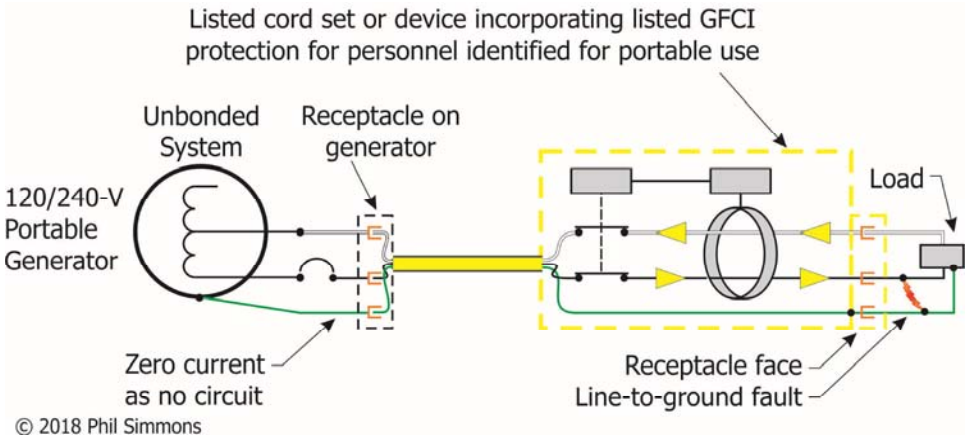

Unbonded
System
GFCI Receptacle
Load
120/240-V
Portable
Generator
Zero current
as no circuit
Receptacle face
Line-to-ground fault
© Phil Simmons


Listed cord set or device incorporating listed GFCI protection for personnel identified for portable use
Unbonded System
Receptacle on generator
120/240-V Portable Generator
Load
Zero current as no circuit
Receptacle face
Line-to-ground fault
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Public Comment No. 1309-NFPA 70-2018 [Section No. 250.36(B)]

(B) Conductor Insulation and Ampacity.

The ~~grounded system~~ conductor from the neutral point of the transformer or generator to its connection point to the grounding impedance shall be fully insulated.

~~The grounded system~~ This conductor shall have an ampacity of not less than the maximum current rating of the grounding impedance but in no case shall the ~~grounded system~~ conductor be smaller than 8 AWG copper or 6 AWG aluminum or copper-clad aluminum.

Statement of Problem and Substantiation for Public Comment

PI 2163 suggested this change. The panel resolution was "Grounded conductors can carry current during normal conditions. Using a different color would indicate that it is an ungrounded conductor which would create safety hazards."

Let me point out that the conductor in question does not carry any current during normal conditions. It only carries current during ground-fault conditions.

The second point that the panel made is probably the best justification for this change. Currently, this conductor must be white. In a ground fault condition, this conductor will be at a voltage of 277 volts (on a 480 volt system). I believe that it is a significant safety hazard to have a white conductor at 277 volts potential.

Related Item

• 2163-NFPA 70-2017

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Public Comment No. 1050-NFPA 70-2018 [Section No. 250.52(A)(3)]

(3) Concrete-Encased Electrode.

A concrete-encased electrode shall consist of at least 6.0 m (20 ft) of either (1) or (2):

(1) One or more bare or zinc galvanized or other electrically conductive coated steel reinforcing bars or rods of not less than 13 mm (½ in.) in diameter, installed in one continuous 6.0 m (20 ft) length, or if in multiple pieces connected together by the usual steel tie wires SHALL overlap 20 diameters , exothermic welding, welding, or other effective means to create a 6.0 m (20 ft) or greater length; or

(2) Bare copper conductor not smaller than 4 AWG

Metallic components shall be encased by at least 50 mm (2 in.) of concrete and shall be located horizontally within that portion of a concrete foundation or footing that is in direct contact with the earth or within vertical foundations or structural components or members that are in direct contact with the earth. If multiple concrete-encased electrodes are present at a building or structure, it shall be permissible to bond only one into the grounding electrode system.

Informational Note: Concrete installed with insulation, vapor barriers, films or similar items separating the concrete from the earth is not considered to be in “direct contact” with the earth.

Statement of Problem and Substantiation for Public Comment

pieces of rusty rebar intersecting at right angles and connected with rusty tie wire will not produce a reliable low resistance pathway for a grounding electrode system or capable of lasting the expected life of the system.

Continuity in the code - NFPA 780 Standard for the Installation of Lightning Protection Systems requires this minimum overlap for similar reasoning

EXERPT

4.13.3.2 The encased electrode shall consist of one of the following:
(1) Not less than 6 m (20 ft) of bare copper main-size conductor
(2) At least 6 m (20 ft) of one or more steel reinforcing bars or rods not less than 12.7 mm (½ in.) in diameter that have been effectively bonded together by either welding or overlapping 20 diameters and wire tying

Using similar language for NFPA 70 and NFPA 780 style and content provides continuity for installation and code enforcement

Related Item

• NFPA 70 art 250A3 vs NFPA 780

Submitter Information Verification

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Public Comment No. 2053-NFPA 70-2018 [Section No. 250.52(A)(4)]

(4) Ground Ring.

A ground ring encircling the building or structure, in direct contact with the earth, consisting of at least 6.0 m (20 ft) of bare copper conductor not smaller than 2 AWG or 6 .0 m (20 ft) of listed ground electrode.

Statement of Problem and Substantiation for Public Comment

It is currently unclear that a Ground Ring can be constructed of any other electrode type than bare copper conductor. But there are other acceptable ground electrodes manufactured in a continuous form that could be substituted for bare copper conductor.

NEC 250.52(A) allows a wide variety of ground electrode types, including a variety of materials and many unlisted types. This includes: Metal water pipe (1), metal in-ground structures (2), reinforcing steel (3), rod and pipe electrodes (5), plate electrodes (7), and other metal underground structures (8). It seems reasonable that any listed ground electrode that can provide 6.0 m (20 ft) of continuous length should be acceptable for a ground ring.

The added stipulation that the ground electrode be listed ensures that the requirement is consistent with 250.52(A) and equivalently safe.

Related Item

• 3584

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Public Comment No. 1740-NFPA 70-2018 [Section No. 250.53(C)]

(C) Bonding Jumper.

The bonding jumper(s) used to connect the grounding electrodes together to form the grounding electrode system shall be installed in accordance with 250.64(A), (B), and (E), shall be sized in accordance with 250.66, and shall be connected in the manner specified in 250.70.Rebar shall not be used as a conductor to interconnect the electrodes of grounding electrode systems.

Statement of Problem and Substantiation for Public Comment

Substantiation: Section 250.68(C)(3)(c) seems to be prohibiting rebar in a concrete-encased electrode that is connected with tie wire, from being used as a bonding jumper to connect other grounding electrodes together to form the grounding electrode system. Section 250.53(C) is the better place to include this prohibition rather than in the section dealing with connections to grounding electrodes.

Related Item

• FR 7985

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Committee: NEC-P05

Public Comment No. 2077-NFPA 70-2018 [New Section after 250.53(F)]

250.53(G) Concrete Encased Electrode

A rebar-type concrete-encased electrode installed in accordance with 250.52(A)(3) with an additional rebar section extended from its location within the concrete foundation or footing to an accessible location that is not subject to corrosion shall be permitted for connection of grounding electrode conductors and bonding jumpers ~~.The rebar extension shall not be exposed to contact with the earth without corrosion protection.~~ in accordance with the following:

1. The additional rebar section shall be continuous with the grounding electrode rebar or shall be connected to the grounding electrode rebar and connected together by the usual steel tie wires, exothermic welding, welding, or other effective means.

2. The rebar extension shall not be exposed to contact with the earth without corrosion protection.

3. Rebar shall not be used as a conductor to interconnect the electrodes of grounding electrode systems.

Statement of Problem and Substantiation for Public Comment

This is a relocation of the text from 250.68(C)(3).

These requirements are more aligned with an aspect of the installation of rebar when being used for a concrete encased electrode and therefore is more suited in this section. See the substantiation submitted in PI 3730.

See related comment where 250.68(C)(3) was deleted.

Related Public Comments for This Document

Related Comment	Relationship
Public Comment No. 2069-NFPA 70-2018 [Section No. 250.68(C)]	
Public Comment No. 2069-NFPA 70-2018 [Section No. 250.68(C)]	

Related Item

• PI 3730 • FR 7985 • FR 8060

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Public Comment No. 1642-NFPA 70-2018 [Section No. 250.64(A)]

(A) Aluminum or Copper-Clad Aluminum Conductors.

Grounding electrode conductors of bare, covered, or insulated aluminum or copper-clad aluminum shall comply with the following:

(1) Bare or covered conductors shall not be installed where subject to corrosive conditions or be installed in direct contact with concrete, masonry, or the earth.

(2) Terminations ~~made~~ within outdoor equipment enclosures that are listed ~~enclosures~~ and identified for ~~outdoor use shall~~ the environment shall be permitted within 450 mm (18 in.) of the ~~earth~~ bottom of the enclosure if the equipment is listed and identified for connection of aluminum or copper-clad aluminum conductors at that location . If open bottom enclosures are installed on a concrete pad that is at or below grade , the concrete pad shall ~~not be considered earth~~ be sloped so moisture will not accumulate within the enclosure .

(3) Aluminum or copper-clad aluminum conductors external to buildings or equipment enclosures shall not be terminated within 450 mm (18 in.) of the earth, unless insulated and the insulation is suitable for the environment . The termination shall be listed as a sealed wire-connector system and listed as grounding and bonding equipment.

Statement of Problem and Substantiation for Public Comment

No substantiation was submitted or considered that will prove that concrete that is at or below grade level is considered to be a dry location. It has been proven that concrete is fairly porous and will retain moisture thus it is effective as a vital component of concrete-encased grounding electrodes.
No substantiation has been submitted to support the allegation that the interior of enclosures that are identified for a wet location are in fact a dry location. This location should be considered to be a location that is corrosive to aluminum connections until proven otherwise. Equipment enclosures must be identified as suitable for connecting aluminum and copper-clad aluminum conductors.
For insulated aluminum and copper-clad aluminum conductors that are installed outdoors, it is important that they have insulation that is suitable for the environment where they are to be installed to avoid corrosion.

Related Item

• FR-7973

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Public Comment No. 1718-NFPA 70-2018 [Section No. 250.64(A)]

(A) Aluminum or Copper-Clad Aluminum Conductors.

Grounding electrode conductors of bare, covered, or insulated aluminum or copper-clad aluminum shall comply with the following:

(1) Bare ~~or covered~~ conductors shall not be installed where subject to corrosive conditions or be installed in direct contact with masonry or the earth.

(2) Terminations made within listed enclosures identified for outdoor use shall be permitted within 450 mm (18 in.) of the earth. If open bottom enclosures are installed on a concrete pad, the concrete shall not be considered earth.

(3) Aluminum or copper-clad aluminum conductors external to buildings or enclosures shall not be terminated within 450 mm (18 in.) of the earth, unless insulated. ~~The termination~~ A termination within 450 mm (18 in.) of the earth shall be listed as a sealed wire-connector system ~~and listed as grounding and bonding equipment~~ .

Statement of Problem and Substantiation for Public Comment

Covered conductors are encased within materials that protect them from contact with wet surfaces or corrosive conditions. Although not evaluated for voltage, the material still separates the metal from the surface and protects it from corrosion.
The requirement for a termination within 18" of the earth to be both a sealed wire connector and listed as a grounding and bonding device creates a conflict with the UL standards requirements. Sealed wire-connectors are listed to UL486D. The grounding and bonding standard, UL 467, only recognizes constructions from UL486A-B and UL486C. Additionally, similar connections are not required to be listed as grounding and bonding devices, and no substantiation was provided to require this additional certification.

Related Item

• PI 2796

Submitter Information Verification

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Submittal Date: Wed Aug 29 17:44:16 EDT 2018
Committee: NEC-P05

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Public Comment No. 2087-NFPA 70-2018 [Section No. 250.64(A)]

(A) Aluminum or Copper-Clad Aluminum Conductors.

Grounding electrode conductors of bare, covered, or insulated aluminum or copper-clad aluminum shall comply with the following:

(1) Bare or covered conductors shall not be installed where subject to corrosive conditions or be installed in direct contact with masonry or the earth.

(2) Terminations made within listed enclosures identified for outdoor use shall be permitted within 450 mm (18 in.) of the earth. ~~If open bottom enclosures are installed on a concrete pad, the concrete shall not be considered earth.~~

(3) Aluminum or copper-clad aluminum conductors external to buildings or enclosures shall not be terminated within 450 mm (18 in.) of the earth, unless insulated. The termination shall be listed as a sealed wire-connector system and listed as grounding and bonding equipment.

Statement of Problem and Substantiation for Public Comment

The submitter of this proposal subtly changed the words "corrosive conditions" to "conditions corrosive to aluminum or copper-clad aluminum", implying that the interior of an enclosure sitting on a concrete pad is not corrosive to those materials without any proof submitted. In fact, concrete is porous and when placed upon wet soil or subject to rain or snow outside the enclosure will absorb moisture from that atmosphere or soil; thus it may be corrosive to those materials.

The second sentence of sub-section (A)(2) as changed is misleading. Concrete is porous and retains moisture (the basis for a concrete-excased electrode). A concrete pad is sitting on the earth is most definitely an extension of the earth, should be considered earth, and aluminum and copper-clad aluminum should not be permitted to be used within 18 inches of the earth.

Related Item

• PI 2796

Submitter Information Verification

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Committee: NEC-P05

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Public Comment No. 298-NFPA 70-2018 [Section No. 250.66 [Excluding any Sub-Sections]]

The size of the grounding electrode conductor at the service, at each building or structure where supplied by a feeder(s) or branch circuit(s), or at a separately derived system of a grounded or ungrounded ac system shall not be less than given in Table 250.66, except as permitted in 250.66(A) through (C).

Table 250.66 Grounding Electrode Conductor for Alternating-Current Systems

Size of Largest Ungrounded Service-Entrance Conductor or Equivalent Area for Parallel Conductors [a] (AWG/kcmil)			
Size of Grounding Electrode Conductor (AWG/kcmil)			
Copper	Aluminum or Copper-Clad Aluminum		
Copper	Aluminum or Copper-Clad Aluminum [b]		
2 or smaller	1/0 or smaller		
		8	6
1 or 1/0	2/0 or 3/0		
		6	4
2/0 or 3/0	4/0 or 250		
	4	2	
~~Over 3~~ 4 / ~~0 through~~ 0 through 350 ~~Over 250~~ 300 through 500			
	2	1/0	
~~Over 350 through~~ 400 through 600 ~~Over 500~~ 600 through 900 ~~Over 900~~			
	1/0	3/0	
~~Over 600 through 1100~~ 700 through 1000	1000 through 1750		
	2/0	4/0	
~~Over 1100~~ ~~Over 1750~~ 1250 or more	2000 or more	3/0	250

Notes:

1. If multiple sets of service-entrance conductors connect directly to a service drop, set of overhead service conductors, set of underground service conductors, or service lateral, the equivalent size of the largest service-entrance conductor shall be determined by the largest sum of the areas of the corresponding conductors of each set.

2. Where there are no service-entrance conductors, the grounding electrode conductor size shall be determined by the equivalent size of the largest service-entrance conductor required for the load to be served.

[a]This table also applies to the derived conductors of separately derived ac systems.

[b]See installation restrictions in 250.64(A).

Statement of Problem and Substantiation for Public Comment

This table was the same table used for everything including Bonding Jumpers, Supply Side Bonding Jumpers and System or Main Bonding Jumpers plus the Grounded conductor. Since Table 250.102(C)(1) is used since the 2014 cycle we do not need the range of conductors specified in 250.66 anymore because the 12.5% rule is not used foe GEC's. This is sometimes confusing to the reader and for test takers to see the wire size listed twice in the table. The GEC will be base directly to the size of the service entrance conductor and not necessarily a wire range.

Related Item

• PI

Submitter Information Verification

Submitter Full Name: Mark Cook
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Submittal Date: Thu Jul 26 11:37:21 EDT 2018
Committee: NEC-P05

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Public Comment No. 473-NFPA 70-2018 [Section No. 250.66 [Excluding any Sub-Sections]]

The size of the grounding electrode conductor at the service, at each building or structure where supplied by a feeder(s) or branch circuit(s), or at a separately derived system of a grounded or ungrounded ac system shall not be less than given in Table 250.66, except as permitted in 250.66(A) through (C).

Table 250.66 Grounding Electrode Conductor for Alternating-Current Systems

Size of Largest Ungrounded Service-Entrance Conductor or Equivalent Area for Parallel ~~Conductors~~ [a] Conductors (AWG/kcmil)		-	Size of Grounding Electrode Conductor (AWG/kcmil)	
Copper	Aluminum or Copper-Clad Aluminum	-	Copper	Aluminum or Copper-Clad Aluminum[b] [a]
2 or smaller	1/0 or smaller	-	8	6
1 or 1/0	2/0 or 3/0	-	6	4
2/0 or 3/0	4/0 or 250	-	4	2
Over 3/0 through 350	Over 250 through 500	-	2	1/0
Over 350 through 600	Over 500 through 900	-	1/0	3/0
Over 600 through 1100	Over 900 through 1750	-	2/0	4/0
Over 1100	Over 1750	-	3/0	250

Notes:

1. If multiple sets of service-entrance conductors connect directly to a service drop, set of overhead service conductors, set of underground service conductors, or service lateral, the equivalent size of the largest service-entrance conductor shall be determined by the largest sum of the areas of the corresponding conductors of each set.

2. Where there are no service-entrance conductors, the grounding electrode conductor size shall be determined by the equivalent size of the largest service-entrance conductor required for the load to be served.

[a] ~~This table also applies to the derived conductors of separately derived ac systems.~~ [b] See installation restrictions in 250.64(A).

Statement of Problem and Substantiation for Public Comment

Editorial revisions are made to delete the existing footnote "a". It seems this footnote is left over from when this table was used to size the neutral (grounded conductor) for services and separately derived systems.
In reviewing 250.30(A)(3) for separately derived systems, the size of the grounded conductor is selected by reference to 250.102(C)(1). Selection of the grounding electrode conductor for separately derived systems is referred to 250.66 by 250.30(A)(5).
So, it appears the existing footnote "a" should be deleted.

Related Item

• PI 1858

Submitter Information Verification

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Submittal Date: Wed Aug 08 19:02:29 EDT 2018
Committee: NEC-P05

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Public Comment No. 1738-NFPA 70-2018 [Section No. 250.68(C)]

(C) Grounding Electrode Conductor Connections.

Grounding electrode conductors and bonding jumpers shall be permitted to be connected at the following locations and used to extend the connection to an electrode(s):

(1) Interior metal water piping that is electrically continuous with a metal underground water pipe electrode and is located not more than 1.52 m (5 ft) from the point of entrance to the building shall be permitted to extend the connection to an electrode(s). Interior metal water piping located more than 1.52 m (5 ft) from the point of entrance to the building shall not be used as a conductor to interconnect electrodes of the grounding electrode system.

Exception: In industrial, commercial, and institutional buildings or structures, if conditions of maintenance and supervision ensure that only qualified persons service the installation, interior metal water piping located more than 1.52 m (5 ft) from the point of entrance to the building shall be permitted as a bonding conductor to interconnect electrodes that are part of the grounding electrode system, or as a grounding electrode conductor, if the entire length, other than short sections passing perpendicularly through walls, floors, or ceilings, of the interior metal water pipe that is being used for the conductor is exposed.

(2) The metal structural frame of a building shall be permitted to be used as a conductor to interconnect electrodes that are part of the grounding electrode system, or as a grounding electrode conductor. Hold-down bolts securing the structural steel column that are connected to a concrete-encased electrode complying with 250.52(A)(3) and located in the support footing or foundation shall be permitted to connect the metal structural frame of a building or structure to the concrete encased grounding electrode. The hold-down bolts shall be connected to the concrete-encased electrode by welding, exothermic welding, the usual steel tie wires, or other approved means.

(3) A rebar-type concrete-encased electrode installed in accordance with 250.52(A)(3) with an additional rebar section extended from its location within the concrete foundation or footing to an accessible location that is not subject to corrosion shall be permitted for connection of grounding electrode conductors and bonding jumpers in accordance with the following:

(a) The additional rebar section shall be continuous with the grounding electrode rebar or shall be connected to the grounding electrode rebar and connected together by the usual steel tie wires, exothermic welding, welding, or other effective means.

(b) The rebar extension shall not be exposed to contact with the earth without corrosion protection.

(c) ~~Rebar shall not be used as a conductor to interconnect the electrodes of grounding electrode systems.~~

Statement of Problem and Substantiation for Public Comment

Substantiation: Section 250.68(C)(3)(c) seems to be prohibiting rebar in a concrete-encased electrode that is connected with tie wire, from being used as a bonding jumper to connect other grounding electrodes together to form the grounding electrode system. Section 250.53(C) is the better place to include this prohibition rather than in the section dealing with connections to grounding electrodes.

Related Item

• FR 7985

Submitter Information Verification

Submitter Full Name: Agnieszka Golriz
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Submittal Date: Wed Aug 29 19:11:28 EDT 2018

Committee: NEC-P05

Public Comment No. 2069-NFPA 70-2018 [Section No. 250.68(C)]

(C) Grounding Electrode Conductor Connections.

Grounding electrode conductors and bonding jumpers shall be permitted to be connected at the following locations and used to extend the connection to an electrode(s):

(1) Interior metal water piping that is electrically continuous with a metal underground water pipe electrode and is located not more than 1.52 m (5 ft) from the point of entrance to the building shall be permitted to extend the connection to an electrode(s). Interior metal water piping located more than 1.52 m (5 ft) from the point of entrance to the building shall not be used as a conductor to interconnect electrodes of the grounding electrode system.

Exception: In industrial, commercial, and institutional buildings or structures, if conditions of maintenance and supervision ensure that only qualified persons service the installation, interior metal water piping located more than 1.52 m (5 ft) from the point of entrance to the building shall be permitted as a bonding conductor to interconnect electrodes that are part of the grounding electrode system, or as a grounding electrode conductor, if the entire length, other than short sections passing perpendicularly through walls, floors, or ceilings, of the interior metal water pipe that is being used for the conductor is exposed.

(2) The metal structural frame of a building shall be permitted to be used as a conductor to interconnect electrodes that are part of the grounding electrode system, or as a grounding electrode conductor. Hold-down bolts securing the structural steel column that are connected to a concrete-encased electrode complying with 250.52(A)(3) and located in the support footing or foundation shall be permitted to connect the metal structural frame of a building or structure to the concrete encased grounding electrode. The hold-down bolts shall be connected to the concrete-encased electrode by welding, exothermic welding, the usual steel tie wires, or other approved means.

(3) ~~A rebar-type concrete-encased electrode installed in accordance with 250.52(A)(3) with an additional rebar section extended from its location within the concrete foundation or footing to an accessible location that is not subject to corrosion shall be permitted for connection of grounding electrode conductors and bonding jumpers in accordance with the following:~~

(4) ~~The additional rebar section shall be continuous with the grounding electrode rebar or shall be connected to the grounding electrode rebar and connected together by the usual steel tie wires, exothermic welding, welding, or other effective means.~~

(5) ~~The rebar extension shall not be exposed to contact with the earth without corrosion protection.~~

(6) ~~Rebar shall not be used as a conductor to interconnect the electrodes of grounding electrode systems.~~

(7)

Statement of Problem and Substantiation for Public Comment

Delete section 250.68(C)(3) for rebar from 250.68(C) and relocate to new 250.53(G). This section deals with the installation of rebar for a concrete encased electrode. Section 250.68(C) is about grounding electrode conductor connections and the permitted use of metallic water systems and structural metal systems as conductors to interconnect other electrodes together forming the grounding electrode system. There is no references or pointers in the Code to 250.68(C)(3) for this purpose or any other purpose. Therefore it is believed these installation requirements would be better located in 250.53 that addresses specifics of different grounding electrode installations.

A related comment has been submitted to complete the relocation to 250.53(G). Future efforts may be warranted to reorganize 250.53 to better align with the sequence of the types of electrode defined in 250.52(A).

Related Public Comments for This Document

Related Comment	Relationship
Public Comment No. 2077-NFPA 70-2018 [New Section after 250.53(F)]	

Public Comment No. 2077-NFPA 70-2018 [New Section after 250.53(F)]

Related Item

• FR 7985

Submitter Information Verification

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Committee: NEC-P05

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Public Comment No. 1206-NFPA 70-2018 [Section No. 250.96(B)]

(B) Isolated Grounding Circuits.

Where installed ~~for the reduction of electrical noise (electromagnetic interference)~~ on the grounding circuit, an equipment enclosure supplied by a branch circuit shall be permitted to be isolated from a raceway containing circuits supplying only that equipment by one or more listed nonmetallic raceway fittings located at the point of attachment of the raceway to the equipment enclosure. The metal raceway shall comply with this article and shall be supplemented by an internal insulated equipment grounding conductor installed in accordance with 250.146(D) to ~~ground the equipment enclosure.~~ fulfill the requirements of 250.4

Informational Note: Use of an isolated equipment grounding conductor does not relieve the ~~requirement for grounding the raceway system.~~ requirements of 250.4.

Statement of Problem and Substantiation for Public Comment

This requirement should be in force whenever an enclosure is isolated from the raceway. As currently written, it is not required when isolation is used for some other reason than reducing noise.
Also, simply grounding the enclosure or raceway does not ensure that the enclosure or raceway is connected back to the source as part of an effective ground fault current path.

Related Public Comments for This Document

Related Comment	Relationship
Public Comment No. 1207-NFPA 70-2018 [Section No. 406.3(D) [Excluding any Sub-Sections]]	
Public Comment No. 1208-NFPA 70-2018 [Section No. 250.146(D)]	

Related Item

- 3761-NFPA 70-2017

Submitter Information Verification

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Committee: NEC-P05

Public Comment No. 951-NFPA 70-2018 [Section No. 250.102(C)(2)]

(2) Size for Parallel Conductor Installations in Two or More Raceways or Cables.

Where the ungrounded supply conductors are paralleled in two or more raceways or cables, and an individual supply-side bonding jumper is used for bonding these raceways or cables, the size of the supply-side bonding jumper for each raceway or cable shall be selected from Table 250.102(C)(1) based on the size of the ungrounded supply conductors in each raceway or cable. A single supply-side bonding jumper installed for bonding two or more raceways or cables shall be sized in accordance with 250.102(C)(1). Where supply side bonding jumpers are routed along with ungrounded supply conductors, in parallel within two or more raceways, the supply side bonding jumpers shall divvy equally and be routed in each raceway and be sized in accordance with 250.102(C)(1) based on the size of the ungrounded conductors in each raceway or cable.

Informational Note No. 1: The term *supply conductors* includes ungrounded conductors that do not have overcurrent protection on their supply side and terminate at service equipment or the first disconnecting means of a separately derived system.

Informational Note No. 2: See Chapter 9, Table 8, for the circular mil area of conductors 18 AWG through 4/0 AWG.

Table 250.102(C)(1) Grounded Conductor, Main Bonding Jumper, System Bonding Jumper, and Supply-Side Bonding Jumper for Alternating-Current Systems

Size of Largest Ungrounded Conductor or Equivalent Area for Parallel Conductors (AWG/kcmil)			Size of Grounded Conductor or Bonding Jumper* (AWG/kcmil)	
Copper	Aluminum or Copper-Clad Aluminum		Copper	Aluminum or Copper-Clad Aluminum
2 or smaller	1/0 or smaller	-	8	6
1 or 1/0	2/0 or 3/0	-	6	4
2/0 or 3/0	4/0 or 250	-	4	2
Over 3/0 through 350	Over 250 through 500	-	2	1/0
Over 350 through 600	Over 500 through 900	-	1/0	3/0
Over 600 through 1100	Over 900 through 1750	-	2/0	4/0
Over 1100	Over 1750	-	See Notes 1 and 2.	

Notes:

1. If the ungrounded supply conductors are larger than 1100 kcmil copper or 1750 kcmil aluminum, the grounded conductor or bonding jumper shall have an area not less than 12½ percent of the area of the largest ungrounded supply conductor or equivalent area for parallel supply conductors. The grounded conductor or bonding jumper shall not be required to be larger than the largest ungrounded conductor or set of ungrounded conductors.

2. If the ungrounded supply conductors are larger than 1100 kcmil copper or 1750 kcmil aluminum and if the ungrounded supply conductors and the bonding jumper are of different materials (copper, aluminum, or copper-clad aluminum), the minimum size of the grounded conductor or bonding jumper shall be based on the assumed use of ungrounded supply conductors of the same material as the grounded conductor or bonding jumper and will have an ampacity equivalent to that of the installed ungrounded supply conductors.

3. If multiple sets of service-entrance conductors are used as permitted in 230.40, Exception No. 2, or if multiple sets of ungrounded supply conductors are installed for a separately derived system, the equivalent size of the largest ungrounded supply conductor(s) shall be determined by the largest sum of the areas of the corresponding conductors of each set.

4. If there are no service-entrance conductors, the supply conductor size shall be determined by the equivalent size of the largest service-entrance conductor required for the load to be served.

*For the purposes of applying this table and its notes, the term *bonding jumper* refers to main bonding jumpers, system bonding jumpers, and supply-side bonding jumpers.

Statement of Problem and Substantiation for Public Comment

This is similar to 250.122F and for the same reasoning. Paralleling supply side bonding jumpers this way facilitates ungrounded conductors in cancelling highly inductive fault currents.

Presently, 250.102(C)(2) language does not prevent someone from routing a supply side bonding jumper through less than each line side raceways. I do know it is unnecessary to route through the metal raceways. The bond for those raceways may derive from either of the metal enclosures that the raceways are connecting using supply side bonding jumpers or utilizing 250.142A grounded conductor bonding. I believe the closest reference to call the practice a violation would be 250.4(A)(5). The parallel paths of the metal raceway and the supply side bonding jumper within may be regarded as a greater impedance with those two different routes imposing on each other in the event of a ground fault, creating a choking affect.

Adding the new NEC language I've shown for 250.102(C)(2) would prevent an electrician from routing a supply side bonding jumper(s) in less than each parallel raceway. The alternative is to add NEC language that prohibits routing supply side bonding jumpers through service metal raceways unnecessarily but I don't agree with this as the title of 250.102(C)(2) already implies compliance.

Now a whole other discussion is in store. 'Non-metallic raceways between metal service enclosures'. Now the supply side bonding jumper is required within the raceway(s) between enclosures to bond the enclosures to meet 250.80 and 250.92B if the grounded conductor wasn't serving that purpose and it wouldn't if main bonding jumpers weren't installed at meter enclosures, line-side gutters, and the like. Page 19

Main bonding jumpers are required at each service disconnect metal enclosure but not the other line side enclosures (A possible exception to that is my newly proposed 250.24(B)(2) of this submittal.). Possibly, a utility company doesn't want that main bonding jumper in the meter or Current Transformer enclosure. Possibly, 250.92B already infers no non-metallic raceways are permitted for service conductors but that would be inconsistent with something like 230.30B or 230.43.

My newly proposed 250.102(C)(2) language covers both metallic and non-metallic service raceways. The highest fault currents of an electrical installation are at the service and I think it's important that parallel supply side bonding jumpers should divvy into each raceway when they are routed within those raceways.

Related Item

• 250.102C2

Submitter Information Verification

Submitter Full Name: Norman Feck
Organization: State of Colorado
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Submittal Date: Mon Aug 20 18:09:51 EDT 2018
Committee: NEC-P05

Public Comment No. 883-NFPA 70-2018 [Section No. 250.102(D)]

(D) Size — Equipment Bonding Jumper on Load Side of an Overcurrent Device.

The equipment bonding jumper on the load side of an overcurrent device(s) shall be sized in accordance with 250.122.

A single common continuous equipment bonding jumper shall be permitted to connect two or more raceways or cables if the bonding jumper is sized in accordance with 250.122 for the largest overcurrent device supplying circuits therein.

Additional Proposed Changes

File Name	Description	Approved
CN_242.pdf	70_CN 242	

Statement of Problem and Substantiation for Public Comment

NOTE: This Public Comment appeared as CC Note No. 242 in the First Draft Report on First Revision No. 8114.

The Correlating Committee directs Code-Making Panel 5 to correlate FR 8114 with 250.102(D), 250.104(B), and 250.190(C)(3).

The Correlating Committee directs that FR 8114 be referred to Code-Making Panel 2 for correlation with Annex D Example D3(a).

The Correlating Committee directs that FR 8114 be referred to Code-Making Panel 4 for correlation with 690.45.

The Correlating Committee directs that FR 8114 be referred to Code-Making Panel 10 for correlation with 215.2(A)(2)(b)(2) and 215.2(B).

The Correlating Committee directs that FR 8114 be referred to Code-Making Panel 15 for correlation with 525.11.

The Correlating Committee directs that FR 8114 be referred to Code-Making Panel 18 for correlation with 600.7(A)(2).

These actions will be considered as public comments.

The Correlating Committee directs that FR 8114 be sent to all panels for information.

Related Item

• FR 8114

Submitter Information Verification

Submitter Full Name: CC on NEC-AAC
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Submittal Date: Mon Aug 20 14:49:40 EDT 2018
Committee: NEC-P05

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Correlating Committee Note No. 242-NFPA 70-2018 [Section No. 250.122]

Submitter Information Verification

Submitter Full Name: Sarah Caldwell
Committee:
Submittal Date: Fri May 11 16:23:39 EDT 2018

Committee Statement and Meeting Notes

Committee Statement: The Correlating Committee directs Code-Making Panel 5 to correlate FR 8114 with 250.102(D), 250.104(B), and 250.190(C)(3).

The Correlating Committee directs that FR 8114 be referred to Code-Making Panel 2 for correlation with Annex D Example D3(a).

The Correlating Committee directs that FR 8114 be referred to Code-Making Panel 4 for correlation with 690.45.

The Correlating Committee directs that FR 8114 be referred to Code-Making Panel 10 for correlation with 215.2(A)(2)(b)(2) and 215.2(B).

The Correlating Committee directs that FR 8114 be referred to Code-Making Panel 15 for correlation with 525.11.

The Correlating Committee directs that FR 8114 be referred to Code-Making Panel 18 for correlation with 600.7(A)(2).

These actions will be considered as public comments.

The Correlating Committee directs that FR 8114 be sent to all panels for information.

First Revision No. 8114-NFPA 70-2018 [Section No. 250.122]

Ballot Results

✔ **This item has passed ballot**

12 Eligible Voters
0 Not Returned
12 Affirmative All
0 Affirmative with Comments
0 Negative with Comments
0 Abstention

Affirmative All

Brunssen, James E.

Dressman, Kevin L.

Hickman, Palmer L.

Hittinger, David L.

Holub, Richard A.

Johnston, Michael J.

Kovacik, John R.

Manche, Alan

McDaniel, Roger D.

Pierce, James F.

Saporita, Vincent J.

Williams, David A.

Public Comment No. 1945-NFPA 70-2018 [Section No. 250.104(A)(1)]

(1) General.

Metal water piping system(s) installed in or attached to a building or structure shall be bonded to any of the following:

(1) Service equipment enclosure

(2) Grounded conductor at the service

(3) Grounding electrode conductor, if of sufficient size

(4) One or more grounding electrodes used, if the grounding electrode conductor or bonding jumper to the grounding electrode is of sufficient size

The bonding jumper(s) shall be installed in accordance with 250.64(A), 250.64(B), and 250.64(E). The points of attachment of the bonding jumper(s) shall be accessible. The bonding jumper(s) shall be sized in accordance with Table 250.102(C)(1) except ~~that it shall not be required to be larger than 3/0 copper or 250 kcmil aluminum or copper-clad aluminum and except~~ as permitted in 250.104(A)(2) and 250.104(A)(3).

Statement of Problem and Substantiation for Public Comment

There was no substantiation or research presented to support this reduction in bonding jumper size to 3/0 maximum. The restriction was arbitrary with no supporting evidence presented that this practice is safe under all circumstances. Table 250.102(C)(1) should be published as it appeared in the 2017 NEC.

Related Item

• PI 3203

Submitter Information Verification

Submitter Full Name: David Brender
Organization: Copper Development Association
Street Address:
City:
State:
Zip:
Submittal Date: Thu Aug 30 12:53:34 EDT 2018
Committee: NEC-P05

Public Comment No. 808-NFPA 70-2018 [Section No. 250.104(B)]

(B) Other Metal Piping.

If installed in or attached to a building or structure, a metal piping system(s), including gas piping, that is likely to become energized shall be bonded to any of the following:

(1) Equipment grounding conductor for the circuit that is likely to energize the piping system

(2) Service equipment enclosure

(3) Grounded conductor at the service

(4) Grounding electrode conductor, if of sufficient size

(5) One or more grounding electrodes used, if the grounding electrode conductor or bonding jumper to the grounding electrode is of sufficient size

The bonding conductor(s) or jumper(s) shall be sized in accordance with Table 250.122, and equipment grounding conductors shall be sized in accordance with Table 250.122 using the rating of the circuit that is likely to energize the piping system(s). The points of attachment of the bonding jumper(s) shall be accessible.

Informational Note No. 1: Bonding all piping and metal air ducts within the premises will provide additional safety.

Informational Note No. 2: Additional information for gas piping systems can be found in Section 7.~~13~~ 12 of NFPA 54-2018, *National Fuel Gas Code*. Information extracted from the National Fuel Gas Code/NFPA 54-2018 covering the bonding requirements for metal gas piping systems can be found in Informative Annex K.

Additional Proposed Changes

File Name	Description	Approved
Informative_Annex_K.docx	new informative annex material extracted from NFPA 54-2018	

Statement of Problem and Substantiation for Public Comment

The NFPA Standards Council has ruled that the bonding requirements for gas piping systems is the responsibility of the NFPA 54 Technical Committee which has required the additional bonding for CSST since the 2009 edition of the NFPA 54 Code. This proposal makes all bonding requirements included in the Section 7.12 of the National Fuel Gas Code-2018 (NFPA-54-2018) readily available to the electrical contractor who would normally perform the required bonding. The proposal adds the bonding requirements as extracted code text in an Informative Annex because electrical contractors do not generally carry or own a copy of the National Fuel Gas Code.

The current absence of coverage in the National Electrical Code for the full range of bonding requirements for all gas piping materials has led to confusion and conflicts in the field. Some states have abdicated the responsibility of bonding CSST to plumbers (NH) and homeowners (NC). Some states (MA) do not enforce the bonding of CSST within the electrical code. If fire safety is important, then consistency must be provided to insure the uniform installation and enforcement of the bonding requirements for all gas piping materials within both NFPA codes (70 and 54).

Related Item

• PI-3236 • PI-3229

Submitter Information Verification

Submitter Full Name: Robert Torbin
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Submittal Date: Sat Aug 18 16:59:10 EDT 2018

Committee: NEC-P05

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Informative Annex K: Bonding Requirements for Metal Gas Piping Systems

7.12 Electrical Bonding and Grounding.

7.12.1 Pipe and Tubing other than CSST. Each aboveground portion of a gas piping system other than CSST that is likely to become energized shall be electrically continuous and bonded to an effective ground-fault current path. Gas piping other than CSST shall be considered to be bonded when it is connected to appliances that are connected to the appliance grounding conductor of the circuit supplying that appliance.

7.12.2 * CSST. CSST gas piping systems and gas piping systems containing one or more segments of CSST, shall be electrically continuous and bonded to the electrical service grounding electrode system or where provided, lightning protection grounding electrode system.

7.12.2.1 The bonding jumper shall connect to a metallic pipe, pipe fitting, or CSST fitting.

7.12.2.2 The bonding jumper shall not be smaller than 6 AWG copper wire or equivalent.

7.12.2.3 The length of the jumper between the connection to the gas piping system and the grounding electrode system shall not exceed 75-ft (22-m). Any additional grounding electrodes installed to meet this requirement shall be bonded to the electrical service grounding electrode system or where provided, lightning protection grounding electrode system.

7.12.2.4 Bonding connections shall be in accordance with NFPA 70, National Electrical Code®.

7.12.2.5 Devices used for the bonding connection shall be listed for the application in accordance with UL 467, Grounding and Bonding Equipment.

7.12.3 Arc Resistant Jacketed CSST. CSST listed with an arc resistant jacket or coating system in accordance with ANSI LC 1/CSA 6.26, *Fuel Gas Piping Systems Using Corrugated Stainless Steel Tubing (CSST)*, shall be electrically continuous and bonded to an effective ground fault current path. Where any CSST component of a piping system does not have an arc resistant jacket or coating system, the bonding requirements of 7.12.2 shall apply. Arc resistant jacketed CSST shall be considered to be bonded when it is connected to appliances that are connected to the appliance grounding conductor of the circuit supplying that appliance.

7.12.4* Prohibited Use. Gas piping shall not be used as a grounding conductor or electrode.

7.12.5* Lighting Protection System. Where a lightning protection system is installed, the bonding of the gas piping shall be in accordance with NFPA 780, Standard for the Installation of Lightning Protection Systems, 2008.

Public Comment No. 884-NFPA 70-2018 [Section No. 250.104(B)]

(B) Other Metal Piping.

If installed in or attached to a building or structure, a metal piping system(s), including gas piping, that is likely to become energized shall be bonded to any of the following:

(1) Equipment grounding conductor for the circuit that is likely to energize the piping system

(2) Service equipment enclosure

(3) Grounded conductor at the service

(4) Grounding electrode conductor, if of sufficient size

(5) One or more grounding electrodes used, if the grounding electrode conductor or bonding jumper to the grounding electrode is of sufficient size

The bonding conductor(s) or jumper(s) shall be sized in accordance with Table 250.122, and equipment grounding conductors shall be sized in accordance with Table 250.122 using the rating of the circuit that is likely to energize the piping system(s). The points of attachment of the bonding jumper(s) shall be accessible.

Informational Note No. 1: Bonding all piping and metal air ducts within the premises will provide additional safety.

Informational Note No. 2: Additional information for gas piping systems can be found in Section 7.13 of NFPA 54-2018, *National Fuel Gas Code*.

Additional Proposed Changes

File Name	Description	Approved
CN_242.pdf	70_CN 242	

Statement of Problem and Substantiation for Public Comment

NOTE: This Public Comment appeared as CC Note No. 242 in the First Draft Report on First Revision No. 8114.

The Correlating Committee directs Code-Making Panel 5 to correlate FR 8114 with 250.102(D), 250.104(B), and 250.190(C)(3).

The Correlating Committee directs that FR 8114 be referred to Code-Making Panel 2 for correlation with Annex D Example D3(a).

The Correlating Committee directs that FR 8114 be referred to Code-Making Panel 4 for correlation with 690.45.

The Correlating Committee directs that FR 8114 be referred to Code-Making Panel 10 for correlation with 215.2(A)(2)(b)(2) and 215.2(B).

The Correlating Committee directs that FR 8114 be referred to Code-Making Panel 15 for correlation with 525.11.

The Correlating Committee directs that FR 8114 be referred to Code-Making Panel 18 for correlation with 600.7(A)(2).

These actions will be considered as public comments.

The Correlating Committee directs that FR 8114 be sent to all panels for information.

Related Item

• FR 8114

Submitter Information Verification

Submitter Full Name: CC on NEC-AAC
Organization: NEC Correlating Committee
Street Address:
City:
State:
Zip:
Submittal Date: Mon Aug 20 14:51:35 EDT 2018
Committee: NEC-P05

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Correlating Committee Note No. 242-NFPA 70-2018 [Section No. 250.122]

Submitter Information Verification

Submitter Full Name: Sarah Caldwell
Committee:
Submittal Date: Fri May 11 16:23:39 EDT 2018

Committee Statement and Meeting Notes

Committee Statement: The Correlating Committee directs Code-Making Panel 5 to correlate FR 8114 with 250.102(D), 250.104(B), and 250.190(C)(3).

The Correlating Committee directs that FR 8114 be referred to Code-Making Panel 2 for correlation with Annex D Example D3(a).

The Correlating Committee directs that FR 8114 be referred to Code-Making Panel 4 for correlation with 690.45.

The Correlating Committee directs that FR 8114 be referred to Code-Making Panel 10 for correlation with 215.2(A)(2)(b)(2) and 215.2(B).

The Correlating Committee directs that FR 8114 be referred to Code-Making Panel 15 for correlation with 525.11.

The Correlating Committee directs that FR 8114 be referred to Code-Making Panel 18 for correlation with 600.7(A)(2).

These actions will be considered as public comments.

The Correlating Committee directs that FR 8114 be sent to all panels for information.

First Revision No. 8114-NFPA 70-2018 [Section No. 250.122]

Ballot Results

✔ **This item has passed ballot**

12 Eligible Voters
0 Not Returned
12 Affirmative All
0 Affirmative with Comments
0 Negative with Comments
0 Abstention

Affirmative All

Brunssen, James E.

Dressman, Kevin L.

Hickman, Palmer L.

Hittinger, David L.

Holub, Richard A.

Johnston, Michael J.

Kovacik, John R.

Manche, Alan

McDaniel, Roger D.

Pierce, James F.

Saporita, Vincent J.

Williams, David A.

Public Comment No. 91-NFPA 70-2018 [Section No. 250.104(B)]

(B) Other Metal Piping.

If installed in or attached to a building or structure, a metal piping system(s), including gas piping, that is likely to become energized shall be bonded to any of the following:

(1) Equipment grounding conductor for the circuit that is likely to energize the piping system

(2) Service equipment enclosure

(3) Grounded conductor at the service

(4) Grounding electrode conductor, if of sufficient size

(5) One or more grounding electrodes used, if the grounding electrode conductor or bonding jumper to the grounding electrode is of sufficient size

The bonding conductor(s) or jumper(s) shall be sized in accordance with Table 250.122, and equipment grounding conductors shall be sized in accordance with Table 250.122 using the rating of the circuit that is likely to energize the piping system(s). The points of attachment of the bonding jumper(s) shall be accessible.

Informational Note No. 1: Bonding all piping and metal air ducts within the premises will provide additional safety.

Informational Note No. 2: Additional information for gas piping systems can be found in Informative Annex K and Section 7.~~13~~ 12 of NFPA 54-2018, *National Fuel Gas Code*.

Statement of Problem and Substantiation for Public Comment

This public comment is in response to resolved PI-1081 and PC-84. Public comment 84 seeks to add a new Informative Annex K for the grounding and bonding of gas piping systems to the NEC for informational purposes for code users. In addition, an editorial change is required in Informational Note 2, as Section 7.12 in NFPA 54 covers the grounding and bonding of gas piping systems.

Related Public Comments for This Document

Related Comment	Relationship
Public Comment No. 84-NFPA 70-2018 [New Section after J.7.2]	Informative Annex for grounding and bonding gas piping systems

Related Item

• PI-1081 NFPA 70-2017

Submitter Information Verification

Submitter Full Name: Brian Baughman
Organization: Generac Power Systems Inc
Street Address:
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Submittal Date: Thu Jun 28 11:47:21 EDT 2018
Committee: NEC-P05

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Public Comment No. 2094-NFPA 70-2018 [Section No. 250.104(C)]

(C) Structural Metal.

Exposed structural metal that is interconnected to form a metal building frame, is not intentionally grounded or bonded, and is likely to become energized shall be bonded to any of the following:

(1) Service equipment enclosure

(2) Grounded conductor at the service

(3) Disconnecting means for buildings or structures supplied by a feeder or branch circuit

(4) Grounding electrode conductor, if of sufficient size

(5) One or more grounding electrodes used, if the grounding electrode conductor or bonding jumper to the grounding electrode is of sufficient size

The bonding conductor(s) or jumper(s) shall be sized in accordance with Table 250.102(C)(1), ~~except that it shall not be required to be larger than 3/0 copper or 250 kcmil aluminum or copper-clad aluminum,~~ _ and installed in accordance with 250.64(A), 250.64(B), and 250.64(E). The points of attachment of the bonding jumper(s) shall be accessible unless installed in compliance with 250.68(A) Exception No. 2.

Statement of Problem and Substantiation for Public Comment

There was no justification or substantiation submitted to limit the bonding jumper to 3/0 copper or 250 kcmil aluminum.

Related Item

• FR 8034

Submitter Information Verification

Submitter Full Name: David Brender
Organization: Copper Development Association
Street Address:
City:
State:
Zip:
Submittal Date: Thu Aug 30 17:19:43 EDT 2018
Committee: NEC-P05

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Public Comment No. 2097-NFPA 70-2018 [Section No. 250.104(D)(1)]

(1) Metal Water Piping System(s).

The grounded conductor of each separately derived system shall be bonded to the nearest available point of the metal water piping system(s) in the area served by each separately derived system. This connection shall be made at the same point on the separately derived system where the grounding electrode conductor is connected. Each bonding jumper shall be sized in accordance with Table 250.102(C)(1) based on the largest ungrounded conductor of the separately derived system ~~except that it shall not be required to be larger than 3/0 copper or 250 kcmil aluminum or copper-clad aluminum~~ .

Exception No. 1: A separate bonding jumper to the metal water piping system shall not be required if the metal water piping system is used as the grounding electrode for the separately derived system and the water piping system is in the area served.

Exception No. 2: A separate water piping bonding jumper shall not be required if the metal frame of a building or structure is used as the grounding electrode for a separately derived system and is bonded to the metal water piping in the area served by the separately derived system.

Statement of Problem and Substantiation for Public Comment

There was no justification or substantiation submitted to limit the bonding jumper to 3/0 copper or 250 kcmil aluminum.

Related Item

• FR 8031

Submitter Information Verification

Submitter Full Name: David Brender
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Street Address:
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Submittal Date: Thu Aug 30 17:27:57 EDT 2018
Committee: NEC-P05

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Public Comment No. 2100-NFPA 70-2018 [Section No. 250.104(D)(2)]

(2) Structural Metal.

If exposed structural metal that is interconnected to form the building frame exists in the area served by the separately derived system, it shall be bonded to the grounded conductor of each separately derived system. This connection shall be made at the same point on the separately derived system where the grounding electrode conductor is connected. Each bonding jumper shall be sized in accordance with Table 250.102(C)(1) based on the largest ungrounded conductor of the separately derived system ~~except that it shall not be required to be larger than 3/0 copper or 250 kcmil aluminum or copper-clad aluminum~~ .

Exception No. 1: A separate bonding jumper to the building structural metal shall not be required if the metal frame of a building or structure is used as the grounding electrode for the separately derived system.

Exception No. 2: A separate bonding jumper to the building structural metal shall not be required if the water piping of a building or structure is used as the grounding electrode for a separately derived system and is bonded to the building structural metal in the area served by the separately derived system.

Statement of Problem and Substantiation for Public Comment

There was no justification or substantiation submitted to limit the bonding jumper to 3/0 copper or 250 kcmil aluminum. There was no evidence presented that this practice is safe under all conditions.

Related Item

• FR 8031

Submitter Information Verification

Submitter Full Name: David Brender
Organization: Copper Development Association
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Submittal Date: Thu Aug 30 17:31:47 EDT 2018
Committee: NEC-P05

Public Comment No. 10-NFPA 70-2018 [Section No. 250.118]

250.118 Types of Equipment Grounding Conductors.

The equipment grounding conductor run with or enclosing the circuit conductors shall be one or more or a combination of the following:

(1) A copper, aluminum, or copper-clad aluminum conductor. This conductor shall be solid or stranded; insulated, covered, or bare; and in the form of a wire or a busbar of any shape.

(2) Rigid metal conduit.

(3) Intermediate metal conduit.

(4) Electrical metallic tubing.

(5) Listed flexible metal conduit meeting all the following conditions:

(6) The conduit is terminated in listed fittings.

(7) The circuit conductors contained in the conduit are protected by overcurrent devices rated at 20 amperes or less.

(8) The size of the conduit does not exceed metric designator 35 (trade size 1 1/4).

(9) The combined length of flexible metal conduit, flexible metallic tubing, and liquidtight flexible metal conduit in the same effective ground-fault current path does not exceed 1.8 m (6 ft).

(10) If used to connect equipment where flexibility is necessary to minimize the transmission of vibration from equipment or to provide flexibility for equipment that requires movement after installation, a wire-type equipment grounding conductor shall be installed.

(11) Listed liquidtight flexible metal conduit meeting all the following conditions:

(12) The conduit is terminated in listed fittings.

(13) For metric designators 12 through 16 (trade sizes 3/8 through 1/2), the circuit conductors contained in the conduit are protected by overcurrent devices rated at 20 amperes or less.

(14) For metric designators 21 through 35 (trade sizes 3/4 through 1 1/4), the circuit conductors contained in the conduit are protected by overcurrent devices rated not more than 60 amperes and there is no flexible metal conduit, flexible metallic tubing, or liquidtight flexible metal conduit in metric designators 12 through 16 (trade sizes 3/8 through 1/2) in the effective ground-fault current path.

(15) The combined length of flexible metal conduit, flexible metallic tubing, and liquidtight flexible metal conduit in the same effective ground-fault current path does not exceed 1.8 m (6 ft).

(16) If used to connect equipment where flexibility is necessary to minimize the transmission of vibration from equipment or to provide flexibility for equipment that requires movement after installation, a wire-type equipment grounding conductor shall be installed.

(17) Flexible metallic tubing where the tubing is terminated in listed fittings and meeting the following conditions:

(18) The circuit conductors contained in the tubing are protected by overcurrent devices rated at 20 amperes or less.

(19) The combined length of flexible metal conduit, flexible metallic tubing, and liquidtight flexible metal conduit in the same effective ground-fault current path does not exceed 1.8 m (6 ft).

(20) Armor of Type AC cable as provided in 320.108.

(21) The copper sheath of mineral-insulated, metal-sheathed cable Type MI.

(22) Type MC cable that provides an effective ground-fault current path in accordance with one or more of the following:

(23) It contains an insulated or uninsulated equipment grounding conductor in compliance with 250.118 (1).

(24) The combined metallic sheath and uninsulated equipment grounding/bonding conductor of interlocked metal tape–type MC cable that is listed and identified as an equipment grounding conductor

(25) The metallic sheath or the combined metallic sheath and equipment grounding conductors of the smooth or corrugated tube-type MC cable that is listed and identified as an equipment grounding

conductor

(26) Cable trays as permitted in 392.10 and 392.60.

(27) Cablebus framework as permitted in 370.60(1).

(28) Other listed electrically continuous metal raceways and listed auxiliary gutters.

(29) Surface metal raceways listed for grounding.

(30) Metallic cabinets complying with Article 312, metallic boxes complying with Article 314, and metal wireways complying with Article 376.

Informational Note: For a definition of *effective ground-fault current path*, see Article 100.

Statement of Problem and Substantiation for Public Comment

This proposal does not seek to address a safety issue or cause any change in field practice. Rather, it addresses an oversight in the code language that unintentionally prohibits many common field practices widely recognized as safe. That this is a possible source of confusion is demonstrated by the number of public inputs on the topic.

Namely, there are several types of metallic electrical components that may be used in dry locations without any listing requirement: cabinets under Article 312, boxes under Article 314, and metal wireways under Article 376. These unlisted metallic components are commonly used as part of an effective ground-fault current path, e.g. by interconnecting equipment grounding conductors of the conduit type. As such, they are being used as equipment grounding conductors per the Article 100 definition, and therefore subject to 250.118. However, they match none of the existing categories included in 250.118.

Unless it is the intention of the Committee that these components should not be relied upon to provide an effective ground-fault current path (which would require an extreme change in field practice), they need to be included in 250.118.

Related Item

- 761-NFPA 70-2017

Submitter Information Verification

Submitter Full Name: Wayne Whitney
Organization: None
Affiliation: None
Street Address:
City:
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Zip:
Submittal Date: Mon Jun 25 14:32:38 EDT 2018
Committee: NEC-P05

Public Comment No. 232-NFPA 70-2018 [Section No. 250.118]

250.118 Types of Equipment Grounding Conductors.

The equipment grounding conductor run with or enclosing the circuit conductors shall be one or more or a combination of the following:

(1) A copper, aluminum, or copper-clad aluminum conductor. This conductor shall be solid or stranded; insulated, covered, or bare; and in the form of a wire or a busbar of any shape.

(2) Rigid metal conduit.

(3) Intermediate metal conduit.

(4) Electrical metallic tubing.

(5) Listed flexible metal conduit meeting all the following conditions:

(6) The conduit is terminated in listed fittings.

(7) The circuit conductors contained in the conduit are protected by overcurrent devices rated at 20 amperes or less.

(8) The size of the conduit does not exceed metric designator 35 (trade size 1 1/4).

(9) The combined length of flexible metal conduit, flexible metallic tubing, and liquidtight flexible metal conduit in the same effective ground-fault current path does not exceed 1.8 m (6 ft).

(10) If used to connect equipment where flexibility is necessary to minimize the transmission of vibration from equipment or to provide flexibility for equipment that requires movement after installation, a wire-type equipment grounding conductor shall be installed.

(11) Listed liquidtight flexible metal conduit meeting all the following conditions:

(12) The conduit is terminated in listed fittings.

(13) For metric designators 12 through 16 (trade sizes 3/8 through 1/2), the circuit conductors contained in the conduit are protected by overcurrent devices rated at 20 amperes or less.

(14) For metric designators 21 through 35 (trade sizes 3/4 through 1 1/4), the circuit conductors contained in the conduit are protected by overcurrent devices rated not more than 60 amperes and there is no flexible metal conduit, flexible metallic tubing, or liquidtight flexible metal conduit in metric designators 12 through 16 (trade sizes 3/8 through 1/2) in the effective ground-fault current path.

(15) The combined length of flexible metal conduit, flexible metallic tubing, and liquidtight flexible metal conduit in the same effective ground-fault current path does not exceed 1.8 m (6 ft).

(16) If used to connect equipment where flexibility is necessary to minimize the transmission of vibration from equipment or to provide flexibility for equipment that requires movement after installation, a wire-type equipment grounding conductor shall be installed.

(17) Flexible metallic tubing where the tubing is terminated in listed fittings and meeting the following conditions:

(18) The circuit conductors contained in the tubing are protected by overcurrent devices rated at 20 amperes or less.

(19) The combined length of flexible metal conduit, flexible metallic tubing, and liquidtight flexible metal conduit in the same effective ground-fault current path does not exceed 1.8 m (6 ft).

(20) Armor of Type AC cable as provided in 320.108.

(21) The copper sheath of mineral-insulated, metal-sheathed cable Type MI.

(22) Type MC cable that provides an effective ground-fault current path in accordance with one or more of the following:

(23) It contains an insulated or uninsulated equipment grounding conductor in compliance with 250.118 (1).

(24) The combined metallic sheath and uninsulated equipment grounding/bonding conductor of interlocked metal tape–type MC cable that is listed and identified as an equipment grounding conductor

(25) The metallic sheath or the combined metallic sheath and equipment grounding conductors of the smooth or corrugated tube-type MC cable that is listed and identified as an equipment grounding

conductor

(26) Cable trays as permitted in 392.10 and 392.60.

(27) Cablebus framework as permitted in 370.60(1).

(28) Other listed electrically continuous metal raceways and listed auxiliary gutters.

(29) Surface metal raceways listed for grounding.

(30) metal boxes, metal conduit bodies, metal cabinets, metal cutout boxes, metal meter socket enclosures, and other listed metal enclosures.

Informational Note: For a definition of *effective ground-fault current path*, see Article 100.

Statement of Problem and Substantiation for Public Comment

This new item #15 is needed to clarify that metal boxes, cabinets and other metal enclosures are permitted to be used for grounding and bonding of metal raceways, metal cables, and other metal equipment that is connected to the metal box, cabinet or enclosure. For example, when installing 2 metal cables into a metal cabinet, the grounding connection between the 2 cables is ultimately established by connecting the cables to the metal cabinet, but there is no section in the code that specifically permits using the metal cabinet as the equipment grounding conductor, even though that is actually what is being done. We could say the same thing when using EMT, RMC or other metal raceways that are permitted to be used as an equipment grounding conductor. If no green or bare equipment grounding wire is installed in the raceway, then grounding/bonding connections are ultimately being established to the EMT or RMC via the metal cabinets or the metal boxes to which the raceways are connected. The code should specifically recognize this practice, otherwise it is a violation if bonding bushings and bonding jumpers are not used for bonding raceway to raceway, raceway to equipment grounding terminal bar, cable to cable, or cable to equipment grounding terminal bar, etc. etc. when connecting these wiring methods to metal cabinets, boxes etc. The Committee statement for PI 2979 was not completely accurate. “The NEC presently addresses the use of metal enclosures and covers in the equipment grounding conductor path (example 250.110)”. In fact, it reaffirms my contention that metal cabinets and boxes are NOT equipment grounding conductors, since they are REQUIRED to be connected to an equipment grounding conductor! The wording in 250.118 clearly states, “The equipment grounding conductor run with or enclosing the circuit conductors SHALL BE one or more or a combination of the following”….. Metal boxes, metal cabinets, and other metal enclosures enclosing circuit conductors are NOT on that list and therefore are not equipment grounding conductors. Until the code wording is revised, a receptacle with a bonding jumper connected to a grounded metal box is NOT actually connected to an equipment grounding conductor as required by 406.4(B). Metal raceways connected to metal cabinets are NOT connected to equipment grounding conductors. Luminaires connected to metal boxes are NOT connected to an equipment grounding conductor as required by Part V of Article 410. And so on and so forth.

Related Item

• PI 2979

Submitter Information Verification

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Committee: NEC-P05

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Public Comment No. 448-NFPA 70-2018 [Section No. 250.118]

250.118 Types of Equipment Grounding Conductors.

The equipment grounding conductor run with or enclosing the circuit conductors shall be one or more or a combination of the following:

(1) A copper, aluminum, or copper-clad aluminum conductor. This conductor shall be solid or stranded; insulated, covered, or bare; and in the form of a wire or a busbar of any shape.

(2) Rigid metal conduit.

(3) Intermediate metal conduit.

(4) Electrical metallic tubing.

(5) Listed flexible metal conduit meeting all the following conditions:

(6) The conduit is terminated in listed fittings.

(7) The circuit conductors contained in the conduit are protected by overcurrent devices rated at 20 amperes or less.

(8) The size of the conduit does not exceed metric designator 35 (trade size 1 1/4).

(9) The combined length of flexible metal conduit, flexible metallic tubing, and liquidtight flexible metal conduit in the same effective ground-fault current path does not exceed 1.8 m (6 ft).

(10) If used to connect equipment where flexibility is necessary to minimize the transmission of vibration from equipment or to provide flexibility for equipment that requires movement after installation, a wire-type equipment grounding conductor shall be installed.

(11) Listed liquidtight flexible metal conduit meeting all the following conditions:

(12) The conduit is terminated in listed fittings.

(13) For metric designators 12 through 16 (trade sizes 3/8 through 1/2), the circuit conductors contained in the conduit are protected by overcurrent devices rated at 20 amperes or less.

(14) For metric designators 21 through 35 (trade sizes 3/4 through 1 1/4), the circuit conductors contained in the conduit are protected by overcurrent devices rated not more than 60 amperes and there is no flexible metal conduit, flexible metallic tubing, or liquidtight flexible metal conduit in metric designators 12 through 16 (trade sizes 3/8 through 1/2) in the effective ground-fault current path.

(15) The combined length of flexible metal conduit, flexible metallic tubing, and liquidtight flexible metal conduit in the same effective ground-fault current path does not exceed 1.8 m (6 ft).

(16) If used to connect equipment where flexibility is necessary to minimize the transmission of vibration from equipment or to provide flexibility for equipment that requires movement after installation, a wire-type equipment grounding conductor shall be installed.

(17) Flexible metallic tubing where the tubing is terminated in listed fittings and meeting the following conditions:

(18) The circuit conductors contained in the tubing are protected by overcurrent devices rated at 20 amperes or less.

(19) The combined length of flexible metal conduit, flexible metallic tubing, and liquidtight flexible metal conduit in the same effective ground-fault current path does not exceed 1.8 m (6 ft).

(20) Armor of Type AC cable as provided in 320.108.

(21) The copper sheath of mineral-insulated, metal-sheathed cable Type MI.

(22) Type MC cable that provides an effective ground-fault current path in accordance with one or more of the following:

(23) It contains an insulated or uninsulated equipment grounding conductor in compliance with 250.118 (1).

(24) The combined metallic sheath and uninsulated equipment grounding/bonding conductor of interlocked metal tape–type MC cable that is listed and identified as an equipment grounding conductor

(25) The metallic sheath or the combined metallic sheath and equipment grounding conductors of the smooth or corrugated tube-type MC cable that is listed and identified as an equipment grounding

conductor

(26) Cable trays as permitted in 392.10 and 392.60.

(27) Cablebus framework as permitted in 370.60(1).

(28) Other listed electrically continuous metal raceways and listed auxiliary gutters.

(29) Surface metal raceways listed for grounding.

(30) Metallic cabinets, cutout, outlet, device, pull and junction boxes and conduit bodies

Informational Note: For a definition of *effective ground-fault current path*, see Article 100.

Additional Proposed Changes

File Name	Description	Approved
box.jpg	4" square box (not an EGC)	
cover.jpg	4" cover requires a connection to EGC	
duplex.jpg	receptacle requires a connection to an EGC	
raised_cover.jpg	raised cover (not an EGC)	
panel.jpg	panelboard cabinet and equipment grounding bar	

Statement of Problem and Substantiation for Public Comment

(NOTE) the software has underlined things that should not have underlined...the only change is new list item 15) The conduit bodies, junction boxes, panel cabinets and other enclosures are commonly used as equipment grounding conductors, but there is no language in the code that actually tells the code user that these items can be used as equipment grounding conductors. The panel comment that these items are not listed as grounding and bonding equipment makes the acceptance of this change even more important. If they are not listed as bonding and grounding equipment how can they be used as equipment grounding conductors?

The code strongly implies that a cabinet that encloses a panelboard is an equipment grounding conductor by permitting the main bonding jumper to be a screw. The code needs to specifically tell the code user that the enclosures that we all currently use as EGCs actually are EGCs. If the code cannot do that, then extensive revisions would be required to the sections that require various devices and equipment to be connected to an EGC.

I have attached two pairs of pictures as examples.

The first pair being a 4" square metal cover and a 4" square metal box. 314.25(A) sends us to 250.110 for the grounding requirement related to the 4" cover. 250.110 tells us that the box cover must be connected to an equipment grounding conductor. The only permitted equipment grounding conductors are the list items in 250.118. The 4" box that the cover will be attached to is not one of the items in the list found in 250.118. Compliance with the code language currently requires that the box cover be connected to a wire type equipment grounding conductor. We all know that the box cover is not connected to a wire type grounding or bonding conductor and that that have not been safety issues with the cover being bonded by the screws to the box itself. This PI is just to make the code language match what it common practice in the field.

We have the same thing with the second pair of pictures were the receptacle grounding terminal is required to be connected to an equipment grounding conductor per the rule in 406.4(B). The raised cover that the receptacle may be installed in is not an equipment grounding conductor.

There are many other examples like this in the NEC. This PI is intended to address those issues by specifically permitting metal enclosures to be used as equipment grounding conductors.

Related Item

- Public Input No. 2979-NFPA 70-2017
- Public Input No. 1382-NFPA 70-2017
- Public Input No. 2584-NFPA 70-2017
- Public Input No. 3205-NFPA 70-2017

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Public Comment No. 682-NFPA 70-2018 [Section No. 250.119]

250.119 Identification of Equipment Grounding Conductors of the Wire Type .

Unless required elsewhere in this *Code,* equipment grounding conductors ~~shall~~ of the wire type shall be permitted to be bare, covered, or insulated. Individually covered or insulated equipment grounding conductors shall have a continuous outer finish that is either green or green with one or more yellow stripes except as permitted in this section. Conductors with insulation or individual covering that is green, green with one or more yellow stripes, or otherwise identified as permitted by this section shall not be used for ungrounded or grounded circuit conductors.

Exception No. 1: Power-limited Class 2 or Class 3 cables, power-limited fire alarm cables, or communications cables containing only circuits operating at less than 50 volts where connected to equipment not required to be grounded in accordance with 250.112(I) shall be permitted to use a conductor with green insulation or green with one or more yellow stripes for other than equipment grounding purposes.

Exception No. 2: Flexible cords having an integral insulation and jacket without an equipment grounding conductor shall be permitted to have a continuous outer finish that is green.

Informational Note: An example of a flexible cord with integral-type insulation is Type SPT-2, 2 conductor.

Exception No. 3: Conductors with green insulation shall be permitted to be used as ungrounded signal conductors where installed between the output terminations of traffic signal control and traffic signal indicating heads. Signaling circuits installed in accordance with this exception shall include an equipment grounding conductor in accordance with 250.118. Wire-type equipment grounding conductors shall be bare or have insulation or covering that is green with one or more yellow stripes.

(A) Conductors 4 AWG and Larger.

Equipment grounding conductors 4 AWG and larger shall comply with 250.119(A)(1) and (A)(2).

(1) An insulated or covered conductor 4 AWG and larger shall be permitted, at the time of installation, to be permanently identified as an equipment grounding conductor at each end and at every point where the conductor is accessible.

Exception: Conductors 4 AWG and larger shall not be required to be marked in conduit bodies that contain no splices or unused hubs.

(2) Identification shall encircle the conductor and shall be accomplished by one of the following:

(3) Stripping the insulation or covering from the entire exposed length

(4) Coloring the insulation or covering green at the termination

(5) Marking the insulation or covering with green tape or green adhesive labels at the termination

(B) Multiconductor Cable.

One or more insulated conductors in a multiconductor cable, at the time of installation, shall be permitted to be permanently identified as equipment grounding conductors at each end and at every point where the conductors are accessible by one of the following means:

(1) Stripping the insulation from the entire exposed length.

(2) Coloring the exposed insulation green.

(3) Marking the exposed insulation with green tape or green adhesive labels. Identification shall encircle the conductor.

(C) Flexible Cord.

Equipment grounding conductors in flexible cords shall be insulated and shall have a continuous outer finish that is either green or green with one or more yellow stripes.

Statement of Problem and Substantiation for Public Comment

I suggest adding 'of the wire type' since EGC can be of different types.

Related Item

• PI-1743

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Committee: NEC-P05

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Public Comment No. 1354-NFPA 70-2018 [Section No. 250.119(B)]

(B) Multiconductor Cable.

~~One~~ Where the conditions of maintenacne and supervision ensure that only qualified persons service the installation, one or more insulated conductors in a multiconductor cable, at the time of installation, shall be permitted to be permanently identified as equipment grounding conductors at each end and at every point where the conductors are accessible by one of the following means:

(1) Stripping the insulation from the entire exposed length.

(2) Coloring the exposed insulation green.

(3) Marking the exposed insulation with green tape or green adhesive labels. Identification shall encircle the conductor.

Statement of Problem and Substantiation for Public Comment

Public Input No. 2784 should have been rejected by CMP-5. Restore the text as it currently is worded in the 2017 NEC. There is a lack of correlation with CMP-5's response to PI 2775 for 200.6(E) and PI 2784 for 250.119(B). For NEC 200.6(E), CMP-5's Committee Statement rejected Public Input No. 2775 stating the "Removal of the requirement for conditions of maintenance and supervision would negate the general rule requirements of identification of the grounded conductor in all installations and would be in contradiction of the general requirement for continuous identification of the grounded conductor upon its entire length." The same argument should be made for 250.119(B); in other words, the equipment grounding conductor in multiconductor cables must be identified in accordance with the parent text in 250.119 for its entire length, except where only qualified persons will service the installation. In summary, the removal of the requirement for special conditions and qualified persons negates the general rule for the proper identification of equipment grounding conductors for any installation that uses multiconductor cables; negating the general rule could have serious unintended consequences and result in extremely dangerous situations. Please restore the text for 250.119(B) as it currently is worded in the 2017 NEC.

Related Item

• PI 2775, FR 7625, PI 2784, FR 8043

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Public Comment No. 2068-NFPA 70-2018 [Section No. 250.119(B)]

(B) Multiconductor Cable.

One or more insulated conductors in a multiconductor cable, at the time of installation, shall be permitted to be permanently identified as equipment grounding conductors at each end and at every point where the conductors are accessible by one of the following means:

(1) Stripping the insulation from the entire exposed length.

(2) Coloring the exposed insulation green.

(3) Marking the exposed insulation with green tape or green adhesive labels. Identification shall encircle the conductor.

Statement of Problem and Substantiation for Public Comment

The deletion of the wording "Where the conditions of maintenance and supervision ensure that only qualified persons service the installation" highly increases the danger of electrocution to not only maintenance personal and installers, but also end users. Especially when dealing with the smaller multiconductor cable the chance of error increases greatly. The lack of identification is a problem now just dealing with ungrounded conductors. Adding one more conductor to be identified would just add to the existing problem.

Related Item

• FR8043

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Public Comment No. 733-NFPA 70-2018 [Section No. 250.119(B)]

(B) Multiconductor Cable.

~~One~~ Where conditions of maintenance and supervision ensure that only qualified persons service the installation, one or more insulated conductors in a multiconductor cable, at the time of installation, shall be permitted to be permanently identified as equipment grounding conductors at each end and at every point where the conductors are accessible by one of the following means:

(1) Stripping the insulation from the entire exposed length.

(2) Coloring the exposed insulation green.

(3) Marking the exposed insulation with green tape or green adhesive labels. Identification shall encircle the conductor.

Statement of Problem and Substantiation for Public Comment

The First Revision to remove the Conditions of Maintenance and Supervision requirement is inconsistent with similar requirements for Grounded Conductors in multiconductor cables in accordance with 200.6(E). Panel 5 voted in favor of modifying 200.6(E) to more closely align it with the general requirements rules for identification of 6 AWG and smaller required to be continuously identified and 4 AWG and larger permitted to be reidentified and rejected the same type of proposal to remove the conditional of maintenance and supervision in 200.6(E) Exception No. 1 The two rules should be consistent with each other, removal of conditions of maintenance and supervision effectively negates the general rule for continuous identification of all equipment grounding conductors in any multi-conductor cable. This is a huge safety concern as any color conductor would be allowed to be re-identified and there effectively is no requirement at all to require a continuous green identified EGC in a multi-conductor cable. A multi-conductor cable used as branch circuit wiring method, to terminate to receptacles, switches, any device would be allowed by this change to re-identify a spare black or red conductor with green tape to identify the EGC. I see this as a huge safety concern to any installer, or those maintaining or troubleshooting this type of installation. The language of "Conditions of Maintenance and Supervision" is not archaic, but rather to allow it in is those closely controlled installations to allow the use of other types of cables. All other installations need to still require a continuously green identified EGC for safety.

Related Item

• FR-7625, FR-8043

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Public Comment No. 1258-NFPA 70-2018 [Section No. 250.119 [Excluding any Sub-Sections]]

Unless required elsewhere in this *Code,* equipment grounding conductors shall be permitted to be bare, covered, or insulated. Individually covered or insulated equipment grounding conductors shall have a continuous outer finish that is either green or green with one or more yellow stripes except as permitted in this section. Conductors with insulation or individual covering that is green, green with one or more yellow stripes, or otherwise identified as permitted by this section shall not be used for ungrounded or grounded circuit conductors.

Exception No. 1: Power-limited Class 2 or Class 3 cables, power-limited fire alarm cables, or communications cables containing only circuits operating at less than ~~50 volts~~ 60 volts where connected to equipment not required to be grounded in accordance with 250.112(I) shall be permitted to use a conductor with green insulation or green with one or more yellow stripes for other than equipment grounding purposes.

Exception No. 2: Flexible cords having an integral insulation and jacket without an equipment grounding conductor shall be permitted to have a continuous outer finish that is green.

Informational Note: An example of a flexible cord with integral-type insulation is Type SPT-2, 2 conductor.

Exception No. 3: Conductors with green insulation shall be permitted to be used as ungrounded signal conductors where installed between the output terminations of traffic signal control and traffic signal indicating heads. Signaling circuits installed in accordance with this exception shall include an equipment grounding conductor in accordance with 250.118. Wire-type equipment grounding conductors shall be bare or have insulation or covering that is green with one or more yellow stripes.

Statement of Problem and Substantiation for Public Comment

This comment is filed on behalf of the IEEE 802.3 Working Group. For reference, this comment is labeled IEEE802.3#1.
The addition of PoE to 725.144 in the 2017 NEC has the unintended consequence that green conductors in a Category cable must be equipment ground. 250.119 Exemption No. 1 allows green conductors to not be equipment ground, but only for circuits of less than 50V. Some IEEE compliant standardized PoE systems have a minimum port voltage of 50V and all of them limit maximum port voltage to 57V. Therefore, IEEE compliant PoE does not qualify for the exemption, making hundreds of millions of PoE installations violate the Code. This exemption was added from the inception of this text, specifically for Category cabling. If these Ethernet ports were forced to follow Code, they would not be functioning today as the requirement to have the green conductors be equipment ground would halt communication. An exemption in practice exists where it does not exist in text – hundreds of millions of these ports have been installed for almost 20 years operating at or above 50V with zero record of loss. IEEE 802.3 requests to fix the exemption by changing 50V to 60V. When PoE was developed, 60V was chosen as the maximum allowable voltage based on the Safety Extra Low Voltage (SELV) section of IEC/UL 60950.

Related Public Comments for This Document

Related Comment	Relationship
Public Comment No. 1259-NFPA 70-2018 [Section No. 250.119 [Excluding any Sub-Sections]]	
Public Comment No. 1259-NFPA 70-2018 [Section No. 250.119 [Excluding any Sub-Sections]]	

Related Item

• PI-1743

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Committee: NEC-P05

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Public Comment No. 1259-NFPA 70-2018 [Section No. 250.119 [Excluding any Sub-Sections]]

Unless required elsewhere in this *Code,* equipment grounding conductors shall be permitted to be bare, covered, or insulated. Individually covered or insulated equipment grounding conductors shall have a continuous outer finish that is either green or green with one or more yellow stripes except as permitted in this section. Conductors with insulation or individual covering that is green, green with one or more yellow stripes, or otherwise identified as permitted by this section shall not be used for ungrounded or grounded circuit conductors.

Exception No. 1: Power-limited Class 2 or Class 3 cables, power-limited fire alarm cables, or communications cables containing only circuits operating at less than 50 volts where connected to equipment not required to be grounded in accordance with 250.112(I) shall be permitted to use a conductor with green insulation or green with one or more yellow stripes for other than equipment grounding purposes.~~Exception No. 2~~

Exception No. 2: Systems using Category cabling as described in ANSI/TIA-568.2-D-2018 that have 2.25kV DC or 1.5kV AC isolation from earth ground to the twisted pair signal conductors shall be permitted to use a conductor with green insulation or green with one or more stripes for other than equipment grounding purposes.

Exception No. 3 : Flexible cords having an integral insulation and jacket without an equipment grounding conductor shall be permitted to have a continuous outer finish that is green.

Informational Note: An example of a flexible cord with integral-type insulation is Type SPT-2, 2 conductor.

Exception No. ~~3~~ 4 : Conductors with green insulation shall be permitted to be used as ungrounded signal conductors where installed between the output terminations of traffic signal control and traffic signal indicating heads. Signaling circuits installed in accordance with this exception shall include an equipment grounding conductor in accordance with 250.118. Wire-type equipment grounding conductors shall be bare or have insulation or covering that is green with one or more yellow stripes.

Statement of Problem and Substantiation for Public Comment

This comment is filed on behalf of the IEEE 802.3 Working Group. This is a companion comment to a previous comment labeled IEEE802.3#1. If IEEE802.3#1 is accepted, this comment is withdrawn.
The addition of PoE to 725.144 in the 2017 NEC has the unintended consequence that green conductors in a Category cable must be equipment ground. 250.119 Exception No. 1 intends to allow Category cable to have green covered or insulated individual conductors that are not equipment ground but limits the exemption to 50V, therefore excluding PoE systems which operate up to 60V (based on the SELV section of IEC/UL 60950). An alternate solution to raising the voltage in Exception No. 1 to 60V is to add a new exception.

Related Public Comments for This Document

Related Comment	Relationship
Public Comment No. 1258-NFPA 70-2018 [Section No. 250.119 [Excluding any Sub-Sections]]	
Public Comment No. 1258-NFPA 70-2018 [Section No. 250.119 [Excluding any Sub-Sections]]	

Related Item

• PI-1743

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Committee: NEC-P05

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Public Comment No. 1469-NFPA 70-2018 [Section No. 250.119 [Excluding any Sub-Sections]]

Unless required elsewhere in this *Code,* equipment grounding conductors shall be permitted to be bare, covered, or insulated. Individually covered or insulated equipment grounding conductors shall have a continuous outer finish that is either green or green with one or more yellow stripes except as permitted in this section. Conductors with insulation or individual covering that is green, green with one or more yellow stripes, or otherwise identified as permitted by this section shall not be used for ungrounded or grounded circuit conductors.

Exception No. 1: Power-limited Class 2 or Class 3 cables, power-limited fire alarm cables, or communications cables containing only circuits operating at less than 50 volts ac or 60 volts dc where connected to equipment not required to be grounded in accordance with 250.112(I) shall be permitted to use a conductor with green insulation or green with one or more yellow stripes for other than equipment grounding purposes.

Exception No. 2: Flexible cords having an integral insulation and jacket without an equipment grounding conductor shall be permitted to have a continuous outer finish that is green.

Informational Note: An example of a flexible cord with integral-type insulation is Type SPT-2, 2 conductor.

Exception No. 3: Conductors with green insulation shall be permitted to be used as ungrounded signal conductors where installed between the output terminations of traffic signal control and traffic signal indicating heads. Signaling circuits installed in accordance with this exception shall include an equipment grounding conductor in accordance with 250.118. Wire-type equipment grounding conductors shall be bare or have insulation or covering that is green with one or more yellow stripes.

Statement of Problem and Substantiation for Public Comment

The Panel's response to PI 1743 was that no technical justification was provided for the shift from 50 Volts to 60 Volts. This public comment
follows up and focuses on the primary issue of 50 V vs. 60 V.

For decades, green wiring has been used within 4-pair LAN Cabling, according to the color codes for pairs in ANSI/TIA-568-C. This has been used for data communications and for Class 2 power + data communications, including Power over Ethernet. While these systems have been deployed for more than 15 years in the hundreds of millions without a record of loss, attention has recently been drawn to them by the inclusion of Article 725.144 in NEC 2017. These systems use DC SELV (Safety Extra Low Voltage) powering greater than 50V and less than 60V. Grounding the green insulated conductors within these cables would result in nonfunctional Ethernet and PoE systems, meaning that the green insulated conductors within the 4-pair LAN cabling has been left ungrounded in the field to date, a de facto exception to the code, without any record of hazard or loss. This Public comment would bring the existing practice of nearly half a billion systems in line with the code, with no impact to safety.

The practice of not grounding the green conductor has resulted in no documented records of loss or hazards, and, has been a of a de-facto exception to the code, as 250.119 has been ignored for Ethernet systems. The panel attempted to exempt Category cable when it first made the exception in 5-141 and 5-264 during the 2008 comment cycle. However, the comment submitted for 5-264 cited only 50 volt systems, without further substantiation of why 50 V and not 60 V dc as referenced in other parts of the code. This appears to have been an oversight at the time, perhaps thinking, incorrectly, these circuits were only used under article 840. They are also used for article 725.144 applications.

Voltage and current limitations on Ethernet and Power over Ethernet systems exceed 50 Volts, but not 60 Volts, and are consistent with Class 2 power source limitations, which are considered safe from electrical shock under the code, per the definition in 725.2. Numerous sections of the code consider 60 volt DC levels safe for exposure and electric shock. Additionally, Class 2 power systems include with appropriate limits for current levels under Table 11(B).

There has been concern that OSHA regulations limit safety at 50 volts, but the hazards cited by OSHA are generally outside the limitations of class 2 power sources – with currents cited at over 100 Amperes, well above the corresponding current of V-A limitations connected with class 2 power sources (Examples cited in OSHA Standards Interpretations – Guarding Requirements for 50 volts or more DC https://www.osha.gov/laws-

regs/standardinterpretations/2015-09-04: including examples, https://www.osha.gov/pls/imis /accidentsearch.accident_detail?id=775742&id=14295083."). The example cited is "USING A MOTOR-GENERATOR ARC WELDER SET AT 135 AMPERES, DC", or cases working with (non-current limited) batteries shorted across rings, all current levels and time durations would be far above those allowed by class 2 power sources provided for in this exception.

As such, extending the exception to class 2 power sources is both consistent with existing practice for LAN cabling, safety specifications including UL 60950, 62368 and numerous other sections of the NEC, including the definitions of Class 2 and Class 3 power sources, as well as under protections for live parts of circuits. The proposed modification is consistent with other references in the NEC where 50 volts is generally associated with the safe voltage for AC circuits and 60 volts for DC. UL 60950-1 also specifies 60 Volts as the limit for SELV (safe) DC power. 60 Volts is an accepted limit for DC power in Table 11(B). There are numerous sections of the code where 60 volts DC is the threshold for extra safety and grounding requirements, and others, related to AC where 50 volts is the limit. One particular example is Article 445.14 which relates to grounding, as it is about protection of live parts of generators where there might be a shock hazard from a lack of ground:

445.14 Protection of Live Parts. Live parts of generators operated at more than 50 volts ac or 60 volts dc to ground shall not be exposed to accidental contact where accessible to unqualified persons.

Expanding the exception to up to 50 volts ac and 60 volts dc will be consistent with the code, with safety specifications, and with existing safe practice, providing guidance so that 250.119 may be properly enforced and followed.

Related Item

• Public Input No. 1743-NFPA 70-2017 [Section No. 250.119 [Excluding any Sub-Sections]]

Submitter Information Verification

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Committee: NEC-P05

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Public Comment No. 174-NFPA 70-2018 [Section No. 250.119 [Excluding any Sub-Sections]]

Unless required elsewhere in this *Code,* equipment grounding conductors shall be permitted to be bare, covered, or insulated. Individually covered or insulated equipment grounding conductors shall have a continuous outer finish that is either green or green with one or more yellow stripes except as permitted in this section. Conductors with insulation or individual covering that is green, green with one or more yellow stripes, or otherwise identified as permitted by this section shall not be used for ungrounded or grounded circuit conductors.

Exception No. 1: Power-limited Class 2 or Class 3 cables installed in compliance with Part III of Article 725 , power-limited fire alarm cables ~~, or communications cables containing only circuits operating at less than 50 volts where connected to equipment not required to be grounded in accordance with 250.112(I)~~ installed in compliance with Part III of Article 760, and communications cables installed in compliance with 725.154(A), 760.154(A) or Part V of Article 805 shall be permitted to use a conductor with green insulation or green with one or more yellow stripes for other than equipment grounding purposes.

Exception No. 2: Flexible cords having an integral insulation and jacket without an equipment grounding conductor shall be permitted to have a continuous outer finish that is green.

Informational Note: An example of a flexible cord with integral-type insulation is Type SPT-2, 2 conductor.

Exception No. 3: Conductors with green insulation shall be permitted to be used as ungrounded signal conductors where installed between the output terminations of traffic signal control and traffic signal indicating heads. Signaling circuits installed in accordance with this exception shall include an equipment grounding conductor in accordance with 250.118. Wire-type equipment grounding conductors shall be bare or have insulation or covering that is green with one or more yellow stripes.

Statement of Problem and Substantiation for Public Comment

Class 2, Class 3, power-limited fire alarm and communications cables all have a color code that includes green wires. These green wires are not intended for grounding, they are signal wires. This is a practice that has existed for many, many years with no incident of safety or hazard. Class 2 and Class 3 power-limited circuits of Article 725 are permitted to operate at voltages up to 150 volts (see Tables 11A and 11B). The present 50-volt restriction of Exception No. 1 precludes the use of green-insulated conductors as signal conductors above 50 volts, conflicting with Article 725 and creating a correlation issue.
Similarly, communications conductors of Chapter 8, Articles 800 (new), 805 (new), 830 and 840 utilize green insulated conductors as signal conductors. Here, once again, this practice has existed for many, many years with no incident of safety or hazard. Some applications of communications conductors, such as Power over ethernet (PoE) as introduced in the NEC 2017 Edition, Section 840.160, are permitted to operate at 60 volts on communications conductors. The present 50-volt restriction of Exception No. 1 precludes the use of green insulated conductors as signal conductors in PoE applications operating above 50 volts. While 250.119 does not apply to the articles of Chapter 8 per 90.3, the 50-volt limit of 250.119, Exception No. 1 conflicts with the permitted applications in Chapter 8, causes confusion, and adversely impacts NEC usability.

Related Item

• PI 1743

Submitter Information Verification

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Submittal Date: Fri Jul 06 15:47:59 EDT 2018

Committee: NEC-P05

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Public Comment No. 188-NFPA 70-2018 [Section No. 250.119 [Excluding any Sub-Sections]]

Unless required elsewhere in this *Code,* equipment grounding conductors shall be permitted to be bare, covered, or insulated. Individually covered or insulated equipment grounding conductors shall have a continuous outer finish that is either green or green with one or more yellow stripes except as permitted in this section. Conductors with insulation or individual covering that is green, green with one or more yellow stripes, or otherwise identified as permitted by this section shall not be used for ungrounded or grounded circuit conductors.

Exception No. 1: Power-limited Class 2 or Class 3 cables installed in cmpliance with Part III of Article 725 , power-limited fire alarm cables ~~, or communications cables containing only circuits operating at less than 50 volts where connected to equipment not required to be grounded in accordance with 250.112(I)~~ installed in compliance with Part III of Article 760, and communications cables installed in compliance with 725.154(A), 760.154(A) or Part V of Article 805 shall be permitted to use a conductor with green insulation or green with one or more yellow stripes for other than equipment grounding purposes.

Exception No. 2: Flexible cords having an integral insulation and jacket without an equipment grounding conductor shall be permitted to have a continuous outer finish that is green.

Informational Note: An example of a flexible cord with integral-type insulation is Type SPT-2, 2 conductor.

Exception No. 3: Conductors with green insulation shall be permitted to be used as ungrounded signal conductors where installed between the output terminations of traffic signal control and traffic signal indicating heads. Signaling circuits installed in accordance with this exception shall include an equipment grounding conductor in accordance with 250.118. Wire-type equipment grounding conductors shall be bare or have insulation or covering that is green with one or more yellow stripes.

Statement of Problem and Substantiation for Public Comment

All Class 2 and Class 3 circuit cables, including communications cables substituting for Class 2 and Class 3 cables, installed in compliance with Article 725, all power-limited and non-power-limited fire alarm circuit cables, including communications cables substituting for fire alarm cables, installed in compliance with Article 760, and all communications cables installed in compliance with Chapter 8, should be exempt from 250.119. All of these cables employ green wires as signal wires that are not intended to be ground wires.

Class 2, Class 3, fire alarm and communications cables are constructed differently from "power cables" which have green ground wires.

If 250.119 were applied to Articles 725, 760 and Chapter 8, the total industry would be put upside down and come to a complete stop. We would not be able to submit this Public Comment because the internet and the telephone system would be shut down.

Related Item

• PI 1743

Submitter Information Verification

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Submittal Date: Mon Jul 09 14:07:31 EDT 2018
Committee: NEC-P05

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Public Comment No. 1974-NFPA 70-2018 [Section No. 250.119 [Excluding any Sub-Sections]]

Unless required elsewhere in this *Code,* equipment grounding conductors shall be permitted to be bare, covered, or insulated. Individually covered or insulated equipment grounding conductors shall have a continuous outer finish that is either green or green with one or more yellow stripes except as permitted in this section. Conductors with insulation or individual covering that is green, green with one or more yellow stripes, or otherwise identified as permitted by this section shall not be used for ungrounded or grounded circuit conductors.

Exception No. 1: Power-limited Class 2 or Class 3 cables, power-limited fire alarm cables, or communications cables containing only circuits operating at less than 50 volts ***ac or 60 volts dc*** *where connected to equipment not required to be grounded in accordance with 250.112(I) shall be permitted to use a conductor with green insulation or green with one or more yellow stripes for other than equipment grounding purposes.*

Exception No. 2: Flexible cords having an integral insulation and jacket without an equipment grounding conductor shall be permitted to have a continuous outer finish that is green.

Informational Note: An example of a flexible cord with integral-type insulation is Type SPT-2, 2 conductor.

Exception No. 3: Conductors with green insulation shall be permitted to be used as ungrounded signal conductors where installed between the output terminations of traffic signal control and traffic signal indicating heads. Signaling circuits installed in accordance with this exception shall include an equipment grounding conductor in accordance with 250.118. Wire-type equipment grounding conductors shall be bare or have insulation or covering that is green with one or more yellow stripes.

Statement of Problem and Substantiation for Public Comment

The Panel's response to PI 1743 was that no technical justification was provided for the shift from 50 Volts to 60 Volts. This public comment follows up and focuses on the primary issue of 50 V vs. 60 V.

For decades, green wiring has been used within 4-pair LAN Cabling, according to the color codes for pairs in ANSI/TIA-568-C. This has been used for data communications and for Class 2 power + data communications, including Power over Ethernet. While these systems have been deployed for more than 15 years in the hundreds of millions without a record of loss, attention has recently been drawn to them by the inclusion of Article 725.144 in NEC 2017. These systems use DC SELV (Safety Extra Low Voltage) powering greater than 50V and less than 60V. Grounding the green insulated conductors within these cables would result in nonfunctional Ethernet and PoE systems, meaning that the green insulated conductors within the 4-pair LAN cabling has been left ungrounded in the field to date, a de facto exception to the code, without any record of hazard or loss. This Public comment would bring the existing practice of nearly half a billion systems in line with the code, with no impact to safety.

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There has been concern that OSHA regulations limit safety at 50 volts, but the hazards cited by OSHA are generally outside the limitations of class 2 power sources – with currents cited at over 100 Amperes, well above the corresponding current of V-A limitations connected with class 2 power sources (Examples cited in OSHA Standards Interpretations – Guarding Requirements for 50 volts or more DC https://www.osha.gov/laws-regs/standardinterpretations/2015-09-04: including examples, https://www.osha.gov/pls/imis

/accidentsearch.accident_detail?id=775742&id=14295083."). The example cited is "USING A MOTOR-GENERATOR ARC WELDER SET AT 135 AMPERES, DC", or cases working with (non-current limited) batteries shorted across rings, all current levels and time durations would be far above those allowed by class 2 power sources provided for in this exception.

As such, extending the exception to class 2 power sources is both consistent with existing practice for LAN cabling, safety specifications including UL 60950, 62368 and numerous other sections of the NEC, including the definitions of Class 2 and Class 3 power sources, as well as under protections for live parts of circuits. The proposed modification is consistent with other references in the NEC where 50 volts is generally associated with the safe voltage for AC circuits and 60 volts for DC. UL 60950-1 also specifies 60 Volts as the limit for SELV (safe) DC power. 60 Volts is an accepted limit for DC power in Table 11(B). There are numerous sections of the code where 60 volts DC is the threshold for extra safety and grounding requirements, and others, related to AC where 50 volts is the limit. One particular example is Article 445.14 which relates to grounding, as it is about protection of live parts of generators where there might be a shock hazard from a lack of ground:

445.14 Protection of Live Parts. Live parts of generators operated at more than 50 volts ac or 60 volts dc to ground shall not be exposed to accidental contact where accessible to unqualified persons.

Expanding the exception to up to 50 volts ac and 60 volts dc will be consistent with the code, with safety specifications, and with existing safe practice, providing guidance so that 250.119 may be properly enforced and followed.

Related Item

• PI 1743

Submitter Information Verification

Submitter Full Name: Jeff Silveira
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Committee: NEC-P05

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Public Comment No. 204-NFPA 70-2018 [Section No. 250.119 [Excluding any Sub-Sections]]

Unless required elsewhere in this *Code,* equipment grounding conductors shall be permitted to be bare, covered, or insulated. Individually covered or insulated equipment grounding conductors shall have a continuous outer finish that is either green or green with one or more yellow stripes except as permitted in this section. Conductors with insulation or individual covering that is green, green with one or more yellow stripes, or otherwise identified as permitted by this section shall not be used for ungrounded or grounded circuit conductors.

Exception No. 1: Power-limited Class 2 ~~or~~ and Class 3 cables, and power-limited fire alarm cables, ~~or communications cables~~ containing only circuits operating at less than 50 volts where connected to equipment not required to be grounded in accordance with 250.112(I) shall be permitted to use a conductor with green insulation or green with one or more yellow stripes for other than equipment grounding purposes.

Exception No. 2: Flexible cords having an integral insulation and jacket without an equipment grounding conductor shall be permitted to have a continuous outer finish that is green.

Informational Note: An example of a flexible cord with integral-type insulation is Type SPT-2, 2 conductor.

Exception No. 3: Conductors with green insulation shall be permitted to be used as ungrounded signal conductors where installed between the output terminations of traffic signal control and traffic signal indicating heads. Signaling circuits installed in accordance with this exception shall include an equipment grounding conductor in accordance with 250.118. Wire-type equipment grounding conductors shall be bare or have insulation or covering that is green with one or more yellow stripes.

Statement of Problem and Substantiation for Public Comment

Section 250.119 has requirements for communications cables without a specific reference from Chapter 8, consequently 250.119 is is in conflict with 90.3.

Section 90.3 Code Arrangement states:

"Chapter 8 covers communications systems and is not subject to the requirements of Chapters 1 through 7 except where the requirements are specifically referenced in Chapter 8.

The recommended text of this Public Comment removes the conflict by deleting the inclusion of communications cables from 250.119.

Related Item

• PI 1743

Submitter Information Verification

Submitter Full Name: Terry Peters
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Committee: NEC-P05

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Public Comment No. 584-NFPA 70-2018 [Section No. 250.119 [Excluding any Sub-Sections]]

Unless required elsewhere in this *Code,* equipment grounding conductors shall be permitted to be bare, covered, or insulated. Individually covered or insulated equipment grounding conductors shall have a continuous outer finish that is either green or green with one or more yellow stripes except as permitted in this section. Conductors with insulation or individual covering that is green, green with one or more yellow stripes, or otherwise identified as permitted by this section shall not be used for ungrounded or grounded circuit conductors.

Exception No. 1: Power-limited Class 2 or Class 3 cables, power-limited fire alarm cables, or communications cables containing only circuits operating at less than 50 volts where connected to equipment not required to be grounded in accordance with 250.112(I) shall be permitted to use a conductor with green insulation or green with one or more yellow stripes for other than equipment grounding purposes.

Exception No. 2: Flexible cords having an integral insulation and jacket without an equipment grounding conductor shall be permitted to have a continuous outer finish that is green.

Informational Note: An example of a flexible cord with integral-type insulation is Type SPT-2, 2 conductor.

Exception No. 3: Conductors with green insulation shall be permitted to be used as ungrounded signal conductors where installed between the output terminations of traffic signal control and traffic signal indicating heads. Signaling circuits installed in accordance with this exception shall include an equipment grounding conductor in accordance with 250.118. Wire-type equipment grounding conductors shall be bare or have insulation or covering that is green with one or more yellow stripes.

Exception No. 4: Where it is obvious that the equipment grounding conductor is the wiring method itself as described in 250.120(A), no additional marking or indication shall be required.

Statement of Problem and Substantiation for Public Comment

If taken literally, the current language, to the extent of marking of the equipment grounding conductor, makes no distinction between an actual "wire" conductor and a metal wiring method, (i.e. metal sheath, EMT, RMC, etc.) which also would be required to be so indicated using the marking methods prescribed. It is a technical "loophole" that could and should be closed.

Related Item

• 250.119 • 250.120(A) • 210.5(B)

Submitter Information Verification

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Committee: NEC-P05

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Public Comment No. 1745-NFPA 70-2018 [Section No. 250.120(B)]

(B) Aluminum and Copper-Clad Aluminum Conductors.

Equipment grounding conductors of bare, covered, or insulated aluminum or copper-clad aluminum shall comply with the following:

(1) Bare or covered conductors shall not be installed where subject to corrosive conditions or be installed in direct contact with concrete, masonry, or the earth.

(2) Terminations ~~made~~ within ~~listed enclosures identified for outdoor use shall~~ outdoor equipment enclosures that are listed and identified for the environment shall be permitted within 450 mm (18 in.) of the ~~earth~~ bottom of the enclosure if the equipment is listed and identifiedfor connection of aluminum or copper-clad conductors at that location . If open bottom enclosures are installed on a concrete pad that is at or below grade , the concrete ~~shall not be considered as earth~~ pad shall be sloped so moisture will not accumulate within the enclosure .

(3) Aluminum or copper-clad aluminum conductors external to buildings or equipment enclosures shall not be terminated within 450 mm (18 in.) of the earth, unless insulated and the insulation is suitable for the environment . The termination shall be listed as a sealed wire-connector system.

Statement of Problem and Substantiation for Public Comment

No substantiation was submitted or considered that will prove that concrete that is at or below grade level is considered to be a dry location. It has been proven that concrete is fairly porous and will retain moisture thus it is effective as a vital component of concrete-encased grounding electrodes.
No substantiation has been submitted to support the allegation that the interior of enclosures that are identified for a wet location are in fact a dry location. This location should be considered to be a location that is corrosive to aluminum connections until proven otherwise.
Equipment enclosures must be identified as suitable for connecting aluminum and copper-clad aluminum conductors.
For insulated aluminum and copper-clad aluminum conductors that are installed outdoors, it is important that they have insulation that is suitable for the environment where they are to be installed to avoid corrosion.

Related Item

• FR-8066

Submitter Information Verification

Submitter Full Name: Phil Simmons
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Committee: NEC-P05

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Public Comment No. 1964-NFPA 70-2018 [Section No. 250.120(B)]

(B) Aluminum and Copper-Clad Aluminum Conductors.

Equipment grounding conductors of bare, covered, or insulated aluminum or copper-clad aluminum shall comply with the following:

(1) ~~Bare~~ Non-insulated conductors shall not be installed where subject to corrosive conditions or be installed in direct contact with masonry the earth.

(2) Terminations made within listed sealed enclosures identified for outdoor use shall be permitted within 450 mm (18 in.) of the earth. ~~If open bottom enclosures are installed on a concrete pad, the concrete shall not be considered as earth.~~

(3) Aluminum or copper-clad aluminum conductors external to buildings or enclosures shall not be terminated within 450 mm (18 in.) of the earth, unless insulated. The termination shall be listed as a sealed wire-connector system.

Statement of Problem and Substantiation for Public Comment

Sub-section (2) does not specify that the enclosure needs to be sealed. The interior of an open-bottom enclosure is a wet location. Concrete pads retain moisture and can be corrosive, They are an extension of the earth. The term "covered" is defined as "not recognized by this Code as insulated" and aluminum and copper-clad aluminum should not be allowed within 18 inches of the earth if not insulated.

Related Item

• PI 2797

Submitter Information Verification

Submitter Full Name: David Brender
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Street Address:
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State:
Zip:
Submittal Date: Thu Aug 30 13:11:09 EDT 2018
Committee: NEC-P05

Public Comment No. 411-NFPA 70-2018 [Section No. 250.121]

250.121 ~~Prohibited~~ Use of Equipment Grounding Conductors.

(A) Grounding Electrode Conductor.

An equipment grounding conductor shall not be used as a grounding electrode conductor.

Exception: A wire-type equipment grounding conductor installed in compliance ~~with 250.6(A) and~~ the applicable requirements for both the equipment grounding conductor and the grounding electrode conductor in Parts II, III, and VI of this article shall be permitted to serve as both an equipment grounding conductor and a grounding electrode conductor.

(B) Metal Frame of Building or Structure.

The structural metal frame of a building or structure shall not be used as an equipment grounding conductor.

Statement of Problem and Substantiation for Public Comment

1. 250.121(A) exception permits the EGC to be used as the GEC under the conditions of the exception. So the title can't be Prohibited Use of Equipment Grounding Conductor, since the exception permits a use.
1. Delete reference to 250.6(A) since this rule always applies and I can't figure out why this reference is in this exception. All this reference does is add confusion.

Related Item

• FR-7544

Submitter Information Verification

Submitter Full Name: Mike Holt
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Zip:
Submittal Date: Sun Aug 05 14:05:50 EDT 2018
Committee: NEC-P05

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☑ By checking this box I affirm that I am Mike Holt, and I agree to be legally bound by the above Copyright Assignment and the terms and conditions contained therein. I understand and intend that, by checking this box, I am creating an electronic signature that will, upon my submission of this form, have the same legal force and effect as a handwritten signature

Public Comment No. 258-NFPA 70-2018 [Section No. 250.121(A)]

(A) Grounding Electrode Conductor.

An equipment grounding conductor shall not be used as a grounding electrode conductor.

Exception: A wire-type equipment grounding conductor installed in compliance with 250.6(A) and the applicable requirements for both the equipment grounding conductor and the grounding electrode conductor in Parts II, III, and VI of this article shall be permitted to serve as both an equipment grounding conductor and a grounding electrode conductor. A caution label shall be installed with the following: Caution

This enclosure has a combination Grounding electrode and Equipment grounding conductor. Removal of this connection may cause the service to become ungrounded.

Statement of Problem and Substantiation for Public Comment

I would not rather wait until someone gets hurt in order to identify a condition that is likely to happen. By means of which a simple label can avoid.

Related Item

• Public Input No. 854-NFPA 70-2017

Submitter Information Verification

Submitter Full Name: Alfio Torrisi
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Submittal Date: Sun Jul 22 10:00:23 EDT 2018
Committee: NEC-P05

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Public Comment No. 1260-NFPA 70-2018 [Section No. 250.121(B)]

250.118 (B) Metal Frame of Building or Structure.

The structural metal frame of a building or structure shall not be used as an equipment grounding conductor.

Statement of Problem and Substantiation for Public Comment

The newly added prohibition on the use of building steel does not belong in a section titled "Prohibited use of Equipment Grounding Conductors". The only thing that belongs under that title would be rules that restrict the use of an Equipment Grounding Conductor. The building steel is not an EGC and the (B) subsection does not address the use of EGCs. Maybe 250.118 is not the correct location for the new rule either, but it certainly does not belong in 250.121.

Related Item

• First Revision No. 7544-NFPA 70-2018

Submitter Information Verification

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Submittal Date: Fri Aug 24 16:03:47 EDT 2018
Committee: NEC-P05

Public Comment No. 259-NFPA 70-2018 [Section No. 250.121(B)]

~~**(B)** Metal Frame of Building or Structure.~~

~~The structural metal frame of a building or structure shall not be used as an equipment grounding conductor.~~

Statement of Problem and Substantiation for Public Comment

this is already addressed in section 250.136 (A)

Related Item

• Public Input No. 854-NFPA 70-2017

Submitter Information Verification

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Committee: NEC-P05

Public Comment No. 1222-NFPA 70-2018 [Section No. 250.122]

250.122 Size of Equipment Grounding Conductors.

(A) General.

Copper, aluminum, or copper-clad aluminum equipment grounding conductors of the wire type shall not be smaller than shown in Table 250.122 . The equipment grounding conductor shall not be required to be larger than the circuit conductors supplying the equipment. If a cable tray, a raceway, or a cable armor or sheath is used as the equipment grounding conductor, as provided in 250.118 and 250.134(A), it shall comply with 250.4(A)(5) or (B)(4).

Equipment grounding conductors shall be permitted to be sectioned within a multiconductor cable, provided the combined circular mil area complies with Table 250.122 .

(B) Multiple Circuits.

A single equipment grounding conductor shall be permitted to be installed for multiple circuits that are installed in the same raceway, cable, or cable tray. It shall be sized from Table 250.122 for the largest circuit conductor in the raceway, cable, or cable tray. Equipment grounding conductors installed in cable trays shall meet the minimum requirements of 392.10(B)(1)(c) .

(C) Motor Circuits.

Equipment grounding conductors for motor circuits shall be sized in accordance with (C)(1) or (C)(2).

(1) General.

The equipment grounding conductor size shall not be smaller than determined by Table 250.122 based on the size of the branch-circuit short-circuit or feeder conductor.

(2) Instantaneous-Trip Circuit Breaker and Motor Short-Circuit Protector.

If the overcurrent device is an instantaneous-trip circuit breaker or a motor short-circuit protector, the equipment grounding conductor shall be sized not smaller than that given by Table 250.122 using the size of the branch-circuit conductor.

(D) Flexible Cord and Fixture Wire.

The equipment grounding conductor in a flexible cord with the largest circuit conductor 10 AWG or smaller, and the equipment grounding conductor used with fixture wires of any size in accordance with 240.5, shall not be smaller than 18 AWG copper and shall not be smaller than the circuit conductors. The equipment grounding conductor in a flexible cord with a circuit conductor larger than 10 AWG shall be sized in accordance with Table 250.122 .

(E) Conductors in Parallel.

For circuits of parallel conductors as permitted in 310.10(G) , the equipment grounding conductor shall be installed in accordance with 250.122(E)(1) or (E)(2). Equipment grounding conductors that are not smaller than that provided in Table 250.122 shall be permitted to be connected in parallel for circuit conductors that are connected in parallel.

~~**(1)** Conductor Installations in Raceways, Auxiliary Gutters, or Cable Trays.~~

~~(a) *Single Raceway or Cable Tray, Auxiliary Gutter , or Cable Tray* . Equipment grounding conductors for circuit conductors that are connected in parallel in the same raceway, auxiliary gutter, or cable tray shall be installed in compliance with one of the following:~~

~~(2) An equipment grounding conductor shall be installed with each set of circuit conductors that are connected in parallel. The wire-type equipment grounding conductor for each set shall be sized in accordance with Table 250.122 .~~

~~(3) A single wire-type equipment grounding conductor shall be installed and sized in accordance with Table 250.122 , based on the total circular mil area of the largest set of circuit conductors for any phase that is connected in parallel. Where the total area does not result in a standard size conductor, the next larger conductor shall be selected from Chapter 9, Table 8.~~

~~(d) *Multiple Raceways* . If conductors are installed in parallel in multiple raceways, wire-type equipment grounding conductors, where used, shall be installed in parallel in each raceway. The equipment grounding conductor installed in each raceway shall be sized in compliance with 250.122 based on the largest circuit conductor in the raceway. Metal raceways or auxiliary gutters in accordance with 250.118 or cable trays complying with 392.60(B) shall be permitted as the equipment grounding conductor.~~

~~(e) *Wire-Type Equipment Grounding Conductors.* Wire-type equipment grounding conductors installed in cable trays shall meet the minimum requirements of 392.10(B)(1)(c).~~

~~(f) *Metal Raceways, Auxiliary Gutters, or Cable Trays.* Metal raceways or auxiliary gutters in accordance with 250.188 or cable trays complying with 392.60(B) shall be permitted as the equipment grounding conductor.~~

~~**(2)** Multiconductor Cables.~~

~~(a) If circuit conductors of multiconductor cables are connected in parallel, the equipment grounding conductor(s) in each cable shall be connected in parallel.~~

~~(b) The equipment grounding conductor in each multiconductor cable shall be sized in compliance with Table 250.122 .~~

~~(c) Equipment grounding conductors installed in cable trays shall meet the minimum requirements of 392.10(B)(1) (c). Cable trays complying with 392.60(B) , metal raceways in accordance with 250.118 , or auxiliary gutters shall be permitted as the equipment grounding conductor.~~

~~**(F)** Feeder Taps.~~

~~Equipment grounding conductors installed with feeder taps shall not be smaller than shown in Table 250.122 based on the size of the feeder conductor on the supply side ahead of the tap but shall not be required to be larger than the tap conductors.~~

~~Table 250.122 Minimum Size Equipment Grounding Conductors for Grounding Raceway and Equipment~~

~~Size of Largest Ungrounded Circuit Conductor (AWG or kcmil) Smallest Size of Equipment Grounding Conductor (AWG or kcmil) Copper Aluminum or Copper-clad Aluminum Copper Aluminum or Copper-clad Aluminum* 14 12 14 12 12 10 12 10 10–8 8–6 10 8 6–3 4–1 8 6 2–3/0 1/0–4/0 6 4 4 /0–300 250–450 4 2 350–550 500–800 3 1 600–800 900–1300 2 1/0 900–1300 1400–2000 1 2 /0 1400–2000 – 1/0 3/0~~

~~Notes:~~

~~1. If necessary to comply with 250.4(A)(5) or (B)(4), the equipment grounding conductor shall be sized larger than given in this table.~~

~~2. If the equivalent area of the largest ungrounded circuit conductor is larger than 2000 kcmil in a single raceway, auxiliary gutter, or cable tray, the equipment grounding conductor shall have an area not less than 12 1/2 percent of the equivalent area of the largest ungrounded conductor.~~

~~*See installation restrictions in 250.120.~~

Statement of Problem and Substantiation for Public Comment

This FR should be rejected for numerous reasons as outlined here. Any single concern would be enough to reject the revision, but taken together there should be no serious argument.

1. Why? Not a rhetorical question; What problem is being remedied by such a major change to a basic requirement in 250.122 that has served us well for over 50 years. It is neither improving safety nor improving usability. It is often difficult to determine the size of installed conductors because of orientation of the markings, spacing of the markings between the end of a cable sheath or raceway and the terminations, poor lighting (and aging eyesight), etc. The OCPD is visible and readily accessible, and it is simple to use that to size the EGC. I can't recall anyone arguing that the basic sizing requirements of 250.122 were confusing, inaccurate, or inadequate. The FR will add confusion and make enforcement more difficult.
2. One rational for the change is to be consistent with sizing of GEC's, supply side bonding jumpers, grounded conductors, etc. But no research was done into the development of sizing of those conductors. Using the OCPD to size grounding conductors is more precise and safer than conductor sizing that can introduce numerous variables (60C, 75C, even 90C sizing in some instances, each necessitating a different size EGC, increasing confusion. I think we are letting the tail wag the dog here; we should be examining the adequacy of the sizing requirements of Tables 250.66 and 250.102 rather than using these "best guess" requirements to drive the more accurate OCPD based technology; the former being requirements that most experts admit are based on the hope that a connection or conductor burns off before major damage is done.
3. How does this apply when using ampacity tables other than 310.15(B)(16)? A 4/0 CU conductor with 75C insulation has an ampacity of 230 amperes per Table . . . (16), but an ampacity of 360 amperes per Table . . . (17). The differences are even more stark when compared to some of the other ampacity tables. Of course Table 310.16(B)(15) is the most common for general use, but those other tables are also used in many installations. Is a circuit protected with a 250 Ampere device equally safe when protected with a 400 ampere device using the same ground fault return wire? My conclusion is that it is either oversized for the first installation or undersized for the later, but it can't possibly be "just right" for both.
4. The technical substantiation presented, that this is consistent with a couple UL standards, offers only circular reasoning, in that UL states that the values in the standards are based on the NEC requirements. And the chosen standards represent only a couple specific, very controlled configurations of conductor relationship. There are no such controlled configurations when conductors are installed in raceways or in free air, and the impedances are different for each. Using standards not available to all of the CMP members, and the public, means they cannot be fully evaluated. There are also UL cable standards which require different size EGC's, but have direct access to those is also restricted. This needs to be fully examined.
5. There are very serious concerns regarding the change to the paralleling requirements. These were introduced some 50 years ago, certainly because of real concerns for safety. There was no investigation or research into the history of the requirement, and no statement about why it is now wrong or unnecessary. This requirement has been explained in highly regarded publications for decades and also explained in countless meetings, seminars, and training classes, often by CMP – 5 members. If the requirement and engineering is now to be abandoned, I would hope to be able to explain what new understanding has been uncovered after half a century, or what new technology now makes such a drastic change equally safe. If either of the rationales exist, they were not used in the PI or the discussions and neither the Panel members nor the public has had the opportunity to evaluate them.
6. The FR does resolve the inconsistency between upsizing the EGC when the ungrounded conductors are upsized. It has never made sense that upsizing from a 10 AWG to an 8 AWG requires an equivalent increase in the size of the EGC, when a 10 AWG EGC is adequate for circuits with overcurrent protection of 30, 35, 40, 45, 50 and 60 amperes. However, I believe this issue can be resolved much more easily and eloquently than completely upending our application of ground fault return path with such thin technical support.
7. In numerous conversations with overcurrent device manufacturers from the time CMP-5 finished its work in Hilton Head until the present, all have expressed concern over the ability to protect circuits under the provisions of FR 8114 as well as per the current code requirements. While sizing of the equipment grounding conductor is under the purview of CMP-5, safety is only achieved if the overcurrent protection clears a fault in the minimum time possible, so this issue is really deserves coordination between Panels 5 and 10 in order to insure proper electrical safety.

Related Item

• FR8114

Submitter Information Verification

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Submittal Date: Fri Aug 24 13:30:02 EDT 2018
Committee: NEC-P05

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Public Comment No. 1290-NFPA 70-2018 [Section No. 250.122]

250.122 Size of Equipment Grounding Conductors.

(A) General.

Copper, aluminum, or copper-clad aluminum equipment grounding conductors of the wire type shall not be smaller than shown in Table 250.122 . The equipment grounding conductor shall not be required to be larger than the circuit conductors supplying the equipment. If a cable tray, a raceway, or a cable armor or sheath is used as the equipment grounding conductor, as provided in 250.118 and 250.134(A), it shall comply with 250.4(A)(5) or (B)(4).

Equipment grounding conductors shall be permitted to be sectioned within a multiconductor cable, provided the combined circular mil area complies with Table 250.122 .

(B) Multiple Circuits.

A single equipment grounding conductor shall be permitted to be installed for multiple circuits that are installed in the same raceway, cable, or cable tray. It shall be sized from Table 250.122 for the largest circuit conductor in the raceway, cable, or cable tray. Equipment grounding conductors installed in cable trays shall meet the minimum requirements of 392.10(B)(1)(c) .

(C) Motor Circuits.

Equipment grounding conductors for motor circuits shall be sized in accordance with (C)(1) or (C)(2).

(1) General.

The equipment grounding conductor size shall not be smaller than determined by Table 250.122 based on the size of the branch-circuit short-circuit or feeder conductor.

(2) Instantaneous-Trip Circuit Breaker and Motor Short-Circuit Protector.

If the overcurrent device is an instantaneous-trip circuit breaker or a motor short-circuit protector, the equipment grounding conductor shall be sized not smaller than that given by Table 250.122 using the size of the branch-circuit conductor.

(D) Flexible Cord and Fixture Wire.

The equipment grounding conductor in a flexible cord with the largest circuit conductor 10 AWG or smaller, and the equipment grounding conductor used with fixture wires of any size in accordance with 240.5, shall not be smaller than 18 AWG copper and shall not be smaller than the circuit conductors. The equipment grounding conductor in a flexible cord with a circuit conductor larger than 10 AWG shall be sized in accordance with Table 250.122 .

(E) Conductors in Parallel.

For circuits of parallel conductors as permitted in 310.10(G) , the equipment grounding conductor shall be installed in accordance with 250.122(E)(1) or (E)(2). Equipment grounding conductors that are not smaller than that provided in Table 250.122 shall be permitted to be connected in parallel for circuit conductors that are connected in parallel.

(1) Conductor Installations in Raceways, Auxiliary Gutters, or Cable Trays.

(a) *Single Raceway or Cable Tray, Auxiliary Gutter , or Cable Tray* . Equipment grounding conductors for circuit conductors that are connected in parallel in the same raceway, auxiliary gutter, or cable tray shall be installed in compliance with one of the following:

(2) An equipment grounding conductor shall be installed with each set of circuit conductors that are connected in parallel. The wire-type equipment grounding conductor for each set shall be sized in accordance with Table 250.122 .

(3) A single wire-type equipment grounding conductor shall be installed and sized in accordance with Table 250.122 , based on the total circular mil area of the largest set of circuit conductors for any phase that is connected in parallel. Where the total area does not result in a standard size conductor, the next larger conductor shall be selected from Chapter 9, Table 8.

(d) *Multiple Raceways* . If conductors are installed in parallel in multiple raceways, wire-type equipment grounding conductors, where used, shall be installed in parallel in each raceway. The equipment grounding conductor installed in each raceway shall be sized in compliance with 250.122 based on the largest circuit conductor in the raceway. Metal raceways or auxiliary gutters in accordance with 250.118 or cable trays complying with 392.60(B) shall be permitted as the equipment grounding conductor.

(e) *Wire-Type Equipment Grounding Conductors.* Wire-type equipment grounding conductors installed in cable trays shall meet the minimum requirements of 392.10(B)(1)(c).

(f) *Metal Raceways, Auxiliary Gutters, or Cable Trays.* Metal raceways or auxiliary gutters in accordance with 250.188 or cable trays complying with 392.60(B) shall be permitted as the equipment grounding conductor.

(2) Multiconductor Cables.

(a) If circuit conductors of multiconductor cables are connected in parallel, the equipment grounding conductor(s) in each cable shall be connected in parallel.

(b) The equipment grounding conductor in each multiconductor cable shall be sized in compliance with Table 250.122 .

(c) Equipment grounding conductors installed in cable trays shall meet the minimum requirements of 392.10(B)(1) (c). Cable trays complying with 392.60(B) , metal raceways in accordance with 250.118 , or auxiliary gutters shall be permitted as the equipment grounding conductor.

(F) Feeder Taps.

Equipment grounding conductors installed with feeder taps shall not be smaller than shown in Table 250.122 based on the size of the feeder conductor on the supply side ahead of the tap but shall not be required to be larger than the tap conductors.

Table 250.122 Minimum Size Equipment Grounding Conductors for Grounding Raceway and Equipment

Size of Largest Ungrounded Circuit Conductor (AWG or kcmil) Smallest Size of Equipment Grounding Conductor (AWG or kcmil) Copper Aluminum or Copper-clad Aluminum Copper Aluminum or Copper-clad Aluminum* 14 12 14 12 12 10 12 10 10–8 8–6 10 8 6–3 4–1 8 6 2–3/0 1/0–4/0 6 4 4 /0–300 250–450 4 2 350–550 500–800 3 1 600–800 900–1300 2 1/0 900–1300 1400–2000 1 2 /0 1400–2000 – 1/0 3/0 ----------

Notes:

1. If necessary to comply with 250.4(A)(5) or (B)(4), the equipment grounding conductor shall be sized larger than given in this table.

2. If the equivalent area of the largest ungrounded circuit conductor is larger than 2000 kcmil in a single raceway, auxiliary gutter, or cable tray, the equipment grounding conductor shall have an area not less than 12 **1/2** percent of the equivalent area of the largest ungrounded conductor.

*See installation restrictions in 250.120.

Delete all FR-8114 editing and return text to the 2017 version.

Statement of Problem and Substantiation for Public Comment

Despite the very high level of work which was obviously put into this editing effort, I believe that the original

justification is flawed, and that added unintentional affects have not been noticed. I doubt that the concept should ever be evaluated as valid, but far more study is certainly required for such a massive change in concept.

There is absolutely no justification for increasing an EGC where the ungrounded conductor has been increased in size due to ampacity deration (IE: ambient heat, bundled conductors, etc.). These deration requirements are imposed to protect the integrity of the insulation.

There is also no justification to allow the decrease in size of the EGC in the case of a qualifying dwelling feeder where the ungrounded conductor is reduced in size. The overcurrent device activation points do not change, and the EGC should be sized by the OC device.

There is some justification to increasing the EGC for cases where the ungrounded conductors are increased due to voltage drop. The need is probably exaggerated, but is covered by the existing 2017 Code.

The EGC has one high-current purpose - to carry fault current for the very short time required to activate the overcurrent device. It must have sufficiently low impedance to allow this to occur. It must not suffer a “fuse-failure” by overheating and melting. The existing Code has done an admirable job of this for decades. It has done an admirable job because the EGC is already required to be of a very conservative size, requiring a conductor size which is likely larger than that technically required to pass sufficient current without fuse-failure. This has been proven over many decades of experience.

The increased sensitivity and higher performance of modern overcurrent devices only makes the sizing of the EGC in accordance with existing 2017 Code even more conservative.

The magnetic fields of this fault current from the involved conductors, which are by Code in close proximity to one another, essentially cancel each other. The matching/cancelling current in a slightly larger ungrounded conductor cannot add impedance which would cause an order of magnitude decrease in the fault current such that the overcurrent device might not activate.

Far better engineering study, and cross-effect analysis of other sections of the Code is required before this massive change in NEC standards can possibly be enacted.

Related Item

• 8114

Submitter Information Verification

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Committee: NEC-P05

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Public Comment No. 1444-NFPA 70-2018 [Section No. 250.122]

250.122 Size of Equipment Grounding Conductors.

(A) General.

Copper, aluminum, or copper-clad aluminum equipment grounding conductors of the wire type shall not be smaller than shown in Table 250.122. The equipment grounding conductor shall not be required to be larger than the circuit conductors supplying the equipment. If a cable tray, a raceway, or a cable armor or sheath is used as the equipment grounding conductor, as provided in 250.118 and 250.134(A), it shall comply with 250.4(A)(5) or (B)(4).

Equipment grounding conductors shall be permitted to be sectioned within a multiconductor cable, provided the combined circular mil area complies with Table 250.122.

(B) Multiple Circuits.

A single equipment grounding conductor shall be permitted to be installed for multiple circuits that are installed in the same raceway, cable, or cable tray. It shall be sized from Table 250.122 for the largest circuit conductor in the raceway, cable, or cable tray. Equipment grounding conductors installed in cable trays shall meet the minimum requirements of 392.10(B)(1)(c).

(C) Motor Circuits.

Equipment grounding conductors for motor circuits shall be sized in accordance with (C)(1) or (C)(2).

(1) General.

The equipment grounding conductor size shall not be smaller than determined by Table 250.122based on the size of the branch-circuit short-circuit or feeder conductor.

(2) Instantaneous-Trip Circuit Breaker and Motor Short-Circuit Protector.

If the overcurrent device is an instantaneous-trip circuit breaker or a motor short-circuit protector, the equipment grounding conductor shall be sized not smaller than that given by Table 250.122 using the size of the branch-circuit conductor.

(D) Flexible Cord and Fixture Wire.

The equipment grounding conductor in a flexible cord with the largest circuit conductor 10 AWG or smaller, and the equipment grounding conductor used with fixture wires of any size in accordance with 240.5, shall not be smaller than 18 AWG copper and shall not be smaller than the circuit conductors. The equipment grounding conductor in a flexible cord with a circuit conductor larger than 10 AWG shall be sized in accordance with Table 250.122.

(E) Conductors in Parallel.

For circuits of parallel conductors as permitted in 310.10(G), the equipment grounding conductor shall be installed in accordance with 250.122(E)(1) or (E)(2). Equipment grounding conductors that are not smaller than that provided in Table 250.122 shall be permitted to be connected in parallel for circuit conductors that are connected in parallel.

(1) Conductor Installations in Raceways, Auxiliary Gutters, or Cable Trays.

(a) *Single Raceway or Cable Tray, Auxiliary Gutter*, *or Cable Tray*. Equipment grounding conductors for circuit conductors that are connected in parallel in the same raceway, auxiliary gutter, or cable tray shall be installed in compliance with one of the following:

(1) An equipment grounding conductor shall be installed with each set of circuit conductors that are connected in parallel. The wire-type equipment grounding conductor for each set shall be sized in accordance with Table 250.122.

(2) A single wire-type equipment grounding conductor shall be installed and sized in accordance with Table 250.122, based on the total circular mil area of the largest set of circuit conductors for any phase that is connected in parallel. Where the total area does not result in a standard size conductor, the next larger conductor shall be selected from Chapter 9, Table 8.

(b) *Multiple Raceways*. If conductors are installed in parallel in multiple raceways, wire-type equipment grounding conductors, where used, shall be installed in parallel in each raceway. The equipment grounding conductor installed in each raceway shall be sized in compliance with 250.122 based on the largest circuit conductor in the raceway. Metal raceways or auxiliary gutters in accordance with 250.118 or cable trays complying with 392.60(B) shall be permitted as the equipment grounding conductor.

(c) *Wire-Type Equipment Grounding Conductors.* Wire-type equipment grounding conductors installed in cable trays shall meet the minimum requirements of 392.10(B)(1)(c).

(d) *Metal Raceways, Auxiliary Gutters, or Cable Trays.* Metal raceways or auxiliary gutters in accordance with 250.188 or cable trays complying with 392.60(B) shall be permitted as the equipment grounding conductor.

(2) Multiconductor Cables.

(a) If circuit conductors of multiconductor cables are connected in parallel, the equipment grounding conductor(s) in each cable shall be connected in parallel.

(b) The equipment grounding conductor in each multiconductor cable shall be sized in compliance with Table 250.122.

(c) Equipment grounding conductors installed in cable trays shall meet the minimum requirements of 392.10(B)(1)(c). Cable trays complying with 392.60(B), metal raceways in accordance with 250.118, or auxiliary gutters shall be permitted as the equipment grounding conductor.

(F) Feeder Taps.

Equipment grounding conductors installed with feeder taps shall not be smaller than shown in Table 250.122 based on the size of the feeder conductor on the supply side ahead of the tap but shall not be required to be larger than the tap conductors.

Table 250.122 Minimum Size Equipment Grounding Conductors for Grounding Raceway and Equipment

Size of Largest Ungrounded Circuit Conductor (AWG or kcmil)		Smallest Size of Equipment Grounding Conductor (AWG or kcmil)					
Copper	Aluminum or Copper-clad Aluminum	Copper	Aluminum or Copper-clad Aluminum*				
14	12	14	12				
12	10	12	10				
10–8	8–6	10	8				
~~6–3~~	4–1	8	6				
~~2–3~~ 2-2 /0	1/0–4/0	6	4				
4 ~~–~~ 3 /0–300	250–450	4	2				
350–550	500–800	~~3~~ 1	1/0				
600–800	900–1300	~~2~~	1/0	~~900–1300~~	~~1400–2000~~	~~1~~ ~~2~~ 3 /0	
900–1300	1400–2000	~~–~~	~~1/0~~	3/0	250		
1400–2000	–	250					
-	-	-	-				
-	-	-	-				
-	-	-	-				
-	-	-	-				
-	-	-	-				
-	-	-	-				
-	-	-	-				
-	-	-	-				
300							

Notes:

1. If necessary to comply with 250.4(A)(5) or (B)(4), the equipment grounding conductor shall be sized larger than given in this table.

2. If the equivalent area of the largest ungrounded circuit conductor is larger than 2000 kcmil in a single raceway, auxiliary gutter, or cable tray, the equipment grounding conductor shall have an area not less than 12 ½ percent of the equivalent area of the largest ungrounded conductor.

*See installation restrictions in 250.120.

Additional Proposed Changes

File Name	Description	Approved
NEC_2021_PC_1444.xlsx	Spreadsheet showing revisions made to Table 250.122.	
PC_1444_Attachment.xlsx		

Statement of Problem and Substantiation for Public Comment

This Comment examines the equipment grounding conductors throughout Table 250.122 and makes revisions to ensure the equipment grounding conductor is not smaller than 12.5% of ungrounded circuit conductor for all sizes of ungrounded circuit conductors not just ungrounded circuit conductors larger than 2000 kcmil. This will also

ensure that all the equipment grounding conductors provide an effective ground-fault current path. It also ensures that the equipment grounding conductor is not smaller than 12.5 percent of the ungrounded circuit conductors for motor applications.The following revisions were made:
1. Copper conductor range of 2 - 3/0 AWG was revised to 2- 2/0 AWG to reflect action taken at the first draft meeting.
2.Copper conductor range of 4/0 - 300 kcmil was revised to 3/0- 350 kcmil to be consistent.
3. EGC for 350 kcmil- 550 kcmil (CU) and 500- 800 (Al) were revised from 3 AWG to 1 AWG (cu) and from #1 AWG to 1/0 AWG (Al).
4. EGC for 600- 800 (Cu) and 900- 1300 (Al) were revised from # 2 AWG to 1/0 AWG (cu) and 1/0 AWG to 3/0 AWG (Al)
5.EGC for 900- 1300 (Cu) and 1400- 2000 (Al) were revised from #1 AWG to 3/0 AWG (Cu) ; and from 3/0 AWG-250 kcmil(AL)
6. EGC for 1400- 2000 (Cu) were revised from 1/0 AWG (cu) to 250 kcmil (cu) and from 3/0 AWG to 300 kcmil (Al)

Related Item

• FR 8114

Submitter Information Verification

Submitter Full Name: Daleep Mohla
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Submittal Date: Tue Aug 28 15:59:45 EDT 2018
Committee: NEC-P05

Table 250.122 Minimum Size Equipment Grounding Conductors for Grounding Raceway and Equipment

Size of Largest Ungrounded Circuit Conductor or Equivalent Area for Parallel Conductors (AWG or kcmil)		Smallest Size of Equipment Grounding Conductor (AWG or kcmil)	
Copper	Aluminum or Copper-clad Aluminum	Copper	Aluminum or Copper-clad Aluminum*
14	12	14	12
12	10	12	10
10-8	8-6	10	8
6-3	4-1	8	6
2- ~~**3/0**~~**2/0**	1/0 - 4/0	6	4
~~**4/0**~~ **3/0 - 300**	250 - 450	4	2
350 - 550	500 - 800	~~3~~ **1**	~~1~~ **1/0**
600 - 800	900 - 1300	~~2~~ **1/0**	~~1/0~~ **3/0**
900 - 1300	1400 - 2000	~~1~~ **3/0**	~~2/0~~ **250**
1400 - 2000	-	~~1/0~~ **250**	~~3/0~~ **300**

Notes:

1. If necessary to comply with 250.4(A)(5) or (B)(4), the equipment grounding conductor shall be sized larger than given in this table.
2. If the equivalent area of the largest ungrounded circuit conductors is larger than 2000 kcmil in a single raceway, auxiliary gutter, or cable tray, the equipment grounding conductor shall have an area not less than 12½ percent of the equivalent area of the largest ungrounded conductors.

*See installation restrictions in 250.120.

Table 250.122 Minimum Size Equipment Grounding Conductors for Grounding Raceway and Equipment

Size of Largest Ungrounded Circuit Conductor or Equivalent Area for Parallel Conductors (AWG or kcmil)		Smallest Size of Equipment Grounding Conductor (AWG or kcmil)	
Copper	Aluminum or Copper-clad Aluminum	Copper	Aluminum or Copper-clad Aluminum*
14	12	14	12
12	10	12	10
10-8	8-6	10	8
6-3	4-1	8	6
2-2/0	1/0 - 4/0	6	4
3/0 - 300	250 - 450	4	2
350 - 550	500 - 800	~~3~~ **1**	~~1~~ **1/0**
600 - 800	900 - 1300	~~2~~ **1/0**	~~1/0~~ **3/0**
900 - 1300	1400 - 2000	~~1~~ **3/0**	~~2/0~~ **250**
1400 - 2000	-	~~1/0~~ **250**	~~3/0~~ **300**

Notes:

1. If necessary to comply with 250.4(A)(5) or (B)(4), the equipment grounding conductor shall be sized larger than given in this table.
2. If the equivalent area of the largest ungrounded circuit conductors is larger than 2000 kcmil in a single raceway, auxiliary gutter, or cable tray, the equipment grounding conductor shall have an area not less than 12½ percent of the equivalent area of the largest ungrounded conductors.

*See installation restrictions in 250.120.

Public Comment No. 1666-NFPA 70-2018 [Section No. 250.122]

250.122 Size of Equipment Grounding Conductors.

(A) General.

Copper, aluminum, or copper-clad aluminum equipment grounding conductors of the wire type shall not be smaller than shown in Table 250.122 . The equipment grounding conductor shall not be required to be larger than the circuit conductors supplying the equipment. If a cable tray, a raceway, or a cable armor or sheath is used as the equipment grounding conductor, as provided in 250.118 and 250.134(A), it shall comply with 250.4(A)(5) or (B)(4).

Equipment grounding conductors shall be permitted to be sectioned within a multiconductor cable, provided the combined circular mil area complies with Table 250.122 .

(B) Multiple Circuits.

A single equipment grounding conductor shall be permitted to be installed for multiple circuits that are installed in the same raceway, cable, or cable tray. It shall be sized from Table 250.122 for the largest circuit conductor in the raceway, cable, or cable tray. Equipment grounding conductors installed in cable trays shall meet the minimum requirements of 392.10(B)(1)(c) .

(C) Motor Circuits.

Equipment grounding conductors for motor circuits shall be sized in accordance with (C)(1) or (C)(2).

(1) General.

The equipment grounding conductor size shall not be smaller than determined by Table 250.122 based on the size of the branch-circuit short-circuit or feeder conductor.

(2) Instantaneous-Trip Circuit Breaker and Motor Short-Circuit Protector.

If the overcurrent device is an instantaneous-trip circuit breaker or a motor short-circuit protector, the equipment grounding conductor shall be sized not smaller than that given by Table 250.122 using the size of the branch-circuit conductor.

(D) Flexible Cord and Fixture Wire.

The equipment grounding conductor in a flexible cord with the largest circuit conductor 10 AWG or smaller, and the equipment grounding conductor used with fixture wires of any size in accordance with 240.5, shall not be smaller than 18 AWG copper and shall not be smaller than the circuit conductors. The equipment grounding conductor in a flexible cord with a circuit conductor larger than 10 AWG shall be sized in accordance with Table 250.122 .

(E) Conductors in Parallel.

For circuits of parallel conductors as permitted in 310.10(G) , the equipment grounding conductor shall be installed in accordance with 250.122(E)(1) or (E)(2). Equipment grounding conductors that are not smaller than that provided in Table 250.122 shall be permitted to be connected in parallel for circuit conductors that are connected in parallel.

(1) Conductor Installations in Raceways, Auxiliary Gutters, or Cable Trays.

(a) *Single Raceway or Cable Tray, Auxiliary Gutter , or Cable Tray* . Equipment grounding conductors for circuit conductors that are connected in parallel in the same raceway, auxiliary gutter, or cable tray shall be installed in compliance with one of the following:

(2) An equipment grounding conductor shall be installed with each set of circuit conductors that are connected in parallel. The wire-type equipment grounding conductor for each set shall be sized in accordance with Table 250.122 .

(3) A single wire-type equipment grounding conductor shall be installed and sized in accordance with Table 250.122 , based on the total circular mil area of the largest set of circuit conductors for any phase that is connected in parallel. Where the total area does not result in a standard size conductor, the next larger conductor shall be selected from Chapter 9, Table 8.

(d) *Multiple Raceways* . If conductors are installed in parallel in multiple raceways, wire-type equipment grounding conductors, where used, shall be installed in parallel in each raceway. The equipment grounding conductor installed in each raceway shall be sized in compliance with 250.122 based on the largest circuit conductor in the raceway. Metal raceways or auxiliary gutters in accordance with 250.118 or cable trays complying with 392.60(B) shall be permitted as the equipment grounding conductor.

(e) *Wire-Type Equipment Grounding Conductors.* Wire-type equipment grounding conductors installed in cable trays shall meet the minimum requirements of 392.10(B)(1)(c).

(f) *Metal Raceways, Auxiliary Gutters, or Cable Trays.* Metal raceways or auxiliary gutters in accordance with 250.188 or cable trays complying with 392.60(B) shall be permitted as the equipment grounding conductor.

(2) Multiconductor Cables.

(a) If circuit conductors of multiconductor cables are connected in parallel, the equipment grounding conductor(s) in each cable shall be connected in parallel.

(b) The equipment grounding conductor in each multiconductor cable shall be sized in compliance with Table 250.122 .

(c) Equipment grounding conductors installed in cable trays shall meet the minimum requirements of 392.10(B)(1) (c). Cable trays complying with 392.60(B) , metal raceways in accordance with 250.118 , or auxiliary gutters shall be permitted as the equipment grounding conductor.

(F) Feeder Taps.

Equipment grounding conductors installed with feeder taps shall not be smaller than shown in Table 250.122 based on the size of the feeder conductor on the supply side ahead of the tap but shall not be required to be larger than the tap conductors.

Table 250.122 Minimum Size Equipment Grounding Conductors for Grounding Raceway and Equipment

Size of Largest Ungrounded Circuit Conductor (AWG or kcmil) Smallest Size of Equipment Grounding Conductor (AWG or kcmil) Copper Aluminum or Copper-clad Aluminum Copper Aluminum or Copper-clad Aluminum* 14 12 14 12 12 10 12 10 10–8 8–6 10 8 6–3 4–1 8 6 2–3/0 1/0–4/0 6 4 4 /0–300 250–450 4 2 350–550 500–800 3 1 600–800 900–1300 2 1/0 900–1300 1400–2000 1 2 /0 1400–2000 – 1/0 3/0 ----------

Notes:

1. If necessary to comply with 250.4(A)(5) or (B)(4), the equipment grounding conductor shall be sized larger than given in this table.

2. If the equivalent area of the largest ungrounded circuit conductor is larger than 2000 kcmil in a single raceway, auxiliary gutter, or cable tray, the equipment grounding conductor shall have an area not less than 12 **1**⁄**2** percent of the equivalent area of the largest ungrounded conductor.

*See installation restrictions in 250.120.

(B) Where ungrounded conductors are increased in size for any reason, other than as provided for in 310.15(B)(2) or 310.15(B)(3), wire-type equipment grounding conductors, where installed, shall be sized per Table 250.122 based on the overcurrent device rating for the upsized ungrounded conductor applied under normal conditions of use.

Statement of Problem and Substantiation for Public Comment

This change anticipates FR 8114 being resolved and is offered to modify the existing language in the 2017 National Electrical Code. It will finally resolve the contradiction in 250.122 between the upsizing of conductors resulting in EGC's being larger than required for other installations where larger OCPD's are applied. One premise is that upsized ungrounded conductors reduce the impedance to the point of a ground fault, and the impedance of the return path must also be reduced in order to facilitate the operation of the overcurrent device. Adherence to Table 250.122 has proven to provide adequate sizing of wire-type EGC's and will also be adequate when applied to upsized conductors when protected by a smaller overcurrent device. The exception for temperature correction and ampacity adjustment recognized that these conditions result in an increased impedance and the upsizing of those conductors simply restores the anticipated impedance for those installations. The revision will capture installations in which the conductors are upsized due to voltage drop, future expansion, availability of minimum size conductors, etc., but eliminates the cumbersome requirement for calculation and reference to conductor property tables. Example: An irrigation pump motor requires a 10 AWG copper conductor based on the nameplate rating. Due to excessive distance from the electrical source and resulting voltage drop, the ungrounded conductor is increased in size to 8 AWG copper. Based on 750 C terminations and insulation. The ampacity of the 8 AWG is 50 amperes, but the circuit is protected by a 30 ampere OCPD. Table 250.122 allows a 10 AWG as the EGC. If the ungrounded conductor is increased to a 6 AWG copper, That conductor has an ampacity of 65 Amperes for the same 750 C terminations, and would require a 8 AWG copper EGC.

Related Item

• FR8114

Submitter Information Verification

Submitter Full Name: Joseph Andre
Organization: JFA Consulting
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Zip:
Submittal Date: Wed Aug 29 14:57:13 EDT 2018
Committee: NEC-P05

Copyright Assignment

I, Joseph Andre, hereby irrevocably grant and assign to the National Fire Protection Association (NFPA) all and full rights in copyright in this Public Comment (including both the Proposed Change and the Statement of Problem and Substantiation). I understand and intend that I acquire no rights, including rights as a joint author, in any publication of the NFPA in which this Public Comment in this or another similar or derivative form is used. I hereby warrant that I am the author of this Public Comment and that I have full power and authority to enter into this copyright assignment.

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Public Comment No. 1699-NFPA 70-2018 [Section No. 250.122]

250.122 Size of Equipment Grounding Conductors.

(A) General.

Copper, aluminum, or copper-clad aluminum equipment grounding conductors of the wire type shall not be smaller than shown in Table 250.122 . The equipment grounding conductor shall not be required to be larger than the circuit conductors supplying the equipment. If a cable tray, a raceway, or a cable armor or sheath is used as the equipment grounding conductor, as provided in 250.118 and 250.134(A), it shall comply with 250.4(A)(5) or (B)(4).

Equipment grounding conductors shall be permitted to be sectioned within a multiconductor cable, provided the combined circular mil area complies with Table 250.122 .

(B) Multiple Circuits.

A single equipment grounding conductor shall be permitted to be installed for multiple circuits that are installed in the same raceway, cable, or cable tray. It shall be sized from Table 250.122 for the largest circuit conductor in the raceway, cable, or cable tray. Equipment grounding conductors installed in cable trays shall meet the minimum requirements of 392.10(B)(1)(c) .

(C) Motor Circuits.

Equipment grounding conductors for motor circuits shall be sized in accordance with (C)(1) or (C)(2).

(1) General.

The equipment grounding conductor size shall not be smaller than determined by Table 250.122 based on the size of the branch-circuit short-circuit or feeder conductor.

(2) Instantaneous-Trip Circuit Breaker and Motor Short-Circuit Protector.

If the overcurrent device is an instantaneous-trip circuit breaker or a motor short-circuit protector, the equipment grounding conductor shall be sized not smaller than that given by Table 250.122 using the size of the branch-circuit conductor.

(D) Flexible Cord and Fixture Wire.

The equipment grounding conductor in a flexible cord with the largest circuit conductor 10 AWG or smaller, and the equipment grounding conductor used with fixture wires of any size in accordance with 240.5, shall not be smaller than 18 AWG copper and shall not be smaller than the circuit conductors. The equipment grounding conductor in a flexible cord with a circuit conductor larger than 10 AWG shall be sized in accordance with Table 250.122 .

(E) Conductors in Parallel.

For circuits of parallel conductors as permitted in 310.10(G) , the equipment grounding conductor shall be installed in accordance with 250.122(E)(1) or (E)(2). Equipment grounding conductors that are not smaller than that provided in Table 250.122 shall be permitted to be connected in parallel for circuit conductors that are connected in parallel.

(1) Conductor Installations in Raceways, Auxiliary Gutters, or Cable Trays.

(a) *Single Raceway or Cable Tray, Auxiliary Gutter , or Cable Tray* . Equipment grounding conductors for circuit conductors that are connected in parallel in the same raceway, auxiliary gutter, or cable tray shall be installed in compliance with one of the following:

(2) An equipment grounding conductor shall be installed with each set of circuit conductors that are connected in parallel. The wire-type equipment grounding conductor for each set shall be sized in accordance with Table 250.122 .

(3) A single wire-type equipment grounding conductor shall be installed and sized in accordance with Table 250.122 , based on the total circular mil area of the largest set of circuit conductors for any phase that is connected in parallel. Where the total area does not result in a standard size conductor, the next larger conductor shall be selected from Chapter 9, Table 8.

(d) *Multiple Raceways* . If conductors are installed in parallel in multiple raceways, wire-type equipment grounding conductors, where used, shall be installed in parallel in each raceway. The equipment grounding conductor installed in each raceway shall be sized in compliance with 250.122 based on the largest circuit conductor in the raceway. Metal raceways or auxiliary gutters in accordance with 250.118 or cable trays complying with 392.60(B) shall be permitted as the equipment grounding conductor.

(e) *Wire-Type Equipment Grounding Conductors.* Wire-type equipment grounding conductors installed in cable trays shall meet the minimum requirements of 392.10(B)(1)(c).

(f) *Metal Raceways, Auxiliary Gutters, or Cable Trays.* Metal raceways or auxiliary gutters in accordance with 250.188 or cable trays complying with 392.60(B) shall be permitted as the equipment grounding conductor.

(2) Multiconductor Cables.

(a) If circuit conductors of multiconductor cables are connected in parallel, the equipment grounding conductor(s) in each cable shall be connected in parallel.

(b) The equipment grounding conductor in each multiconductor cable shall be sized in compliance with Table 250.122 .

(c) Equipment grounding conductors installed in cable trays shall meet the minimum requirements of 392.10(B)(1) (c). Cable trays complying with 392.60(B) , metal raceways in accordance with 250.118 , or auxiliary gutters shall be permitted as the equipment grounding conductor.

(F) Feeder Taps.

Equipment grounding conductors installed with feeder taps shall not be smaller than shown in Table 250.122 based on the size of the feeder conductor on the supply side ahead of the tap but shall not be required to be larger than the tap conductors.

Table 250.122 Minimum Size Equipment Grounding Conductors for Grounding Raceway and Equipment

Size of Largest Ungrounded Circuit Conductor (AWG or kcmil) Smallest Size of Equipment Grounding Conductor (AWG or kcmil) Copper Aluminum or Copper-clad Aluminum Copper Aluminum or Copper-clad Aluminum* 14 12 14 12 12 10 12 10 10–8 8–6 10 8 6–3 4–1 8 6 2–3/0 1/0–4/0 6 4 4 /0–300 250–450 4 2 350–550 500–800 3 1 600–800 900–1300 2 1/0 900–1300 1400–2000 1 2 /0 1400–2000 – 1/0 3/0 ----------

Notes:

1. If necessary to comply with 250.4(A)(5) or (B)(4), the equipment grounding conductor shall be sized larger than given in this table.

2. If the equivalent area of the largest ungrounded circuit conductor is larger than 2000 kcmil in a single raceway, auxiliary gutter, or cable tray, the equipment grounding conductor shall have an area not less than 12 **1/2** percent of the equivalent area of the largest ungrounded conductor.

*See installation restrictions in 250.120.

Statement of Problem and Substantiation for Public Comment

This FR should be rejected for the following reasons:

1. There is no compelling reason for this change. The Committee statement does not give a reason: there is no

statement of problems with the current test nor rational why this would be an improvement. In fact, it will increase confusion and misapplication of this section of the NEC.
2. The statement that this will make sizing of equipment grounding conductors consistent with supply-side bonding jumpers is irrelevant and an inappropriate comparison. These conductors perform very different functions, and the sizing of the supply-side jumpers is not based on definitive physics or engineering but the hope they they will survive long enough to clear a fault in conductors without proper overcurrent protection. The current requirements for sizing equipment grounding/bonding conductors is more accurate and demonstratively safer.
3. The conductor sizing in the proposed table anticipates only 750 C conductors based on Table 310.15(B)(16). There is no information regarding different ampacities for insulation ratings from different temperature ratings or from different ampacity tables, such as when applied in free air.
4. The UL standards referenced in the FR are not readily available to everyone without a significant financial investment. It is not appropriate to say these standards are appropriate based on the statements of a few Panel members who have access to them. For the process to be fully vested and transparent, the basis for the change needs to be made public and available to everyone.
5. The standards referenced address only a couple of tightly controlled configurations under factory control and 3rd-party review. Assuming these conditions transfer to the many installation configurations in raceways, free air, underground has not been investigated and introduces additional uncertainties.
6. Abandoning the time-tested requirements for grounding of parallel installations without a full engineering investigation or modeling is irresponsible and inserts additional unknowns into the requirements. (none was made available at the Input stage). There is no information or documentation that the current requirements, in place for 50 years, has been inadequate or unsafe.
7. There is a great deal of uncertainty about the ability of standard overcurrent devices to quickly clear ground faults under the proposed revisions to Table 250.122. This is essential to the basic safety requirements found in 250.4, and should not be discarded without extensive evaluation.

Related Item

• FR 8114

Submitter Information Verification

Submitter Full Name: Dale Crawford
Organization: Steel Tube Institute
Street Address:
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Zip:
Submittal Date: Wed Aug 29 17:03:33 EDT 2018
Committee: NEC-P05

Public Comment No. 2189-NFPA 70-2018 [Section No. 250.122]

250.122 Size of Equipment Grounding Conductors.

(A) General.

Copper, aluminum, or copper-clad aluminum equipment grounding conductors of the wire type shall not be smaller than shown in Table 250.122. The equipment grounding conductor shall not be required to be larger than the circuit conductors supplying the equipment. If a cable tray, a raceway, or a cable armor or sheath is used as the equipment grounding conductor, as provided in 250.118 and 250.134(A), it shall comply with 250.4(A)(5) or (B)(4).

Equipment grounding conductors shall be permitted to be sectioned within a multiconductor cable, provided the combined circular mil area complies with Table 250.122.

(B) Multiple Circuits.

A single equipment grounding conductor shall be permitted to be installed for multiple circuits that are installed in the same raceway, cable, or cable tray. It shall be sized from Table 250.122 for the largest circuit conductor in the raceway, cable, or cable tray. Equipment grounding conductors installed in cable trays shall meet the minimum requirements of 392.10(B)(1)(c).

(C) Motor Circuits.

Equipment grounding conductors for motor circuits shall be sized in accordance with (C)(1) or (C)(2).

(1) General.

The equipment grounding conductor size shall not be smaller than determined by Table 250.122based on the size of the branch-circuit short-circuit or feeder conductor.

(2) Instantaneous-Trip Circuit Breaker and Motor Short-Circuit Protector.

If the overcurrent device is an instantaneous-trip circuit breaker or a motor short-circuit protector, the equipment grounding conductor shall be sized not smaller than that given by Table 250.122 using the size of the branch-circuit conductor.

(D) Flexible Cord and Fixture Wire.

The equipment grounding conductor in a flexible cord with the largest circuit conductor 10 AWG or smaller, and the equipment grounding conductor used with fixture wires of any size in accordance with 240.5, shall not be smaller than 18 AWG copper and shall not be smaller than the circuit conductors. The equipment grounding conductor in a flexible cord with a circuit conductor larger than 10 AWG shall be sized in accordance with Table 250.122.

(E) Conductors in Parallel.

For circuits of parallel conductors as permitted in 310.10(G), the equipment grounding conductor shall be installed in accordance with 250.122(E)(1) or (E)(2). Equipment grounding conductors that are not smaller than that provided in Table 250.122 shall be permitted to be connected in parallel for circuit conductors that are connected in parallel.

(1) Conductor Installations in Raceways, Auxiliary Gutters, or Cable Trays.

(a) *Single Raceway or Cable Tray, Auxiliary Gutter*, *or Cable Tray*. Equipment grounding conductors for circuit conductors that are connected in parallel in the same raceway, auxiliary gutter, or cable tray shall be installed in compliance with one of the following:

(1) An equipment grounding conductor shall be installed with each set of circuit conductors that are connected in parallel. The wire-type equipment grounding conductor for each set shall be sized in accordance with Table 250.122.

(2) A single wire-type equipment grounding conductor shall be installed and sized in accordance with Table 250.122, based on the total circular mil area of the largest set of circuit conductors for any phase that is connected in parallel. Where the total area does not result in a standard size conductor, the next larger conductor shall be selected from Chapter 9, Table 8.

(b) *Multiple Raceways*. If conductors are installed in parallel in multiple raceways, wire-type equipment grounding conductors, where used, shall be installed in parallel in each raceway. The equipment grounding conductor installed in each raceway shall be sized in compliance with 250.122 based on the largest circuit conductor in the raceway. Metal raceways or auxiliary gutters in accordance with 250.118 or cable trays complying with 392.60(B) shall be permitted as the equipment grounding conductor.

(c) *Wire-Type Equipment Grounding Conductors.* Wire-type equipment grounding conductors installed in cable trays shall meet the minimum requirements of 392.10(B)(1)(c).

(d) *Metal Raceways, Auxiliary Gutters, or Cable Trays.* Metal raceways or auxiliary gutters in accordance with 250.188 or cable trays complying with 392.60(B) shall be permitted as the equipment grounding conductor.

(2) Multiconductor Cables.

(a) If circuit conductors of multiconductor cables are connected in parallel, the equipment grounding conductor(s) in each cable shall be connected in parallel.

(b) The equipment grounding conductor in each multiconductor cable shall be sized in compliance with Table 250.122.

(c) Equipment grounding conductors installed in cable trays shall meet the minimum requirements of 392.10(B)(1)(c). Cable trays complying with 392.60(B), metal raceways in accordance with 250.118, or auxiliary gutters shall be permitted as the equipment grounding conductor.

(F) Feeder Taps.

Equipment grounding conductors installed with feeder taps shall not be smaller than shown in Table 250.122 based on the size of the feeder conductor on the supply side ahead of the tap but shall not be required to be larger than the tap conductors.

Table 250.122 Minimum Size Equipment Grounding Conductors for Grounding Raceway and Equipment /0–300

Size of Largest Ungrounded Circuit Conductor (AWG or kcmil)		Smallest Size of Equipment Grounding Conductor (AWG or kcmil)	
Copper	Aluminum or Copper-clad Aluminum	Copper	Aluminum or Copper-clad Aluminum *
14	12	14	
12	12	10	12
10	10–8	8–6	10 8
6–3	4–1	8	6
2–3/0	1/0–4/0	6	4
4		250–450	4 2
350–550	500–800	3	1
600–800	900–1300	2	1/0
900–1300	1400–2000	1	2/0
1400–2000	–	1/0	3/0
- -	-	-	
- -	-	-	
- -	-	-	
- -	-	-	
- -	-	-	
- -	-	-	
- -	-	-	
- -	-	-	
- -	-	-	

Notes:

1. If necessary to comply with 250.4(A)(5) or (B)(4), the equipment grounding conductor shall be sized larger than given in this table.

2. If the equivalent area of the largest ungrounded circuit conductor is larger than 2000 kcmil in a single raceway, auxiliary gutter, or cable tray, the equipment grounding conductor shall have an area not less than 12 ½ percent of the equivalent area of the largest ungrounded conductor.

*See installation restrictions in 250.120.

Statement of Problem and Substantiation for Public Comment

The first draft process is to gather public comments. This change of one of the most fundamental tables in the NEC is unnecessary and will carry several unintended consequences. First of all, it creates a further separation from the purpose of the table in the first place and how it was derived. The EGC is sized based upon the size of the overcurrent device since one of the major roles of the EGC is to clear the overcurrent device. Without this basic connection, conductor sizes will continue to grow since fewer and fewer people will understand where the table came from in the first place. The argument about enforcement is unfounded as this is one of the tables that most enforcers actually understand--now they will be confused learning a new table.

It also confuses the reason for the sizing of grounding electrode conductors and bonding jumpers which are based on the circular mil area of the supply conductors that have NO overcurrent protection. It seems that this change was well intentioned, but it misses the mark. Hopefully enough of us users of the NEC will speak up and strike this down.

The one potentially beneficial change in this table is to limit the upper end of the table as conductors in the very large sizes are rarely run and if they are run, they are not run in raceways as they are impossible to pull through conduit bends. Limit the end of the table and go back to the table based on overcurrent device size.

By the way, the statement in the PI that formed this change was wrong in saying that it matched up with how the previous table was sized. One clear change is that 60-amp circuits, that normally use 6 AWG conductors would now have to install 8 AWG EGCs rather than 10 AWG EGCs. This is a substantial difference and shows how this new table oversizes EGCs that have not been found to be an issue in the field. Additionally, sections such as 690.45 refer back to this Table 250.122 and we might now have to make our own table in CMP4 because this table creates a problem for sizing EGCs for other types of systems.

Related Item

•

Submitter Information Verification

Submitter Full Name: William Brooks
Organization: Brooks Engineering--Member of CMP4
Street Address:
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Zip:
Submittal Date: Thu Aug 30 22:45:13 EDT 2018
Committee: NEC-P05

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☑ By checking this box I affirm that I am William Brooks, and I agree to be legally bound by the above Copyright Assignment and the terms and conditions contained therein. I understand and intend that, by checking this box, I am creating an electronic signature that will, upon my submission of this form, have the same legal force and effect as a handwritten signature

Public Comment No. 36-NFPA 70-2018 [Section No. 250.122]

250.122 Size of Equipment Grounding Conductors.

(A) General.

Copper, aluminum, or copper-clad aluminum equipment grounding conductors of the wire type shall not be smaller than shown in Table 250.122. The equipment grounding conductor shall not be required to be larger than the circuit conductors supplying the equipment. If a cable tray, a raceway, or a cable armor or sheath is used as the equipment grounding conductor, as provided in 250.118 and 250.134(A), it shall comply with 250.4(A)(5) or (B)(4).

Equipment grounding conductors shall be permitted to be sectioned within a multiconductor cable, provided the combined circular mil area complies with Table 250.122.

(B) Multiple Circuits.

A single equipment grounding conductor shall be permitted to be installed for multiple circuits that are installed in the same raceway, cable, or cable tray. It shall be sized from Table 250.122 for the largest circuit conductor in the raceway, cable, or cable tray. Equipment grounding conductors installed in cable trays shall meet the minimum requirements of 392.10(B)(1)(c).

(C) Motor Circuits.

Equipment grounding conductors for motor circuits shall be sized in accordance with (C)(1) or (C)(2).

(1) General.

The equipment grounding conductor size shall not be smaller than determined by Table 250.122based on the size of the branch-circuit short-circuit or feeder conductor.

(2) Instantaneous-Trip Circuit Breaker and Motor Short-Circuit Protector.

If the overcurrent device is an instantaneous-trip circuit breaker or a motor short-circuit protector, the equipment grounding conductor shall be sized not smaller than that given by Table 250.122 using the size of the branch-circuit conductor.

(D) Flexible Cord and Fixture Wire.

The equipment grounding conductor in a flexible cord with the largest circuit conductor 10 AWG or smaller, and the equipment grounding conductor used with fixture wires of any size in accordance with 240.5, shall not be smaller than 18 AWG copper and shall not be smaller than the circuit conductors. The equipment grounding conductor in a flexible cord with a circuit conductor larger than 10 AWG shall be sized in accordance with Table 250.122.

(E) Conductors in Parallel.

For circuits of parallel conductors as permitted in 310.10(G), the equipment grounding conductor shall be installed in accordance with 250.122(E)(1) or (E)(2). Equipment grounding conductors that are not smaller than that provided in Table 250.122 shall be permitted to be connected in parallel for circuit conductors that are connected in parallel.

(1) Conductor Installations in Raceways, Auxiliary Gutters, or Cable Trays.

(a) *Single Raceway or Cable Tray, Auxiliary Gutter*, *or Cable Tray*. Equipment grounding conductors for circuit conductors that are connected in parallel in the same raceway, auxiliary gutter, or cable tray shall be installed in compliance with one of the following:

(1) An equipment grounding conductor shall be installed with each set of circuit conductors that are connected in parallel. The wire-type equipment grounding conductor for each set shall be sized in accordance with Table 250.122.

(2) A single wire-type equipment grounding conductor shall be installed and sized in accordance with Table 250.122, based on the total circular mil area of the largest set of circuit conductors for any phase that is connected in parallel. Where the total area does not result in a standard size conductor, the next larger conductor shall be selected from Chapter 9, Table 8.

(b) *Multiple Raceways*. If conductors are installed in parallel in multiple raceways, wire-type equipment grounding conductors, where used, shall be installed in parallel in each raceway. The equipment grounding conductor installed in each raceway shall be sized in compliance with 250.122 based on the largest circuit conductor in the raceway. Metal raceways or auxiliary gutters in accordance with 250.118 or cable trays complying with 392.60(B) shall be permitted as the equipment grounding conductor.

(c) *Wire-Type Equipment Grounding Conductors.* Wire-type equipment grounding conductors installed in cable trays shall meet the minimum requirements of 392.10(B)(1)(c).

(d) *Metal Raceways, Auxiliary Gutters, or Cable Trays.* Metal raceways or auxiliary gutters in accordance with 250.188 or cable trays complying with 392.60(B) shall be permitted as the equipment grounding conductor.

(2) Multiconductor Cables.

(a) If circuit conductors of multiconductor cables are connected in parallel, the equipment grounding conductor(s) in each cable shall be connected in parallel.

(b) The equipment grounding conductor in each multiconductor cable shall be sized in compliance with Table 250.122.

(c) Equipment grounding conductors installed in cable trays shall meet the minimum requirements of 392.10(B)(1)(c). Cable trays complying with 392.60(B), metal raceways in accordance with 250.118, or auxiliary gutters shall be permitted as the equipment grounding conductor.

(F) Feeder Taps.

Equipment grounding conductors installed with feeder taps shall not be smaller than shown in Table 250.122 based on the size of the feeder conductor on the supply side ahead of the tap but shall not be required to be larger than the tap conductors.

Table 250.122 Minimum Size Equipment Grounding Conductors for Grounding Raceway and Equipment

Size of Largest Ungrounded Circuit Conductor (AWG or kcmil)		Smallest Size of Equipment Grounding Conductor (AWG or kcmil)	
Copper	Aluminum or Copper-clad Aluminum	Copper	Aluminum or Copper-clad Aluminum*
14	12	14	12
12	10	12	10
10–8	8–6	10	8
6–3	4–1	8	6
2–3/0	1/0–4/0	6	4
4/0–300	250–450	4	2
350–550	500–800	3	1
600–800	900–1300	2	1/0
900–1300	1400–2000	1	2/0
1400–2000	–	1/0	3/0

Notes:

1. If necessary to comply with 250.4(A)(5) or (B)(4), the equipment grounding conductor shall be sized larger than given in this table.

2. If the equivalent area of the largest ungrounded circuit conductor is larger than 2000 kcmil in a single raceway, auxiliary gutter, or cable tray, the equipment grounding conductor shall have an area not less than 12 ½ percent of the equivalent area of the largest ungrounded conductor.

*See installation restrictions in 250.120.

Statement of Problem and Substantiation for Public Comment

Restore original 250.122.

Although I and many people are not fans of 250.122(B), I agree with the negative comments: more investigation/justification needs to be done. The simplicity seems great, however everything should be made as simple as possible but not simpler.
The changes seem to be based on convenience and without technical justification or how it affects other parts of code. The general understanding is that the EGC is an effective fault path and that the circuit in case of a fault will be safely protected: ground and hot wires will not be damaged. How can a whole change be justified by “reasonably expected breaker/wire combinations”. Are the other combinations not safe?
The table is only based on 75 degC but on the raceway ampacities. How should other sizes be addressed? Is there an adjustment factor? For instance… free-air ampacities. I can run a 500 kcmil on a 600 A breaker, which would usually require a #1 and not a #3.
8114-NFPA 70-2018 states... "Because the size of the circuit conductor that is installed is used in Table 250.122 to determine the size of the equipment grounding conductor, there is no need for increasing the size of the equipment grounding conductor based on an increase in the size of an ungrounded conductor. It will automatically be maintained in proper proportion"

"Proper proportion" does not seem correct. Ampacities in conductors are not linear, so how can we justify that the ground sizing is based on them. For example, parallel 250 MCM can carry 510 A (600 A breaker) with a ground of #1. A 500 MCM can only carry 380 A (400 A) breaker with a #3 ground. The new table would make the parallel a #3, which was less than the 600 A breaker. A 900 MCM, however on a 600 A breaker would be a #2.
Is the justification correct? Shouldn't the argument be conductor size/resistance/available fault potential = grounding size? This seems complicated, and sizing grounds off of the breaker seems like a closer approximation.

Related Item

• FR8114

Submitter Information Verification

Submitter Full Name: Evan Zaker
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Submittal Date: Tue Jun 26 19:01:09 EDT 2018
Committee: NEC-P05

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☑ By checking this box I affirm that I am Evan Zaker, and I agree to be legally bound by the above Copyright Assignment and the terms and conditions contained therein. I understand and intend that, by checking this box, I am creating an electronic signature that will, upon my submission of this form, have the same legal force and effect as a handwritten signature

Public Comment No. 55-NFPA 70-2018 [Section No. 250.122]

NEMA opposes this FR and request that the language on Section 250. 122 should be reverted back to 2017 NEC Code.

250. 122 Size of Equipment Grounding Conductors.

(A) General.

Copper, aluminum, or copper-clad aluminum equipment grounding conductors of the wire type shall not be smaller than shown in Table 250.122. The equipment grounding conductor shall not be required to be larger than the circuit conductors supplying the equipment. If a cable tray, a raceway, or a cable armor or sheath is used as the equipment grounding conductor, as provided in 250.118 and 250.134(A), it shall comply with 250.4(A)(5) or (B)(4).

Equipment grounding conductors shall be permitted to be sectioned within a multiconductor cable, provided the combined circular mil area complies with Table 250.122.

(B) Multiple Circuits.

A single equipment grounding conductor shall be permitted to be installed for multiple circuits that are installed in the same raceway, cable, or cable tray. It shall be sized from Table 250.122 for the largest circuit conductor in the raceway, cable, or cable tray. Equipment grounding conductors installed in cable trays shall meet the minimum requirements of 392.10(B)(1)(c).

(C) Motor Circuits.

Equipment grounding conductors for motor circuits shall be sized in accordance with (C)(1) or (C)(2).

(1) General.

The equipment grounding conductor size shall not be smaller than determined by Table 250.122based on the size of the branch-circuit short-circuit or feeder conductor.

(2) Instantaneous-Trip Circuit Breaker and Motor Short-Circuit Protector.

If the overcurrent device is an instantaneous-trip circuit breaker or a motor short-circuit protector, the equipment grounding conductor shall be sized not smaller than that given by Table 250.122 using the size of the branch-circuit conductor.

(D) Flexible Cord and Fixture Wire.

The equipment grounding conductor in a flexible cord with the largest circuit conductor 10 AWG or smaller, and the equipment grounding conductor used with fixture wires of any size in accordance with 240.5, shall not be smaller than 18 AWG copper and shall not be smaller than the circuit conductors. The equipment grounding conductor in a flexible cord with a circuit conductor larger than 10 AWG shall be sized in accordance with Table 250.122.

(E) Conductors in Parallel.

For circuits of parallel conductors as permitted in 310.10(G), the equipment grounding conductor shall be installed in accordance with 250.122(E)(1) or (E)(2). Equipment grounding conductors that are not smaller than that provided in Table 250.122 shall be permitted to be connected in parallel for circuit conductors that are connected in parallel.

(1) Conductor Installations in Raceways, Auxiliary Gutters, or Cable Trays.

(a) *Single Raceway or Cable Tray, Auxiliary Gutter*, *or Cable Tray*. Equipment grounding conductors for circuit conductors that are connected in parallel in the same raceway, auxiliary gutter, or cable tray shall be installed in compliance with one of the following:

(1) An equipment grounding conductor shall be installed with each set of circuit conductors that are connected in parallel. The wire-type equipment grounding conductor for each set shall be sized in accordance with Table 250.122.

(2) A single wire-type equipment grounding conductor shall be installed and sized in accordance with Table 250.122, based on the total circular mil area of the largest set of circuit conductors for any phase that is connected in parallel. Where the total area does not result in a standard size conductor, the next larger conductor shall be selected from Chapter 9, Table 8.

(b) *Multiple Raceways*. If conductors are installed in parallel in multiple raceways, wire-type equipment grounding conductors, where used, shall be installed in parallel in each raceway. The equipment grounding conductor installed in each raceway shall be sized in compliance with 250.122 based on the largest circuit conductor in the raceway. Metal raceways or auxiliary gutters in accordance with 250.118 or cable trays complying with 392.60(B) shall be permitted as the equipment grounding conductor.

(c) *Wire-Type Equipment Grounding Conductors.* Wire-type equipment grounding conductors installed in cable trays shall meet the minimum requirements of 392.10(B)(1)(c).

(d) *Metal Raceways, Auxiliary Gutters, or Cable Trays.* Metal raceways or auxiliary gutters in accordance with 250.188 or cable trays complying with 392.60(B) shall be permitted as the equipment grounding conductor.

(2) Multiconductor Cables.

(a) If circuit conductors of multiconductor cables are connected in parallel, the equipment grounding conductor(s) in each cable shall be connected in parallel.

(b) The equipment grounding conductor in each multiconductor cable shall be sized in compliance with Table 250.122.

(c) Equipment grounding conductors installed in cable trays shall meet the minimum requirements of 392.10(B)(1)(c). Cable trays complying with 392.60(B), metal raceways in accordance with 250.118, or auxiliary gutters shall be permitted as the equipment grounding conductor.

(F) Feeder Taps.

Equipment grounding conductors installed with feeder taps shall not be smaller than shown in Table 250.122 based on the size of the feeder conductor on the supply side ahead of the tap but shall not be required to be larger than the tap conductors.

Table 250.122 Minimum Size Equipment Grounding Conductors for Grounding Raceway and Equipment

Size of Largest Ungrounded Circuit Conductor (AWG or kcmil)		Smallest Size of Equipment Grounding Conductor (AWG or kcmil)	
Copper	Aluminum or Copper-clad Aluminum	Copper	Aluminum or Copper-clad Aluminum*
14	12	14	12
12	10	12	10
10–8	8–6	10	8
6–3	4–1	8	6
2–3/0	1/0–4/0	6	4
4/0–300	250–450	4	2
350–550	500–800	3	1
600–800	900–1300	2	1/0
900–1300	1400–2000	1	2/0
1400–2000	–	1/0	3/0
-	-	-	-
-	-	-	-
-	-	-	-
-	-	-	-
-	-	-	-
-	-	-	-
-	-	-	-
-	-	-	-
-	-	-	-

Notes:

1. If necessary to comply with 250.4(A)(5) or (B)(4), the equipment grounding conductor shall be sized larger than given in this table.

2. If the equivalent area of the largest ungrounded circuit conductor is larger than 2000 kcmil in a single raceway, auxiliary gutter, or cable tray, the equipment grounding conductor shall have an area not less than 12 ½ percent of the equivalent area of the largest ungrounded conductor.

*See installation restrictions in 250.120.

Statement of Problem and Substantiation for Public Comment

FR 8114 will compromise the safe and reliable operation of electrical systems. Table 250.122 is based on the size of the overcurrent device for a reason, to ensure appropriate current flow to open the overcurrent device. The opening of the overcurrent device can serve two important roles; 1) protect the electrical infrastructure, and to 2) protect the electrical worker from an arc-flash event. No mechanical or technical testing for the substantiation has been provided to support the reduction of the equipment grounding conductor. A fact finding report would be recommended before making such a drastic revision.

The requirements for the EGC must work for all configurations including factory assembled cables such as MC and TC as well as installation configurations in trench, wireway, and raceways. No substantiation has been presented nor have the vast configurations been appropriately reviewed by the code panel that would demonstrate the revised language will support appropriate sizing of the EGC in all configurations. The submitter (CMP 5) must provide the necessary substantiation to demonstrate the safe application of these configurations.

The application of the revised language in parallel configurations points to a compromise in safe and reliable operation of the electrical system. The panel discussion noted a condition in which a single EGC might be required to carry the entire fault current in a parallel installation; unfortunately it was completely dismissed in favor of creating the first revision. There are multiple publications that identify applications in which an insulation failure in a run of cable or non-metallic raceway faults to a bare equipment grounding conductor or a phase conduct or requiring the single conductor to serve as the only ground fault return path. The revised language compromises the ability to protect many parallel path configurations. The bottom line is the language proposed in FR8144 to reduce the EGC can NOT be generally applied without safety being compromised.

Related Item

• FR 8114

Submitter Information Verification

Submitter Full Name: Vince Baclawski
Organization: Nema
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State:
Zip:
Submittal Date: Wed Jun 27 14:57:14 EDT 2018
Committee: NEC-P05

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Public Comment No. 905-NFPA 70-2018 [Section No. 250.122]

250.122 Size of Equipment Grounding Conductors.

(A) General.

Copper, aluminum, or copper-clad aluminum equipment grounding conductors of the wire type shall not be smaller than shown in Table 250.122. The equipment grounding conductor shall not be required to be larger than the circuit conductors supplying the equipment. If a cable tray, a raceway, or a cable armor or sheath is used as the equipment grounding conductor, as provided in 250.118 and 250.134(A), it shall comply with 250.4(A)(5) or (B)(4).

Equipment grounding conductors shall be permitted to be sectioned within a multiconductor cable, provided the combined circular mil area complies with Table 250.122.

(B) Multiple Circuits.

A single equipment grounding conductor shall be permitted to be installed for multiple circuits that are installed in the same raceway, cable, or cable tray. It shall be sized from Table 250.122 for the largest circuit conductor in the raceway, cable, or cable tray. Equipment grounding conductors installed in cable trays shall meet the minimum requirements of 392.10(B)(1)(c).

(C) Motor Circuits.

Equipment grounding conductors for motor circuits shall be sized in accordance with (C)(1) or (C)(2).

(1) General.

The equipment grounding conductor size shall not be smaller than determined by Table 250.122based on the size of the branch-circuit short-circuit or feeder conductor.

(2) Instantaneous-Trip Circuit Breaker and Motor Short-Circuit Protector.

If the overcurrent device is an instantaneous-trip circuit breaker or a motor short-circuit protector, the equipment grounding conductor shall be sized not smaller than that given by Table 250.122 using the size of the branch-circuit conductor.

(D) Flexible Cord and Fixture Wire.

The equipment grounding conductor in a flexible cord with the largest circuit conductor 10 AWG or smaller, and the equipment grounding conductor used with fixture wires of any size in accordance with 240.5, shall not be smaller than 18 AWG copper and shall not be smaller than the circuit conductors. The equipment grounding conductor in a flexible cord with a circuit conductor larger than 10 AWG shall be sized in accordance with Table 250.122.

(E) Conductors in Parallel.

For circuits of parallel conductors as permitted in 310.10(G), the equipment grounding conductor shall be installed in accordance with 250.122(E)(1) or (E)(2). Equipment grounding conductors that are not smaller than that provided in Table 250.122 shall be permitted to be connected in parallel for circuit conductors that are connected in parallel.

(1) Conductor Installations in Raceways, Auxiliary Gutters, or Cable Trays.

(a) *Single Raceway or Cable Tray, Auxiliary Gutter*, *or Cable Tray*. Equipment grounding conductors for circuit conductors that are connected in parallel in the same raceway, auxiliary gutter, or cable tray shall be installed in compliance with one of the following:

(1) An equipment grounding conductor shall be installed with each set of circuit conductors that are connected in parallel. The wire-type equipment grounding conductor for each set shall be sized in accordance with Table 250.122.

(2) A single wire-type equipment grounding conductor shall be installed and sized in accordance with Table 250.122, based on the total circular mil area of the largest set of circuit conductors for any phase that is connected in parallel. Where the total area does not result in a standard size conductor, the next larger conductor shall be selected from Chapter 9, Table 8.

(b) *Multiple Raceways*. If conductors are installed in parallel in multiple raceways, wire-type equipment grounding conductors, where used, shall be installed in parallel in each raceway. The equipment grounding conductor installed in each raceway shall be sized in compliance with 250.122 based on the largest circuit conductor in the raceway. Metal raceways or auxiliary gutters in accordance with 250.118 or cable trays complying with 392.60(B) shall be permitted as the equipment grounding conductor.

(c) *Wire-Type Equipment Grounding Conductors.* Wire-type equipment grounding conductors installed in cable trays shall meet the minimum requirements of 392.10(B)(1)(c).

(d) *Metal Raceways, Auxiliary Gutters, or Cable Trays.* Metal raceways or auxiliary gutters in accordance with 250.188 or cable trays complying with 392.60(B) shall be permitted as the equipment grounding conductor.

(2) Multiconductor Cables.

(a) If circuit conductors of multiconductor cables are connected in parallel, the equipment grounding conductor(s) in each cable shall be connected in parallel.

(b) The equipment grounding conductor in each multiconductor cable shall be sized in compliance with Table 250.122.

(c) Equipment grounding conductors installed in cable trays shall meet the minimum requirements of 392.10(B)(1)(c). Cable trays complying with 392.60(B), metal raceways in accordance with 250.118, or auxiliary gutters shall be permitted as the equipment grounding conductor.

(F) Feeder Taps.

Equipment grounding conductors installed with feeder taps shall not be smaller than shown in Table 250.122 based on the size of the feeder conductor on the supply side ahead of the tap but shall not be required to be larger than the tap conductors.

Table 250.122 Minimum Size Equipment Grounding Conductors for Grounding Raceway and Equipment

Size of Largest Ungrounded Circuit Conductor (AWG or kcmil)		Smallest Size of Equipment Grounding Conductor (AWG or kcmil)	
Copper	Aluminum or Copper-clad Aluminum	Copper	Aluminum or Copper-clad Aluminum*
14	12	14	12
12	10	12	10
10–8	8–6	10	8
6–3	4–1	8	6
2–3/0	1/0–4/0	6	4
4/0–300	250–450	4	2
350–550	500–800	3	1
600–800	900–1300	1/0	3/0
900–1300	1400–2000	250	250
1400–2000	–	250	

Notes:

1. If necessary to comply with 250.4(A)(5) or (B)(4), the equipment grounding conductor shall be sized larger than given in this table.

2. If the equivalent area of the largest ungrounded circuit conductor is larger than 2000 kcmil in a single raceway, auxiliary gutter, or cable tray, the equipment grounding conductor shall have an area not less than 12 1/2 20 percent of the equivalent area of the largest ungrounded conductor.

*See installation restrictions in 250.120.

Additional Proposed Changes

File Name	Description	Approved
Public_Comment_for_FR_8114_Final_Draft_R1.docx	Return to 2017 NEC Table 250.122 or make the proposed revisions if CMP 5 decides to move forward	

Statement of Problem and Substantiation for Public Comment

I do not support the changes made in Table 250.122 and would ask that they remain as is per the 2017 NEC. There are major correlation issues throughout the code that were not addressed by the FR or the substantiation. However, if the code panel moves forward with sizing per ungrounded conductors, there are several issues with the way CMP-5 has viewed the change indicated in FR 8114 for table 250.122. Based on the following data, the recommended changes should be made to FR-8114 or CMP-5 should not vote to include in NEC 2020. One issue is that when you compare EGC sizes across typical circuit sizes for both the 2017 table and the proposed 2020 change you see a significant concern as you parallel more conductors. The sizes proposed may not enable the overcurrent protective device to provide the appropriate protection. There have been discussions around adding the cross sections of the EGC's and comparing them to the 2017 table. This comparison is not valid since it ignores the issues around parallel conduits. The changes in FR 8114 would not allow that to occur.

"See Attached file showing comparison of EGC sizing when using parallel conductors based on FR8114 and the 2017 NEC Table 250.122"

The sizes equipment grounding conductors shown in the revised table 250.122 for the higher ampacity power circuits are in direct conflict with Note 2. Some of the published equipment grounding conductors are less than 10% in cross sectional diameter. Thus, they are effectively potential fuse links. Equipment grounding conductors are often used as part of the required "effective ground fault return paths" when there are no dedicated grounding conductors installed with each feeder, sub-feeder, or branch circuit. As such, there have been incidents where equipment grounding conductors have melted or burnt off at their respective termination points. By increasing the minimum sized of an equipment grounding conductor to 20% of the ungrounded conductor there is a reduced probability of the grounding conductor melting or becoming a fuse link. These changes will also reduce the risk that over current protection device will not function properly.

Related Item

• FR-8114 (250.122)

Submitter Information Verification

Submitter Full Name: Keith Waters
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Affiliation: Schneider Electric
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State:
Zip:
Submittal Date: Mon Aug 20 15:24:08 EDT 2018
Committee: NEC-P05

I attempted to make the changes within Terra View and they were not readable. Therefore, I am including my proposed changes and comments within this document.

Proposed Change:

Table 250.122 Minimum Size Equipment Grounding Conductors for Grounding Raceway and Equipment			
Size of Largest Ungrounded Circuit Conductor (AWG or kcmil)		**Smallest Size of Equipment Grounding Conductor (AWG or kcmil)**	
Copper	**Aluminum or Copper-clad Aluminum**	**Copper**	**Aluminum or Copper-clad Aluminum***
14	12	14	12
12	10	12	10
10 - 8	8 - 6	10	8
6 - 3	4 - 1	8	6
2 - 3/0	1/0 - 4/0	~~6~~ **4**	~~4~~ **3**
4/0 - 300	250 - 450	~~4~~ **2**	~~2~~ **1/0**
350 - 550	500 - 800	~~3~~ **1/0**	~~1~~ **2/0**
600 - 800	900 - 1300	~~2~~ **3/0**	~~1/0~~ **250kcilm**
900 - 1300	1400 - 2000	~~1~~ **250kcilm**	~~2/0~~ **250kcilm**
1400 - 2000	-	~~1/0~~ **250kcilm**	~~3/0~~ **350kcilm**
Notes: 1. If necessary to comply with 250.4(A)(5) or (B)(4), the equipment grounding conductor shall be sized larger than given in this table.			

2. If the equivalent area of the largest ungrounded circuit conductors is larger than 2000 kcmil in a single raceway, auxiliary gutter, or cable tray, the equipment grounding conductor shall have an area not less than 20-percent of the equivalent area of the largest ungrounded conductors.
*See installation restrictions in 250.120.

Public Comments

I do not support the changes made in Table 250.122 and would ask that they remain as is per the 2017 NEC. There are major correlation issues throughout the code that were not addressed by the FR or the substantiation. However, if the code panel moves forward with sizing per ungrounded conductors, there are several issues with the way CMP-5 has viewed the change indicated in FR 8114 for table 250.122. Based on the following data, the recommended changes should be made to FR-8114 or CMP-5 should not vote to include in NEC 2020. One issue is that when you compare EGC sizes across typical circuit sizes for both the 2017 table and the proposed 2020 change you see a significant concern as you parallel more conductors. The sizes proposed may not enable the overcurrent protective device to provide the appropriate protection. There have been discussions around adding the cross sections of the EGC's and comparing them to the 2017 table. This comparison is not valid since it ignores the issues around parallel conduits. The changes in FR 8114 would not allow that to occur.

	2020 NEC FR 8114 revision for Table 250.122 cross sectional areas						2017 NEC Data for Table 250.122 cross sectional areas				
CKT Size	EGC AWG	Phase Cond	#/Phase	Dia (in)	Area	CKT Size	EGC AWG	Phase Cond	#/Phase	Dia (in)	Area
1000	3	3-400kcmil	3	0.26	0.1593	1000	2/0	3-400kcmil	3	0.419	0.4137
1200	3	3-500kcmil	3	0.26	0.1593	1200	3/0	3-500kcmil	3	0.471	0.5227
1600	3	4-500kcmil	4	0.26	0.2124	1600	4/0	4-500kcmil	4	0.528	0.8758
2000	3	6-400kcmil	6	0.26	0.3186	2000	250	6-400kcmil	6	0.575	1.5580
2500	3	7-500kcmil	7	0.26	0.3717	2500	350	7-500kcmil	7	0.681	2.5497

	2020 NEC "Public Comment" Data for Table 250.122 cross sectional areas				
CKT Size	EGC AWG	Phase Cond	#/Phase	Dia (in)	Area
1000	1/0	3-400kcmil	3	0.3249	0.2487
1200	1/0	3-500kcmil	3	0.3249	0.2487
1600	1/0	4-500kcmil	4	0.3249	0.3316
2000	1/0	6-400kcmil	6	0.3249	0.4974
2500	1/0	7-500kcmil	7	0.3249	0.5803

The sizes equipment grounding conductors shown in the revised table 250.122 for the higher ampacity power circuits are in direct conflict with Note 2. Some of the published equipment grounding conductors are less than 10% in cross sectional diameter. Thus, they are effectively potential fuse links. Equipment grounding conductors are often used as part of the required “effective ground fault return paths” when there are no dedicated grounding conductors installed with each feeder, sub-feeder, or branch circuit. As such, there have been incidents where equipment grounding conductors have melted or burnt off at their respective termination points. By increasing the minimum sized of an equipment grounding conductor to 20% of the ungrounded conductor there is a reduced probability of the grounding conductor melting or becoming a fuse link. These changes will also reduce the risk that over current protection device will not function properly.

Public Comment No. 478-NFPA 70-2018 [New Section after 250.122(A)]

(B) Increased in Size

If ungrounded conductors are increased in size due to voltage drop, excessive current carrying conductors or elevated ambient temperature, wire-type equipment grounding conductors, if installed, shall be increased in size proportionately to the increase in circular mil area of the ungrounded conductors. The increase in size of ungrounded conductors shall be determined using the size of conductors that are adequate for the circuit without applying any compensating factors.

Statement of Problem and Substantiation for Public Comment

For proper application of this section, it is necessary to determine when the size of ungrounded conductors have been increased. In other words, what is the size of ungrounded conductors that are appropriate for the circuit, be it feeder or branch circuit conductors?
Equipment grounding conductors of the wire type are subject to the same conditions of use, be it elevated temperatures or heat generated by excessive current-carrying conductors, as the ungrounded conductors.
Code-panel 5 has never been supplied by any factual information that adverse conditions of use can impede the performance of equipment grounding conductors in carrying out their function of carrying fault current. We have heard unfounded conjecture on this issue.
It should be noted that the title of Table 250.122 contains the word "Minimum". This indicates that the size of the EGC may need to be larger than that found in the table. The Note to the table states that the size of the equipment grounding conductor "shall" be increased in size if necessary to provide the effective equipment grounding conductor that is required by 250.4(A)(5) or (B)(4). No details are provided as to how or when this increase in size is to be triggered.
The proposed changes to this section should be accepted to ensure that the critical effective ground fault current path is provided.

Related Item

• PI 3291

Submitter Information Verification

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Committee: NEC-P05

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Public Comment No. 1910-NFPA 70-2018 [Section No. 250.122(A)]

(A) General.

Copper, aluminum, or copper-clad aluminum equipment grounding conductors of the wire type shall not be smaller than shown in Table 250.122. The equipment grounding conductor shall not be required to be larger than the circuit conductors supplying the equipment. If a cable tray, a raceway, or a cable armor or sheath is used as the equipment grounding conductor, as provided in 250.118 and 250.134(A), it shall comply with 250.4(A)(5) or (B)(4).

Equipment grounding conductors shall be permitted to be sectioned within a multiconductor cable, provided the combined circular mil area complies with Table 250.122.

Additional Proposed Changes

File Name	Description	Approved
250-122.docx	Proposed text (unchanged from 2017 edition).	

Statement of Problem and Substantiation for Public Comment

The shift to basing EGC sizing a circuit wiring size is poorly substantiated, and results in some increases in EGC sizing without any indication of loss experience. For example, a standard 60 amp circuit, wired with the customary #6 and employing a 10 AWG EGC, has been acceptable for equipment grounding for over 100 years; now it becomes a #8! The larger issue, however, is whether we should ever have started down the road to raising EGC sizes based on any increases of circuit size. This practice started with voltage drop increases in the 1975 NEC, and the reasoning has always been flawed. The impedance of a faulted circuit is the sum of the impedance going out to the fault plus the impedance returning from the fault. Increasing the ungrounded conductor size, even if only in one direction, necessarily decreases the impedance of the faulted circuit to below what the impedance would be if the voluntary (in the case of voltage drop calculations) wire size increase were not made. Nevertheless, as of the 1975 NEC, we have been punished for decreasing fault impedance below code minimum requirements by the need to decrease it even further. Old Mel Borleis made this point in his negative vote at the time, and he was right. CMP 5 should reconsider this entire project, and go back to the 1971 rule.

Related Item

• FR 8114

Submitter Information Verification

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250.122 Size of Equipment Grounding Conductors.

(A) General. Copper, aluminum, or copper-clad aluminum equipment grounding conductors of the wire type shall not be smaller than shown in Table 250.122, but in no case shall they be required to be larger than the circuit conductors supplying the equipment. Where a cable tray, a raceway, or a cable armor or sheath is used as the equipment grounding conductor, as provided in 250.118 and 250.134(A), it shall comply with 250.4(A)(5) or (B)(4). Equipment grounding conductors shall be permitted to be sectioned within a multiconductor cable, provided the combined circular mil area complies with Table 250.122.

(B) Increased in Size. Where ungrounded conductors are increased in size from the minimum size that has sufficient ampacity for the intended installation, wire-type equipment grounding conductors, where installed, shall be increased in size proportionately, according to the circular mil area of the ungrounded conductors.

(C) Multiple Circuits. Where a single equipment grounding conductor is run with multiple circuits in the same raceway, cable, or cable tray, it shall be sized for the largest overcurrent device protecting conductors in the raceway, cable, or cable tray. Equipment grounding conductors installed in cable trays shall meet the minimum requirements of 392.10(B)(1)(c).

(D) Motor Circuits. Equipment grounding conductors for motor circuits shall be sized in accordance with (D)(1) or (D)(2). **(1) General.** The equipment grounding conductor size shall not be smaller than determined by 250.122(A) based on the rating of the branch-circuit short-circuit and ground-fault protective device.

(2) Instantaneous-Trip Circuit Breaker and Motor Short-Circuit Protector. Where the overcurrent device is an instantaneous trip circuit breaker or a motor short-circuit protector, the equipment grounding conductor shall be sized not smaller than that given by 250.122(A) using the maximum permitted rating of a dual element time-delay fuse selected for branch circuit short-circuit and ground-fault protection in accordance with 430.52(C)(1), Exception No. 1.

(E) Flexible Cord and Fixture Wire. The equipment grounding conductor in a flexible cord with the largest circuit conductor 10 AWG or smaller, and the equipment grounding conductor used with fixture wires of any size in accordance with 240.5, shall not be smaller than 18 AWG copper and shall not be smaller than the circuit conductors. The equipment grounding conductor in a flexible cord with a circuit conductor larger than 10 AWG shall be sized in accordance with Table 250.122.

(F) Conductors in Parallel. For circuits of parallel conductors as permitted in 310.10(H), the equipment grounding conductor shall be installed in accordance with (1) or (2).

(1) Conductor Installations in Raceways, Auxiliary Gutters, or Cable Trays.

(a) *Single Raceway or Cable Tray*. If conductors are installed in parallel in the same raceway or cable tray, a single wire type conductor shall be permitted as the equipment grounding conductor. The wire-type equipment grounding conductor shall be sized in accordance with 250.122, based on the overcurrent protective device for the feeder or branch circuit. Wire type equipment grounding conductors installed in cable trays shall meet the minimum requirements of 392.10(B)(1)(c). Metal raceways or auxiliary gutters in accordance with 250.118 or cable trays complying with 392.60(B) shall be permitted as the equipment grounding conductor.

(b) *Multiple Raceways*. If conductors are installed in parallel in multiple raceways, wire-type equipment grounding conductors, where used, shall be installed in parallel in each raceway. The equipment grounding conductor installed in each raceway shall be sized in compliance with 250.122 based on the overcurrent protective device for the feeder or branch circuit. Metal raceways or auxiliary gutters in accordance with 250.118 or cable trays complying with 392.60(B) shall be permitted as the equipment grounding conductor.

(2) Multiconductor Cables.

(a) If multiconductor cables are installed in parallel, the equipment grounding conductor(s) in each cable shall be connected in parallel. (b) If multiconductor cables are installed in parallel in the same raceway, auxiliary gutter, or cable tray, a single equipment grounding conductor that is sized in accordance with 250.122 shall be permitted in combination with the equipment grounding conductors provided within the multiconductor cables and shall all be connected together.

(c) Equipment grounding conductors installed in cable trays shall meet the minimum requirements of 392.10(B)(1)(c). Cable trays complying with 392.60(B), metal raceways in accordance with 250.118, or auxiliary gutters shall be permitted as the equipment grounding conductor.

(d) Except as provided in 250.122(F)(2)(b) for raceway or cable tray installations, the equipment grounding conductor in each multiconductor cable shall be sized in accordance with 250.122 based on the overcurrent protective device for the feeder or branch circuit.

(G) Feeder Taps. Equipment grounding conductors run with feeder taps shall not be smaller than shown in Table 250.122 based on the rating of the overcurrent device ahead of the feeder but shall not be required to be larger than the tap conductors.

Table 250.122 Minimum Size Equipment Grounding Conductors for Grounding Raceway and Equipment

Rating or Setting of Automatic Overcurrent Device in Circuit Ahead of Equipment, Conduit, etc., Not Exceeding	Size (AWG or kcmil)	
(Amperes)	Copper	Aluminum or Copper-Clad Aluminum*
15	14	12
20	12	10
60	10	8
100	8	6
200	6	4
300	4	2
400	3	1
500	2	1/0
600	1	2/0
800	1/0	3/0
1000	2/0	4/0
1200	3/0	250
1600	4/0	350
2000	250	400
2500	350	600
3000	400	600
4000	500	750
5000	700	1200
6000	800	1200

Note: Where necessary to comply with 250.4(A)(5) or (B)(4), the equipment grounding conductor shall be sized larger than given in this table.

*See installation restrictions in 250.120.

Public Comment No. 966-NFPA 70-2018 [Section No. 250.122(B)]

(B) Multiple Circuits.

A single equipment grounding conductor shall be permitted to be installed for multiple circuits that are installed in the same raceway, cable, or cable tray. It shall be sized from Table 250.122 for the largest circuit conductor in the raceway, cable, trench or cable tray. Equipment grounding conductors installed in cable trays shall meet the minimum requirements of 392.10(B)(1)(c).

Statement of Problem and Substantiation for Public Comment

In 300.3 the NEC it addresses the installation of equipment grounding conductors in a trench. The EGC is required to be in close proximity with the ungrounded and grounded conductors. Using the same theory, and similar installation requirements from 300.3. NEC 250.122 (B) should also include an underground trench to allow installers to forgo multiple EGCs for the same reasons

Related Item

• PI 3909 • FR 8114

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Public Comment No. 1163-NFPA 70-2018 [Section No. 250.122(C)]

(C) Motor Circuits.

Equipment grounding conductors for motor circuits shall be sized in accordance with (C)(1) or (C)(2).

(1) General.

The equipment grounding conductor size shall not be smaller than determined by Table 250.~~122~~ 122 based on the ~~size of~~ rating of the branch-circuit short-circuit ~~or feeder conductor~~ and ground-fault protective device .

(2) Instantaneous-Trip Circuit Breaker and Motor Short-Circuit Protector.

If the overcurrent device is an instantaneous-trip circuit breaker or a motor short-circuit protector, the equipment grounding conductor shall be sized not smaller than that given by Table 250.122 using the ~~size of the~~ maximum permited rating of a dual element time-delay fude selected for branch-circuit ~~conductor.~~ short-circuit and ground-fault protection in accordance with 430.52(C)(1), Exception No.1

Statement of Problem and Substantiation for Public Comment

Substantiation: Sizing motor circuit equipment grounding conductors was previously based on the rating of the overcurrent protective device applied in the circuit and using Table 250.122. 430.52 and Table 430.52 allows for increased sizing the branch circuit short circuit and ground-fault protective device based on the type of device selected for the design. This allows for carrying the starting current of the motor, as indicated in 430.52(B). The concern is for the higher percentages that could be applied for sizing the overcurrent protective device. Percentages such as 800% for instantaneous trip breakers, 300% for non-time delay fuses, 250% for inverse time breakers, and so forth. With the motor circuit conductors having to meet the sizing rules in Part II of Article 430, it would seem that using the size of the motor circuit conductors to establish the size of the equipment grounding conductor would leave the EGC severely undersized in some instances. Seems that there is a gap created here that has not been addressed.

Another possible solution would be to maintain existing Table 250.122 as Table 250.122A for sizing motor circuit EGCs, and designate the newly developed Table 250.122 under FR 8114 could become Table 250.122B, and would base the sizing requirements on the associated ungrounding conductors of the circuit as proposed in FR 8114.

Related Item

• FR 8114

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Public Comment No. 488-NFPA 70-2018 [Section No. 250.122(C)]

(C) Motor and hermetic refrigerant motor-compressor. Circuits.

Equipment grounding conductors for motor circuits shall be sized in accordance with (C)(1) or (C)(2).

(1) General.

The equipment grounding conductor size shall not be smaller than determined by Table 250.122 based on the size of the ~~branch-~~ smallest 75°C conductor that has an ampacity at least equal to the rating of the feeder or branch circuit short ~~-circuit or feeder conductor.~~ circuit and ground fault protective device.

(2) Instantaneous-Trip Circuit Breaker and Motor Short-Circuit Protector.

If the overcurrent device is an instantaneous-trip circuit breaker or a motor short-circuit protector, the equipment grounding conductor shall be sized not smaller than that given by Table 250.122 ~~using~~ based on the size of the smallest 75°C conductor that has an ampacity at least equal to the rating of the maximum permitted rating of a dual element time-delay fuse selected for branch circuit short -circuit ~~conductor~~ and ground-fault protection .

Statement of Problem and Substantiation for Public Comment

With the acceptance of new Table 250.122, the size of the EGC for motors and hermetic compressor circuits will be smaller than what has been previously permitted. This comment proposes that an "assumed" wire size based on the rating of the short circuit and ground fault protective device be used to size the EGCs for these types of circuits. The concept of basing the size of the EGC on the size of the ungrounded conductor is a very good one and will improve the usability of the code for many users. Please consider making changes to the rules for sizing motor circuit EGCs so that the new table can remain in the code.

Related Item

• First Revision No. 8114-NFPA 70-2018

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Public Comment No. 1373-NFPA 70-2018 [Sections 250.122(C)(1), 250.122(C)(2)]

Sections 250.122(C)(1), 250.122(C)(2)

(1) General.

The equipment grounding conductor size shall not be smaller than determined by Table 250.122(C) based on ~~the size~~ the rating of the branch-circuit short-circuit ~~or feeder conductor~~ and ground fault protective device .

(2) Instantaneous-Trip Circuit Breaker and Motor Short-Circuit Protector.

If the overcurrent device is an instantaneous-trip circuit breaker or a motor short-circuit protector, the equipment grounding conductor shall be sized not smaller than that given by Table 250.122(C) using the ~~size of the branch-circuit conductor.~~ maximum permitted rating of a dual element time delay fuse selected for branch-circuit short-circuit and ground fault protection in accordance with 430.52(C)(1), Exception No. 1.

Additional Proposed Changes

File Name	Description	Approved
FR_8114_Public_Comment_Table_250.122C.docx	Proposed new Table 250.122(C) (old Table 250.122)	

Statement of Problem and Substantiation for Public Comment

The committee statement for FR 8114 states that the sizes of equipment grounding conductor in the new table (250.122) are the same as the sizes required by the current table (250.122). However, the change inadvertently allows for smaller equipment grounding conductors in certain cases. One instance is motor branch circuits. For example, under current requirements a 200 amp motor (other than wound rotor) branch circuit protected by an inverse time circuit breaker would require an equipment grounding conductor sized at no less than 1 AWG (Cu). Under the revised requirements, the same branch circuit would be allowed to be provided with an equipment grounding conductor sized at no less than 4 AWG (Cu), three sizes smaller than current requirements. Without further evidence or research, it is not known if this change to allow smaller equipment grounding conductors is safe or not. Therefore the requirements of sizing of the equipment earthing conductor for motor branch circuits must remain the same. This public comment proposes that the current Table 250.122 be included back in the code for sizing of equipment earthing conductors for motor branch circuits as a second Table (Table 250.122(C) in proposed revisions of this public comment).

A more wholistic approach should be considered by CMP 5 to determine if the changes of FR 8114 impact other sections of the code, which would necessitate further modifications to the FR.

Related Item

• FR 8114

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Table 250.122(C) Minimum Size Equipment Grounding Conductors for Grounding Raceway and Equipment in Motor Circuits

Rating or Setting of Automatic Overcurrent Device in Circuit Ahead of Equipment, Conduit, etc., Not Exceeding (Amperes)	Size (AWG or kcmil)	
	Copper	Aluminum or Copper-Clad Aluminum*
15	14	12
20	12	10
60	10	8
100	8	6
200	6	4
300	4	2
400	3	1
500	2	1/0
600	1	2/0
800	1/0	3/0
1000	2/0	4/0
1200	3/0	250
1600	4/0	350
2000	250	400
2500	350	600
3000	400	600
4000	500	750
5000	700	1200
6000	800	1200

*See installation restrictions in 250.120

Public Comment No. 487-NFPA 70-2018 [Section No. 250.122(E)]

(E) Conductors in Parallel.

For circuits of parallel conductors as permitted in 310.10(G), the equipment grounding conductor shall be installed in accordance with 250.122(E)(1) or (E)(2). Equipment grounding conductors that are not smaller than that provided in Table 250.122 shall be permitted to be connected in parallel for circuit conductors that are connected in parallel.

(1) Conductor Installations in Raceways, Auxiliary Gutters, or Cable Trays.

(a) *Single Raceway or Cable Tray, Auxiliary Gutter*, *or Cable Tray*. Equipment grounding conductors for circuit conductors that are connected in parallel in the same raceway, auxiliary gutter, or cable tray shall be installed in compliance with one of the following:

(1) An equipment grounding conductor shall be installed with each set of circuit conductors that are connected in parallel. The wire-type equipment grounding conductor for each set shall be sized in accordance with Table 250.122.

(2) A single wire-type equipment grounding conductor shall be installed and sized in accordance with Table 250.122, based on the total circular mil area of the largest set of circuit conductors for any phase that is connected in parallel. ~~Where the total area does not result in a standard size conductor, the next larger conductor shall be selected from Chapter 9, Table 8.~~

(b) *Multiple Raceways*. If conductors are installed in parallel in multiple raceways, a wire-type equipment grounding ~~conductors~~ conductor(s) , where used, shall be installed in ~~parallel in~~ each raceway and shall be connected in parallel . The equipment grounding conductor installed in each raceway shall be sized in compliance with 250.122 based on the largest circuit conductor in the raceway. Metal raceways or auxiliary gutters in accordance with 250.118 or cable trays complying with 392.60(B) shall be permitted as the equipment grounding conductor.

(c) *Wire-Type Equipment Grounding Conductors.* Wire-type equipment grounding conductors installed in cable trays shall meet the minimum requirements of 392.10(B)(1)(c).

(d) *Metal Raceways, Auxiliary Gutters, or Cable Trays.* Metal raceways or auxiliary gutters in accordance with 250.188 or cable trays complying with 392.60(B) shall be permitted as the equipment grounding conductor.

(2) Multiconductor Cables.

(a) If circuit conductors of multiconductor cables are connected in parallel, the equipment grounding conductor(s) in each cable shall be connected in parallel.

(b) The equipment grounding conductor in each multiconductor cable shall be sized in compliance with Table 250.122.

(c) Equipment grounding conductors installed in cable trays shall meet the minimum requirements of 392.10(B)(1)(c). Cable trays complying with 392.60(B), metal raceways in accordance with 250.118, or auxiliary gutters shall be permitted as the equipment grounding conductor.

Statement of Problem and Substantiation for Public Comment

For 250.122(E)(1)(a)(2), the second sentence is not needed because CMP-5 added Note 2 to Table 250.122 that ensures that the equipment grounding conductor is not smaller than 12.5% of the circuit conductor.

Related Item

• FR-8114

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Public Comment No. 207-NFPA 70-2018 [Section No. 250.122(E)(1)]

(1) Conductor Installations in Raceways, Auxiliary Gutters, or Cable Trays.

(a) *Single Raceway or Cable Tray, Auxiliary Gutter*, *or Cable Tray*. Equipment grounding conductors for circuit conductors that are connected in parallel in the same raceway, auxiliary gutter, or cable tray shall be installed in compliance with one of the following:

(1) An equipment grounding conductor shall be installed with each set of circuit conductors that are connected in parallel. The wire-type equipment grounding conductor for each set shall be sized in accordance with Table 250.122.

(2) A single wire-type equipment grounding conductor shall be installed and sized in accordance with Table 250.122, based on the total circular mil area of the largest set of circuit conductors for any phase that is connected in parallel. Where the total area does not result in a standard size conductor, the next larger conductor shall be selected from Chapter 9, Table 8.

(b) *Multiple Raceways*. If conductors are installed in parallel in multiple raceways, wire-type equipment grounding conductors, where used, shall be installed in parallel in each raceway. The equipment grounding conductor installed in each raceway shall be sized in compliance with 250.122 based on the largest circuit conductor in the raceway. ~~Metal raceways or auxiliary gutters in accordance with 250.118 or cable trays complying with 392.60(B) shall be permitted as the equipment grounding conductor.~~

(c) *Wire-Type Equipment Grounding Conductors.* Wire-type equipment grounding conductors installed in cable trays shall meet the minimum requirements of 392.10(B)(1)(c).

(d) *Metal Raceways, Auxiliary Gutters, or Cable Trays.* Metal raceways or auxiliary gutters in accordance with 250.~~188~~ 118, or cable trays complying with 392.60(B) shall be permitted as the equipment grounding conductor.

Statement of Problem and Substantiation for Public Comment

The reference in 250.122(E)(1)(a)(2)(d) is incorrect (I believe a simple editorial error) - I am sure that the reference is intended to be to 250.118 [as it is in 250.122(E)(1)(a)(2)(b)] and not to 250.188.

Given the presence of 250.122(E)(1)(a)(2)(d), which applies to both single and multiple cases, the inclusion of the last sentence of 250.122(E)(1)(a)(2)(b) is redundant and may be deleted for simplicity.

In either (b) or (d), the Oxford comma after 118 is required since gutters and trays are separate subject items and are referred to different section numbers.

Related Item

• 8114

Submitter Information Verification

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Committee: NEC-P05

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Public Comment No. 2019-NFPA 70-2018 [Section No. 250.122(E)(2)]

(2) Multiconductor Cables.

(a) If circuit conductors of multiconductor cables are connected in parallel, the equipment grounding conductor(s) in each cable shall be connected in parallel.

(b) The equipment grounding conductor in each multiconductor cable shall be sized in compliance with Table 250.122.

(c) Equipment grounding conductors installed in cable trays shall meet the minimum requirements of 392.10(B)(1)(c). Cable trays complying with 392.60(B), metal raceways in accordance with 250.118, or auxiliary gutters shall be permitted as the equipment grounding conductor.

Statement of Problem and Substantiation for Public Comment

In parallel raceway, I can have a ground sized by the conductors, why does the ground in multi-conductor cables have to be sized for the full load?
If I put that multi-conductor in the conduit, then the ground size can be reduced? It seems if we can justify smaller ground in conduit, then we should be able to do that in multi-conductor cables. Then standard ground sizing in TC-ER cables will still work out.

Related Item

• FR8114

Submitter Information Verification

Submitter Full Name: Evan Zaker
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Committee: NEC-P05

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Public Comment No. 1694-NFPA 70-2018 [Section No. 250.122(F)]

~~(F) Feeder Taps.~~

~~Equipment grounding conductors installed with feeder taps shall not be smaller than shown in Table 250.122 based on the size of the feeder conductor on the supply side ahead of the tap but shall not be required to be larger than the tap conductors.~~

~~Table 250.122 Minimum Size Equipment Grounding Conductors for Grounding Raceway and Equipment~~

~~Size of Largest Ungrounded Circuit Conductor (AWG or kcmil) Smallest Size of Equipment Grounding Conductor (AWG or kcmil) Copper Aluminum or Copper-clad Aluminum Copper Aluminum or Copper-clad Aluminum* 14 12 14 12 12 10 12 10 10–8 8–6 10 8 6–3 4–1 8 6 2–3/0 1/0–4/0 6 4 4 /0–300 250–450 4 2 350–550 500–800 3 1 600–800 900–1300 2 1/0 900–1300 1400–2000 1 2 /0 1400–2000 – 1/0 3/0 ----------~~

~~Notes:~~

~~1. If necessary to comply with 250.4(A)(5) or (B)(4), the equipment grounding conductor shall be sized larger than given in this table.~~

~~2. If the equivalent area of the largest ungrounded circuit conductor is larger than 2000 kcmil in a single raceway, auxiliary gutter, or cable tray, the equipment grounding conductor shall have an area not less than 12 1/2 percent of the equivalent area of the largest ungrounded conductor.~~

~~*See installation restrictions in 250.120.~~

Revert back to table in 2017 NEC.

Statement of Problem and Substantiation for Public Comment

FR 8114 will compromise the safe and reliable operation of electrical systems. Table 250.122 is based on the size of the overcurrent device for a reason, to ensure appropriate current flow to open the overcurrent device. The opening of the overcurrent device can serve two important roles; 1) protect the electrical infrastructure, and to 2) protect the electrical worker from an arc-flash event. No substantiation has been provided to support the reduction of the equipment grounding conductor that can compromise the proper operation of the electrical system.

The requirements for the EGC must work for all configurations including factory assembled cables such as MC and TC as well as installation configurations in trench, wireway, and raceways. No substantiation has been presented nor have the vast configurations been appropriately reviewed by the code panel that would demonstrate the revised language will support appropriate sizing of the EGC in all configurations. The submitter must provide the necessary substantiation to demonstrate the safe application of these configurations which has not be done.

The application of the revised language in parallel configurations points to a compromise in safe and reliable operation of the electrical system. The panel discussion noted a condition in which a single EGC might be required to carry the entire fault current in a parallel installation, unfortunately it was completely dismissed in favor or creating the first revision. There are multiple publications that identify applications in which an insulation failure in a run of cable or non-metallic raceway faults to a bare equipment grounding conductor or a phase conduct requiring the single conductor to serve as the only ground fault return path. The revised language compromises the ability of many parallel path configurations to no longer be protected. The bottom line is the language proposed in FR8144 to reduce the EGC can NOT be generally applied without safety being compromised.

Related Item

• FR 8114

Submitter Information Verification

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Submittal Date: Wed Aug 29 16:26:24 EDT 2018

Committee: NEC-P05

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Public Comment No. 1755-NFPA 70-2018 [Section No. 250.122(F)]

(F) Feeder Taps.

Equipment grounding conductors installed with feeder taps shall not be smaller than shown in Table 250.122 based on the size of the feeder conductor on the supply side ahead of the tap but shall not be required to be larger than the tap conductors.

Table 250.122 Minimum Size Equipment Grounding Conductors for Grounding Raceway and Equipment

Size of Largest Ungrounded Circuit Conductor or Equivalent Area for Parallel Conductors (AWG or kcmil)		Smallest Size of Equipment Grounding Conductor (AWG or kcmil)					
Copper	Aluminum or Copper-clad Aluminum	Copper	Aluminum or Copper-clad Aluminum*				
14	12	14	12				
12	10	12	10				
10–8	8–6	10	8				
6–3	4–1	8	6				
~~2–3~~ 2–2 /0	1/0–4/0	6	4				
4 - 3 /0–300	250–450	4	2				
350–550	500–800	~~3~~ 1	1/0				
600–800	900–1300	2	1/0	~~900–1300~~	~~1400–2000~~	~~1~~ ~~2~~ 3 /0	
900–1300	1400–2000	–	~~1/0~~	3/0	250		
1400–2000	–	250					
-	-	-	-				
-	-	-	-				
-	-	-	-				
-	-	-	-				
-	-	-	-				
-	-	-	-				
-	-	-	-				
-	-	-	-				
300							

Notes:

1. If necessary to comply with 250.4(A)(5) or (B)(4), the equipment grounding conductor shall be sized larger than given in this table.

2. If the equivalent area of the largest ungrounded circuit ~~conductor~~ conductors that are connected in parallel is larger than 2000 kcmil in a single raceway, auxiliary gutter, or cable tray, the equipment grounding conductor shall have an area not ~~less than~~ smaller than 12 ½ percent of the equivalent area of the largest ungrounded ~~conductor~~ conductors .

*See installation restrictions in 250.120.

Additional Proposed Changes

File Name	Description	Approved

Table_250.122_for_SD.pdf	PDF File of Table 250.122 for Second Draft meeting
EGC_Motors-2.pdf	Equipment Grounding Conductor for Motors using Revised Table 250.122

Statement of Problem and Substantiation for Public Comment

The title above the left two columns is corrected to agree with the text that was accepted by CMP-5 at the First Draft meeting.
The first value in the fifth row in the first column is changed from 3/0 to 2/0. This was included in the text that was approved by CMP-5 at the First Draft meeting.
The first value in the sixth row in the first column is changed from 4/0 to 3/0. This was included in the text that was approved by CMP-5 at the First Draft meeting.
The sizes of the equipment grounding conductors in lowest four rows are increased to ensure that the EGCs are not smaller than 12.5% of the circuit conductors. The primary reason for these increased sizes is to ensure that the EGC for motor branch circuits is not smaller than 12.5% of the circuit conductors.

Related Item

• FR-8114

Submitter Information Verification

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Committee: NEC-P05

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Table 250.122 Minimum Size Equipment Grounding Conductors for Grounding Raceway and Equipment

Size of Largest Ungrounded Circuit Conductor or Equivalent Area for Parallel Conductors (AWG or kcmil)		Smallest Size of Equipment Grounding Conductor (AWG or kcmil)	
Copper	Aluminum or Copper-clad Aluminum	Copper	Aluminum or Copper-clad Aluminum*
14	12	14	12
12	10	12	10
10-8	8-6	10	8
6-3	4-1	8	6
2-2/0	1/0 - 4/0	6	4
3/0 - 300	250 - 450	4	2
350 - 550	500 - 800	1	1/0
600 - 800	900 - 1300	1/0	3/0
900 - 1300	1400 - 2000	3/0	250
1400 - 2000	-	250	300

Notes:

1. If necessary to comply with 250.4(A)(5) or (B)(4), the equipment grounding conductor shall be sized larger than given in this table.

2. If the equivalent area of the largest ungrounded circuit conductors that are connected in parallel is larger than 2000 kcmil in a single raceway, auxiliary gutter, or cable tray, the equipment grounding conductor shall have an area not smaller than 12½ percent of the equivalent area of the largest ungrounded conductors.

*See installation restrictions in 250.120.

Use of REVISED Table 6.2 of UL-1569 for Motor Circuits

Motor HP Rating	Voltage (Ph)	FLA[1]	Min. Wire Ampacity[2]	Min Wire Size[3]	Max. OCP[4]	Round-up OCP[5]	EGC 2017 NEC[6]	EGC per REVISED UL-1569	UL-1569 % of Circuit Wire
1/4	115 (1)	5.8	7	14 AWG	14.5	15	14 AWG	14 AWG	100%
1/2	115 (1)	9.8	12	14 AWG	24.5	25	14 AWG	14 AWG	100%
1	230 (1)	8	10	14 AWG	20	20	14 AWG	14 AWG	100%
5	230 (1)	28	35	10 AWG	70	70	10 AWG	10 AWG	100%
10	208 (3)	30.8	39	8 AWG	77	80	8 AWG	10 AWG	63%
40	460 (3)	52	65	6 AWG	130	150	6 AWG	8 AWG	63%
50	460 (3)	65	81	4 AWG	163	175	6 AWG	8 AWG	40%
75	460 (3)	96	120	1/0 AWG	240	250	4 AWG	6 AWG	25%
100	460 (3)	124	155	2/0 AWG	310	350	3 AWG	6 AWG	20%
150	460 (3)	180	225	4/0 AWG	450	450	2 AWG	4 AWG	20%
200	460 (3)	240	300	350 kcmil	600	600	1 AWG	1 AWG	24%
250	460 (3)	302	378	500 kcmil	755	800	1/0 AWG	1 AWG	17%
300	460 (3)	361	451	(2) 4/0 AWG	903	1000	(2) 2/0 AWG	(2) 4 AWG	20%
400	460 (3)	477	596	(2) 350 kcmil	1193	1200	(2) 3/0 AWG	(2) 1 AWG	24%
500	460 (3)	590	738	(2) 500 kcmil	1475	1600	(2) 4/0 AWG	(2) 1 AWG	17%

[1] Table 430.248 or 430.250 as applicable

[2] 125% of FLA per 430.22

[3] 75°C column of Table 310.15(B)(16)

[4] 250% of FLA for Inverse-time Circuit Breaker from Table 430.52

[5] Round-up to next standard OC device rating, if applicable, 430.52(C)(1) Exception No. 1

[6] From Table 250.122 but not larger than circuit wire size, 250.122(A)

Print:
8/29/2018

Public Comment No. 2131-NFPA 70-2018 [Section No. 250.122(F)]

(F) Feeder Taps.

Equipment grounding conductors installed with feeder taps shall not be smaller than shown in Table 250.122 based on the size of the feeder conductor on the supply side ahead of the tap but shall not be required to be larger than the tap conductors.

Table 250.122 Minimum Size Equipment Grounding Conductors for Grounding Raceway and Equipment

~~Size of Largest Ungrounded Circuit Conductor (AWG or kcmil)~~		Rating or Setting of Automatic Overcurrent Device in Circuit Ahead of Equipment, Conduit, etc., Not Exceeding (Amperes)		Smallest Size of Equipment Grounding Conductor (AWG or kcmil)
Copper	Aluminum or Copper-clad Aluminum	Copper	Aluminum or Copper-clad Aluminum*	
14	12	14	12	
12	10	12	10	
10–8	8–6	10	8	
6–3	4–1	8	6	
2–3/0	1/0–4/0	6	4	
4/0–300	250–450	4	2	
350–550	500–800	3	1	
600–800	900–1300	2	1/0	
900–1300	1400–2000	1	2/0	
1400–2000	–	1/0	3/0	
-	-	-	-	
-	-	-	-	
-	-	-	-	
-	-	-	-	
-	-	-	-	
-	-	-	-	
-	-	-	-	
-	-	-	-	
-	-	-	-	

Notes:

1. If necessary to comply with 250.4(A)(5) or (B)(4), the equipment grounding conductor shall be sized larger than given in this table.

2. If the equivalent area of the largest ungrounded circuit conductor is larger than 2000 kcmil in a single raceway, auxiliary gutter, or cable tray, the equipment grounding conductor shall have an area not less than 12 ½ percent of the equivalent area of the largest ungrounded conductor.

*See installation restrictions in 250.120.

Statement of Problem and Substantiation for Public Comment

I submitted this comment only changing the Header Line in Table 250.122 I understand that many more changes would have to take place should CMP 5 decide to revert back to the requirement of utilizing the overcurrent device to size grounding conductors. I submitted the comment that as Terra makes you make a change in order to submit a comment. What I really want to do is support the ballot statements submitted by Mr. Andre and Mr. Sasso regarding the lack of technical merit for changing this long standing safe practice. It has been my opinion based on what I was taught that sizing equipment grounding conductors was based on their ability to withstand faults until the overcurrent device opens and that has worked well. Sizing bonding jumpers ahead of overcurrent devices such as described in 250.102 was based on their ability to withstand faults until conductors burned clear and that is why they are sized basedon the size of the phase conductors that they are installed with. I do not see any reason to treat these two types of installations the same and I do not see why CMP 5 states that this revised requirement will be easier to understand by installers and enforcers. i hope that CMP 5 gives this further consideration.

Related Item

• FR8114

Submitter Information Verification

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Committee: NEC-P05

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Public Comment No. 2179-NFPA 70-2018 [Section No. 250.122(F)]

(F) Feeder Taps.

Equipment grounding conductors installed with feeder taps shall not be smaller than shown in Table 250.122 based on the size of the feeder conductor on the supply side ahead of the tap but shall not be required to be larger than the tap conductors.

Table 250.122 Minimum Size Equipment Grounding Conductors for Grounding Raceway and Equipment

Size of Largest Ungrounded Circuit Conductor (AWG or kcmil)		Smallest Size of Equipment Grounding Conductor (AWG or kcmil)	
Copper	Aluminum or Copper-clad Aluminum	Copper	Aluminum or Copper-clad Aluminum*
14	12	14	12
12	10	12	10
10–8	8–6	10	8
6–3	4–1	8	6
2–3/0	1/0–4/0	6	4
4/0–300	250–450	4	2
350–550	500–800	3	1
600–800	900–1300	2	1/0
900–1300	1400–2000	1	2/0
1400–2000	–	1/0	3/0

Notes:

1. If necessary to comply with 250.4(A)(5) or (B)(4), the equipment grounding conductor shall be sized larger than given in this table.

2. If the equivalent area of the largest ungrounded circuit conductor is larger than 2000 kcmil in a single raceway, auxiliary gutter, or cable tray, the equipment grounding conductor shall have an area not less than 12 ½ percent of the equivalent area of the largest ungrounded conductor.

*See installation restrictions in 250.120.

Statement of Problem and Substantiation for Public Comment

Raceway and Equipment" and the notes at the bottom of the table also directed the user to comply with 250.4 (A)(5) & (B)(4) which would require the user to ensure that the equipment grounding path was sufficient to carry the fault current likely to be imposed on the conductor. Currently the minimum size equipment grounding conductor is based upon the rating or setting of the overcurrent device in the circuit ahead of the equipment grounding conductor. To use the table properly the user should also consider the amount of let through energy that the device that is being used can allow, keeping in mind that the table is only a minimum. There are 3 different validations that need to be considered when sizing the equipment grounding path 1) the integrity of the insulation of the conductor, 2) the termination of the conductor and 3) the melting point of the conductor.

The Integrity of the Insulation of the Conductor

Although 250.118(1) does state that an insulated or bare conductor It appears to me that there is a conflict with Article 110.10 “The overcurrent protective devices, the total impedance, the equipment short-circuit current ratings, and other characteristics of the circuit to be protected shall be selected and coordinated to permit the circuit protective devices used to clear a fault to do so without extensive damage to the electrical equipment of the circuit. This fault shall be assumed to be either between two or more of the circuit conductors or between any circuit conductor and the equipment grounding conductor(s) permitted in 250.118.” In particular, “equipment of the circuit” and the reference to the “equipment grounding conductor”. Article 250.118(1) does allow a bare conductor but does that really meet the intent of 110.10? Based on the ICEA tables insulation damage occurs when raising the conductor temperature from 75 degrees C to 150 degrees C. Table 1 below illustrates the conductor rating for 5 seconds for an equipment grounding conductor size and the point at which the conductor insulation damage level occurs using a thermoplastic insulation. If an insulated conductor were used then damage to the insulation of the grounding conductor would occur, if a bare conductor were used then damage to the insulation of the surrounding conductors would occur.

Table 1: 75ºC Conductor 5 Second Current (Based on RMS Amperes)

Cond Size	Cond Area Circ. Mils	5 Second Rating (Amps) ICEA Insulation 150 Deg. C
14 AWG	4110	97.31
12 AWG	6530	154.61
10 AWG	10380	245.76
8 AWG	16510	390.90

Table 2 shows the maximum short-circuit current rating of the equipment grounding conductor based upon the opening time of the overcurrent device used to protect the normally current carrying conductors of the circuit. The let through energy of the overcurrent device that is used for the circuit should be considered when sizing the equipment grounding conductor to protect the insulation of the equipment grounding conductor or the surrounding conductors if a bare equipment grounding conductor is used. If the let through energy of the overcurrent device used for the circuit conductors exceeds the minimum short-circuit current ratings in tables 1 or 2 the equipment grounding conductor size would need to be increased until the let through energy of the overcurrent device protecting the circuit is less than the short-circuit current of the equipment grounding conductor.

Table 2 Maximum Short-Circuit Current Rating In Amperes (Per ICEA 75ºC Insulation Damage)

Cond Size	Cond Area Circ. Mils	Maximum Short-Circuit Current Rating In RMS Amperes 1/2* Cycles 0.0083 Seconds	1 Cycle 0.0167 Seconds	2 Cycle 0.0333 Seconds	3 Cycle 0.0500 Seconds	6 Cycle 0.1 Seconds	12 Cycle 0.2 Seconds	18 Cycle 0.3 Seconds	24 Cycle 0.4 Seconds	30 Cycle 0.5 Seconds
14 AWG	4110	2384	1685	1192	973	688	487	397	344	308
12 AWG	6530	3787	2678	1894	1546	1093	773	631	547	489
10 AWG	10380	6020	4257	3010	2458	1738	1229	1003	869	777
8 AWG	16510	9575	6771	4788	3909	2764	1954	1596	1382	1236

The Termination of the Conductor

Table 3 illustrates the maximum short-circuit current rating of copper conductors. The information in this table is from a book that was originally published by Eustace Soares in 1966. This table is based on the annealing point of copper (the point at which a conductor becomes loose under a lug).

Table 3: Maximum Short-Circuit Current Rating In Amperes (per Soares Annealing 250 Deg C)

Cond Size	Cond Area Circ. Mils	Maximum Short-Circuit Current Rating In RMS Symmetrical Amperes 1/2* Cycles 0.0083 Seconds	1 Cycle 0.0167 Seconds	2 Cycle 0.0333 Seconds	3 Cycle 0.0500 Seconds	6 Cycle 0.1 Seconds	12 Cycle 0.2 Seconds	18 Cycle 0.3 Seconds	24 Cycle 0.4 Seconds	30 Cycle 0.5 Seconds
14 AWG	4110	3425	2422	1713	1398	989	699	571	494	442
12 AWG	6530	5442	3848	2721	2222	1571	1111	907	786	703
10 AWG	10380	8651	6117	4325	3532	2497	1766	1442	1249	1117
8 AWG	16510	13760	9730	6880	5617	3972	2809	2293	1986	1776

If a circuit breaker is used as current limiting, then the breaker would need to meet the requirements of UL 489 with a clearing time of ½ cycle and the short circuit current rating in amperes of the equipment grounding conductor would need to exceed the RMS symmetrical value. If the breaker is not current limiting the let through current could be as high as 1.3 times the RMS symmetrical value of the rating of the breaker requiring an even larger equipment grounding conductor to prevent the conductor from becoming annealed during a fault condition.

The Melting Point of a Conductor

Table 4 illustrates the maximum short-circuit rating of copper conductors based upon the Onderdonk damage level. This is the damage level of a conductor with raising the conductor temperature from 75-degree C to 1083-degree C (the temperature at which copper melts)

Table 4: Maximum Short-Circuit Current Rating in Amperes (per Onderdonk Melting 1083 Deg C)

Cond Size	Cond Area Circ. Mils	Maximum Short-Circuit Current Rating In RMS Symmetrical Amperes 1/2* Cycles 0.0083 Seconds	1 Cycle 0.0167 Seconds	2 Cycle 0.0333 Seconds	3 Cycle 0.0500 Seconds	6 Cycle 0.1 Seconds	12 Cycle 0.2 Seconds	18 Cycle 0.3 Seconds	24 Cycle 0.4 Seconds	30 Cycle 0.5 Seconds
14 AWG	4110	6157	4353	3078	2513	1777	1257	1026	889	795
12 AWG	6530	9782	6917	4891	3993	2824	1997	1630	1412	1263
10 AWG	10380	15549	10995	7775	6348	4489	3174	2592	2244	2007
8 AWG	16510	24732	17488	12366	10097	7139	5048	4122	3570	3193

The values in this table should never be reached.

Examples:
Using NEC Table 310.16(B)(16) a #3awg conductor has an ampacity of 100 amperes in the 75 degree column and by using Article 240.4 the #3awg conductor could be protected by a 100 amp overcurrent device. With the current Table 250.122 as written the minimum equipment grounding conductor would be required to be a #8awg conductor.

If a circuit breaker was current limiting, at a 40,000A fault with a clearing time of ½ cycle, per UL 489 the let through current could be as high as 40,000A RMS symmetrical or if the breaker was not current limiting the let through current could be as high as 52,000A (40,000 x 1.3 = 52,000). This would exceed the insulation damage level from the IAEC table, annealing temperature level from Soares table and melting point from the Onderdonk table for the phase conductors and the fault level for a #8awg equipment grounding conductor.

If a typical residential breaker were used the rating would typically be 10KA and the fault level would likely be lower. Using the same 100-amp circuit with a 10KA rated device the fault level could be 10KA. The #8awg conductor could experience insulation damage at ½ cycle as the insulation damage would occur at 9575 amps for ½ cycle and only 3909 amps at 3 cycles. If the breaker were capable of opening at ½ cycle the #8 would be protected from annealing at ½ cycle as annealing would not occur until 13,760 amps for ½ cycle. However, if the breaker did not open until 3 cycles the annealing temperature of the #8awg only be 5617 amps exceeding the annealing temperature of copper creating a poor connection. The melting point of a #8 would not be reached if the breaker were to open at ½ cycle as the melting point would be 24,732 amps but for all practical purposes would be reached if the breaker did not open until 3 cycles as the melting point at 3 cycles for #8awg would be 10,097amps.

Summary
The current way that the table is written by stating that it is a minimum based on the size of the overcurrent device would be correct. The equipment grounding conductor should be based on the opening time of the overcurrent device protecting the normal current carrying conductors of the circuit. The type of device used for the overcurrent protection of the circuit would determine the amount of energy that the equipment grounding conductor could be exposed to during a fault condition. Changing the table to be based on the conductor size of the current carrying circuit conductors would lead the user to not look at the overcurrent device protecting the circuit.

Related Item

• Table 250.122

Submitter Information Verification

Submitter Full Name: Dennis Querry
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Submittal Date: Thu Aug 30 22:03:57 EDT 2018
Committee: NEC-P05

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Public Comment No. 416-NFPA 70-2018 [Section No. 250.132]

250.132 Short Sections of Raceway.

Isolated sections of metal raceway or cable armor, where required to be ~~grounded~~ connected to the equipment grounding conductor , shall be connected to an equipment grounding conductor in accordance with 250.134.

Statement of Problem and Substantiation for Public Comment

The term 'grounded' should be replaced with 'equipment grounding conductor' to coordinate with the text contained 250.86 Exception 3.

Related Item

• PI-1839

Submitter Information Verification

Submitter Full Name: Mike Holt
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Zip:
Submittal Date: Sun Aug 05 17:37:36 EDT 2018
Committee: NEC-P05

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Public Comment No. 417-NFPA 70-2018 [Section No. 250.138]

250.138 Cord-and-Plug-Connected Equipment.

Non–current-carrying metal parts of cord-and-plug-connected equipment, ~~if grounded, shall~~ that are not listed as double insulated, shall be connected to an equipment grounding conductor by one of the methods in 250.138(A) or (B).

(A) By Means of an Equipment Grounding Conductor.

By means of an equipment grounding conductor run with the power supply conductors in a cable assembly or flexible cord properly terminated in a grounding-type attachment plug with one fixed grounding contact.

Exception: The grounding contacting pole of grounding-type plug-in ground-fault circuit interrupters shall be permitted to be of the movable, self-restoring type on circuits operating at not over 150 volts between any two conductors or over 150 volts between any conductor and ground.

(B) By Means of a Separate Flexible Wire or Strap.

By means of a separate flexible wire or strap, insulated or bare, connected to an equipment grounding conductor, and protected as well as practicable against physical damage, where part of equipment.

Statement of Problem and Substantiation for Public Comment

All metal parts of cord-and-plug connected equipment must be connected to the circuit equipment grounding conductor. It doesn't matter if the system is grounded or not, except double insualted equipment.

Related Item

• PI-1841

Submitter Information Verification

Submitter Full Name: Mike Holt
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Zip:
Submittal Date: Sun Aug 05 17:43:36 EDT 2018
Committee: NEC-P05

Public Comment No. 898-NFPA 70-2018 [Section No. 250.142(A)]

(A) Supply-Side Equipment.

A grounded circuit conductor shall be permitted to be connected to non–current-carrying metal parts of equipment, raceways, and other enclosures under any of the following conditions:

(1) On the supply side or within the enclosure of the ac service-disconnecting means

(2) On the supply side or within the enclosure of the main disconnecting means for separate buildings as provided in 250.32(B)(1) Exception No. 1

(3) On the supply side or within the enclosure of the main disconnecting means or overcurrent devices of a separately derived system where permitted by 250.30(A)(1)

(4) On the supply side or within the enclosure of a supply-side disconnect(s)

Additional Proposed Changes

File Name	Description	Approved
CN_243.pdf	70_CN 243	

Statement of Problem and Substantiation for Public Comment

NOTE: This Public Comment appeared as CC Note No. 243 in the First Draft Report on First Revision No. 7545.

The Correlating Committee directs that the panel clarify the panel action on FR 7545. The introductory text refers to “conditions” as discussed in the list that follows, but the list actually discusses locations.

This action will be considered as a public comment.

The Correlating Committee directs that FR 7545 be referred to Code-Making Panel 4 for information.

Related Item

• FR 7545

Submitter Information Verification

Submitter Full Name: CC on NEC-AAC
Organization: NEC Correlating Committee
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State:
Zip:
Submittal Date: Mon Aug 20 15:10:29 EDT 2018
Committee: NEC-P05

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Correlating Committee Note No. 243-NFPA 70-2018 [Section No. 250.142(A)]

Submitter Information Verification

Submitter Full Name: Sarah Caldwell
Committee:
Submittal Date: Fri May 11 16:39:40 EDT 2018

Committee Statement and Meeting Notes

Committee Statement: The Correlating Committee directs that the panel clarify the panel action on FR 7545. The introductory text refers to “conditions” as discussed in the list that follows, but the list actually discusses locations. This action will be considered as a public comment.

The Correlating Committee directs that FR 7545 be referred to Code-Making Panel 4 for information.

First Revision No. 7545-NFPA 70-2018 [Section No. 250.142(A)]

Ballot Results

This item has passed ballot

12 Eligible Voters
0 Not Returned
12 Affirmative All
0 Affirmative with Comments
0 Negative with Comments
0 Abstention

Affirmative All

Brunssen, James E.
Dressman, Kevin L.
Hickman, Palmer L.
Hittinger, David L.
Holub, Richard A.
Johnston, Michael J.
Kovacik, John R.
Manche, Alan
McDaniel, Roger D.
Pierce, James F.
Saporita, Vincent J.
Williams, David A.

Public Comment No. 568-NFPA 70-2018 [Section No. 250.142(B)]

(B) Load-Side Equipment.

Except as permitted in 250.30(A)(1), 250.32(B)(1), Exception No. 1, and Part X of Article 250, a grounded circuit conductor shall not be connected to non–current-carrying metal parts of equipment on the load side of the service disconnecting means, on the load side of a supply-side disconnect, or on the load side of a separately derived system disconnecting means or the overcurrent devices for a separately derived system not having a main disconnecting means.

Exception No. 1: The frames of ranges, wall-mounted ovens, counter-mounted cooking units, and clothes dryers under the conditions permitted for existing installations by 250.140 shall be permitted to be connected to the grounded circuit conductor.

Exception No. 2: It shall be permissible to connect meter enclosures to the grounded circuit conductor on the load side of the service disconnect if all of the following conditions apply:

(1) Ground-fault protection of equipment is not installed.

(2) All meter enclosures are located immediately adjacent to the service disconnecting means.

(3) The size of the grounded circuit conductor is not smaller than the size specified in Table 250.122 for equipment grounding conductors.

Exception No. 3: Electrode-type boilers operating at over 1000 volts shall be grounded as required in 490.72(E)(1) and 490.74.

Statement of Problem and Substantiation for Public Comment

Editorial changes are proposed to improve clarity.

Related Item

• FR-7548

Submitter Information Verification

Submitter Full Name: Phil Simmons
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City:
State:
Zip:
Submittal Date: Sat Aug 11 18:50:55 EDT 2018
Committee: NEC-P05

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Public Comment No. 1208-NFPA 70-2018 [Section No. 250.146(D)]

(D) Isolated Ground Receptacles.

~~Where installed for the reduction of electrical noise (electromagnetic interference) on the equipment grounding conductor, a~~ A receptacle in which the grounding terminal is purposely insulated from the receptacle mounting means shall be permitted. The receptacle grounding terminal shall be connected to an insulated equipment grounding conductor run with the circuit conductors. This equipment grounding conductor shall be permitted to pass through one or more panelboards without a connection to the panelboard grounding terminal bar as permitted in 408.40, Exception, so as to terminate within the same building or structure directly at an equipment grounding conductor terminal of the applicable derived system or service. Where installed in accordance with this section, this equipment grounding conductor shall also be permitted to pass through boxes, wireways, or other enclosures without being connected to such enclosures.

Informational Note: Use of an isolated equipment grounding conductor does not relieve the ~~requirement for grounding the raceway system and outlet box.~~ requirements of 250.4.

Statement of Problem and Substantiation for Public Comment

This requirement should be in force whenever an isolated ground receptacle is used. Not just when installed for noise purposes.

The informational note currently only references grounding requirements. The requirements for effective fault current path should also be referenced. Both are covered by 250.4

Related Public Comments for This Document

Related Comment	Relationship
Public Comment No. 1206-NFPA 70-2018 [Section No. 250.96(B)]	Related sections
Public Comment No. 1207-NFPA 70-2018 [Section No. 406.3(D) [Excluding any Sub-Sections]]	Related sections

Related Item

• 3761-NFPA 70-2017

Submitter Information Verification

Submitter Full Name: Eric Stromberg
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Submittal Date: Fri Aug 24 12:37:36 EDT 2018
Committee: NEC-P05

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Public Comment No. 2135-NFPA 70-2018 [Section No. 250.146(D)]

(D) Isolated Ground Receptacles.

Where installed for the reduction ~~of electrical noise (electromagnetic~~ of electromagnetic interference ~~)~~ on the equipment grounding conductor, a receptacle in which the grounding terminal is purposely insulated from the receptacle mounting means shall be permitted. The receptacle grounding terminal shall be connected to an insulated equipment grounding conductor run with the circuit conductors. This equipment grounding conductor shall be permitted to pass through one or more panelboards without a connection to the panelboard grounding terminal bar as permitted in 408.40, Exception, so as to terminate within the same building or structure directly at an equipment grounding conductor terminal of the applicable derived system or service. Where installed in accordance with this section, this equipment grounding conductor shall also be permitted to pass through boxes, wireways, or other enclosures without being connected to such enclosures.

Informational Note: Use of an isolated equipment grounding conductor does not relieve the requirement for grounding the raceway system and outlet box.

Statement of Problem and Substantiation for Public Comment

Delete the term "electrical noise" and remove the parenthesis around electromagnetic interference. Change the term "electrical noise" to "electromagnetic interference" because it is a better understood term. This change will be consistent with Actions in Article 406 such as in 406.3(D).

Related Item

• PI 1511, FR 8257

Submitter Information Verification

Submitter Full Name: Paul Dobrowsky
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Submittal Date: Thu Aug 30 20:05:00 EDT 2018
Committee: NEC-P05

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Public Comment No. 406-NFPA 70-2018 [Section No. 250.146(D)]

(D) Isolated Ground Receptacles.

~~Where installed for the reduction of electrical noise (electromagnetic interference) on the equipment grounding conductor, a receptacle in which the grounding terminal is purposely insulated from the receptacle mounting means shall be permitted.~~ The receptacle grounding terminal shall be connected to an insulated equipment grounding conductor run with the circuit conductors. This equipment grounding conductor shall be permitted to pass through one or more panelboards without a connection to the panelboard grounding terminal bar as permitted in 408.40, Exception, so as to terminate within the same building or structure directly at an equipment grounding conductor terminal of the applicable derived system or service. Where installed in accordance with this section, this equipment grounding conductor shall also be permitted to pass through boxes, wireways, or other enclosures without being connected to such enclosures.

Informational Note: Use of an isolated equipment grounding conductor does not relieve the requirement for grounding the raceway system and outlet box.

Statement of Problem and Substantiation for Public Comment

There are many applications where designers/engineers want to use and Isolated Ground Receptacle. Not all of them are for the reduction of electrical noise. The way the current text is written, IGR can only be used when it can be proven to the AHJ that they are 'required' to for the reduction of noise. By removing this sentence, IGR can be used anytime without having to prove it need for noise reduction, and it does not take away from the safe requirements.
What is important is that the installation is safe, not that the designer has to prove to the AHJ why they want to do something. Let this be a designer decision, not theory debate between the engineer and AHJ.

Related Item

• PI-1511

Submitter Information Verification

Submitter Full Name: Mike Holt
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Committee: NEC-P05

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Public Comment No. 1972-NFPA 70-2018 [Section No. 250.148 [Excluding any Sub-Sections]]

If circuit conductors are spliced within a box or terminated on equipment within or supported by a box, all wire-type equipment grounding conductor(s) associated with any of those circuit conductors shall be connected together within the box or to the box in accordance with 250.8 and 250.148(A) through (D).

Exception: The equipment grounding conductor permitted in 250.146(D) shall not be required to be connected to the other equipment grounding conductors or to the box.

Statement of Problem and Substantiation for Public Comment

The change, and it is a dramatic one, to requiring every single equipment grounding conductor in an enclosure to be tied together with the ones of a particular circuit that happens to be spliced in the box, is excessive and unsubstantiated. Remember, some boxes are bigger than others. A pull box adjacent to a panel might have 20 cables in it. In order to comply with this, one would need several power distribution blocks mounted within it just to comply with this rewording. Remember, if the box only contained the circuit being spliced, the equipment grounding return path would be judged adequate based on the EGCs at hand. Where is the substantiation to go after every other cable? Splices are inherent weak points in a wiring system; why are we deliberately forcing more EGC splices than necessary? And, based on the literal text, even a cable passing through the box without splice would need to be opened and terminated. This needs to be completely rethought.

Related Item

• FR 8115

Submitter Information Verification

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Committee: NEC-P05

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Public Comment No. 373-NFPA 70-2018 [Section No. 250.148 [Excluding any Sub-Sections]]

If circuit conductors are spliced within a box or terminated on equipment within or supported by a box, all wire-type equipment grounding conductor(s) shall be connected together within the box ~~or~~ and to the box in accordance with 250.8 and 250.148(A) through (D).

Exception: The equipment grounding conductor permitted in 250.146(D) shall not be required to be connected to the other equipment grounding conductors or to the box.

Statement of Problem and Substantiation for Public Comment

I think the code panel wants these EGCs to be bonded together 'and bonded to the box'. My suggested text should accomplish that goat. Currently the text only requires the EGCs to be bonded together 'or' bonded to the box, but not both.

Related Item

• FR 8115

Submitter Information Verification

Submitter Full Name: Mike Holt
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Submittal Date: Sat Aug 04 10:17:10 EDT 2018
Committee: NEC-P05

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Public Comment No. 902-NFPA 70-2018 [Section No. 250.176]

250.176 Cases of Instruments, Meters, and Relays — Operating at Over 1000 Volts.

Where instruments, meters, and relays have current-carrying parts of over 1000 volts to ground, they shall be isolated by elevation or protected by suitable barriers, grounded metal, or insulating covers or guards. Their cases shall not be connected to the equipment grounding conductor.

Exception: Cases of electrostatic ground detectors where the internal ground segments of the instrument are connected to the instrument case and grounded and the ground detector is isolated by elevation.

Additional Proposed Changes

File Name	Description	Approved
CN_245.pdf	70_CN 245	

Statement of Problem and Substantiation for Public Comment

NOTE: This Public Comment appeared as CC Note No. 245 in the First Draft Report on First Revision No. 7568.

The Correlating Committee directs that the panel reconsider the text of the exception to be rewritten as a complete sentence that is in mandatory language.

This action will be considered as a public comment.

Related Item

• FR 7568

Submitter Information Verification

Submitter Full Name: CC on NEC-AAC
Organization: NEC Correlating Committee
Street Address:
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Submittal Date: Mon Aug 20 15:19:41 EDT 2018
Committee: NEC-P05

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Correlating Committee Note No. 245-NFPA 70-2018 [Section No. 250.176]

Submitter Information Verification

Submitter Full Name: Sarah Caldwell
Committee:
Submittal Date: Fri May 11 16:44:46 EDT 2018

Committee Statement and Meeting Notes

Committee Statement: The Correlating Committee directs that the panel reconsider the text of the exception to be rewritten as a complete sentence that is in mandatory language. This action will be considered as a public comment.

First Revision No. 7568-NFPA 70-2018 [Section No. 250.176]

Ballot Results

This item has passed ballot

12 Eligible Voters
0 Not Returned
12 Affirmative All
0 Affirmative with Comments
0 Negative with Comments
0 Abstention

Affirmative All

Brunssen, James E.
Dressman, Kevin L.
Hickman, Palmer L.
Hittinger, David L.
Holub, Richard A.
Johnston, Michael J.
Kovacik, John R.
Manche, Alan
McDaniel, Roger D.
Pierce, James F.
Saporita, Vincent J.
Williams, David A.

Public Comment No. 2121-NFPA 70-2018 [Section No. 250.187(B)]

(B) Insulated.

The ~~grounding system~~ groumded conductor shall be insulated for the maximum neutral voltage.

Informational Note: The maximum neutral voltage in a 3-phase wye system is 57.7 percent of the phase-to-phase voltage.

Statement of Problem and Substantiation for Public Comment

It seems the term "Grounded Conductor" is consistent with the use of that term throughout this section.

Related Item

• FR 7820

Submitter Information Verification

Submitter Full Name: Paul Dobrowsky
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Submittal Date: Thu Aug 30 19:23:22 EDT 2018
Committee: NEC-P05

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Public Comment No. 569-NFPA 70-2018 [Section No. 250.187(B)]

(B) Insulated.

The ~~grounding system~~ grounded system conductor shall be insulated for the maximum neutral voltage.

Informational Note: The maximum neutral voltage in a 3-phase wye system is 57.7 percent of the phase-to-phase voltage.

Statement of Problem and Substantiation for Public Comment

Editorial correction.

Related Item

• FR-7820

Submitter Information Verification

Submitter Full Name: Phil Simmons
Organization: Simmons Electrical Services
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Zip:
Submittal Date: Sat Aug 11 19:17:06 EDT 2018
Committee: NEC-P05

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Public Comment No. 885-NFPA 70-2018 [Section No. 250.190(C)(3)]

(3) Sizing.

Equipment grounding conductors shall be sized in accordance with Table 250.122 based on the current rating of the fuse or the overcurrent setting of the protective relay.

Informational Note: The overcurrent rating for a circuit breaker is the combination of the current transformer ratio and the current pickup setting of the protective relay.

Additional Proposed Changes

File Name	Description	Approved
CN_242.pdf	70_CN 242	

Statement of Problem and Substantiation for Public Comment

NOTE: This Public Comment appeared as CC Note No. 242 in the First Draft Report on First Revision No. 8114.

The Correlating Committee directs Code-Making Panel 5 to correlate FR 8114 with 250.102(D), 250.104(B), and 250.190(C)(3).

The Correlating Committee directs that FR 8114 be referred to Code-Making Panel 2 for correlation with Annex D Example D3(a).

The Correlating Committee directs that FR 8114 be referred to Code-Making Panel 4 for correlation with 690.45.

The Correlating Committee directs that FR 8114 be referred to Code-Making Panel 10 for correlation with 215.2(A)(2)(b)(2) and 215.2(B).

The Correlating Committee directs that FR 8114 be referred to Code-Making Panel 15 for correlation with 525.11.

The Correlating Committee directs that FR 8114 be referred to Code-Making Panel 18 for correlation with 600.7(A)(2).

These actions will be considered as public comments.

The Correlating Committee directs that FR 8114 be sent to all panels for information.

Related Item

• FR 8114

Submitter Information Verification

Submitter Full Name: CC on NEC-AAC
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Submittal Date: Mon Aug 20 14:53:00 EDT 2018
Committee: NEC-P05

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Correlating Committee Note No. 242-NFPA 70-2018 [Section No. 250.122]

Submitter Information Verification

Submitter Full Name: Sarah Caldwell
Committee:
Submittal Date: Fri May 11 16:23:39 EDT 2018

Committee Statement and Meeting Notes

Committee Statement: The Correlating Committee directs Code-Making Panel 5 to correlate FR 8114 with 250.102(D), 250.104(B), and 250.190(C)(3).

The Correlating Committee directs that FR 8114 be referred to Code-Making Panel 2 for correlation with Annex D Example D3(a).

The Correlating Committee directs that FR 8114 be referred to Code-Making Panel 4 for correlation with 690.45.

The Correlating Committee directs that FR 8114 be referred to Code-Making Panel 10 for correlation with 215.2(A)(2)(b)(2) and 215.2(B).

The Correlating Committee directs that FR 8114 be referred to Code-Making Panel 15 for correlation with 525.11.

The Correlating Committee directs that FR 8114 be referred to Code-Making Panel 18 for correlation with 600.7(A)(2).

These actions will be considered as public comments.

The Correlating Committee directs that FR 8114 be sent to all panels for information.

First Revision No. 8114-NFPA 70-2018 [Section No. 250.122]

Ballot Results

✔ **This item has passed ballot**

12 Eligible Voters
0 Not Returned
12 Affirmative All
0 Affirmative with Comments
0 Negative with Comments
0 Abstention

Affirmative All

Brunssen, James E.

Dressman, Kevin L.

Hickman, Palmer L.

Hittinger, David L.

Holub, Richard A.

Johnston, Michael J.

Kovacik, John R.

Manche, Alan

McDaniel, Roger D.

Pierce, James F.

Saporita, Vincent J.

Williams, David A.

Public Comment No. 1706-NFPA 70-2018 [Part II.]

Part II. System ~~Grounding and Bonding~~ Grounding

Statement of Problem and Substantiation for Public Comment

Remove the term "bonding" from the title of this part.

The submitter of the PI and the panel did not provide substantiation to justify reversing a long-standing organizational structure.

The NEC usability task group spend several years before the 1999 NEC cycle, and CMP-5 spent many hours into days for the 1999 NEC cycle to reorganize Article 250 for better usability. Part of this was creating very specific parts for grounding of items and one section for the bonding that applies to those sections as indicated in figure 250.1. The main premise was that trying to lump many different requirements to ground, grounding electrode and bonding into single sections caused repeated text, redundancy, confusion to the users, and through cycle revisions inconsistencies. I suggest the panel remember the number of different ways the panel discovered the 12 1/2 percent rules were written before being consolidated into a single item as note 1 to Table 250.102(C)(1). If the panel believes this is necessary, then it would seem that the term "bonding" should be add to the titles of Parts III, IV, VI, VII, VIII and X as all these parts also use or include bonding requirements, then eliminate the figure 250.1 as not needed. I strongly recommend the panel does not go this route.

As still shown in figure 250.1, part II is for system grounding which now creates a correlating inconsistency within the Article. Part II is to provide the requirements to the installer to ground the system or not ground the system. The focus of these sections in Part II is for the "system" i.e. the source, and not the enclosures, and all the other parts of the distribution or utilization equipment. If grounding is needed, connection points for the grounding electrode conductor, main or system bonding jumpers the grounded conductor were provided. Further the installation requirements for the grounding electrode system and grounding electrode conductor is in Part III. Bonding requirements for sizing and installation is in Part V. The move in this cycle to now combine various requirements together for grounding and bonding in part II is reversing all the work done over the past 7 code cycles and there is no good technical substantiation to undo this work. The NEC is not a teaching document and users have to be trained that they need to use the whole Article or whole Code and not ever assume they can only go to one Article or one Section and find all the installation requirements. The panel is strongly encouraged to consider this action and those in 250.24 and the new 250.25 and reverse the direction taken to maintain the organization agreed to from the 1999 NEC cycle unless there is overwhelming justification to change.

Related Item

• FR7651

Submitter Information Verification

Submitter Full Name: Charles Mello
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Submittal Date: Wed Aug 29 17:12:25 EDT 2018
Committee: NEC-P05

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Public Comment No. 84-NFPA 70-2018 [New Section after J.7.2]

Informative Annex K Electrical Bonding and Grounding of Gas Piping Systems

This informative annex is not part of the requirements of this NFPA document, but is included for information purposes only.

The provisions cited in Informative Annex K are intended to assist the users of this *Code* in properly bonding and grounding gas piping systems, and are part of NFPA 54 National Fuel Gas Code -2018. They are the same provisions as those found in ANSI/ICC Z223.1-2018 *International Fuel Gas Code.*

K.1 Pipe and Tubing Other Than CSST. Each aboveground portion of a gas piping system, other than CSST, that is likely to become energized shall be electrically continuous and bonded to an effective ground-fault return path. Gas piping, other than CSST, shall be considered to be bonded when it is connected to appliances that are connected to the appliance equipment grounding conductor of the branch circuit supplying that appliance. *(See 250.104(B))*

K.2 CSST (Corrugated Stainless Steel Tubing). CSST gas piping systems, and gas piping systems containing one or more sections of CSST, shall be electrically continuous and bonded to the electrical service grounding electrode system or, where provided, lightning protection grounding electrode system.

K.3 Bonding Jumper for CSST. **T** he bonding jumper shall connect to a metallic pipe, pipe fitting, or CSST fitting. The bonding jumper shall not be smaller than 6 AWG copper wire or equivalent.

K.4 Length of Bonding Jumper for CSST. The length of the bonding jumper between the connection to the CSST gas piping system and the grounding electrode system shall not exceed 22 m (75 ft.). Any additional grounding electrodes installed to meet this requirement shall be bonded to the electrical service grounding electrode system or, where provided, lightning protection grounding electrode system.

K.5 Bonding Connections for CSST. Bonding connections shall be in accordance with this *Code.* Devices used for the bonding connection shall be listed for the application in accordance with ANSI/UL 467, *Grounding and Bonding Equipment.*

K.6 Arc-Resistant Jacketed CSST. CSST listed with an arc-resistant jacket or coating system in accordance with ANSI LC1/CSA 6.26, *Fuel Gas Piping Systems Using Corrugated Stainless Steel Tubing,* shall be electrically continuous and bonded to an effective ground fault current path. Where any CSST component of a piping system does not have an arc-resistant jacket or coating system, the bonding requirements for CSST shall apply. Arc-resistant jacketed CSST shall be considered to be bonded when it is connected to appliances that are connected to the appliance equipment grounding conductor of the branch circuit supplying that appliance. (See 250.104(B))

K.7 Prohibited Use. Gas piping shall not be used as an equipment grounding conductor or grounding electrode.

K.8 Lightning Protection Systems. Where a lightning protection system is installed, the bonding of the gas piping system shall be in accordance with NFPA 780, *Standard for the Installation of Lightning Protection Systems* – 2020.

Additional Proposed Changes

File Name	Description	Approved
Informative_Annex_K.doc	Word document version of my Public Comment	✓

Statement of Problem and Substantiation for Public Comment

The Public Comment seeks to add a new informative annex to the NEC on the bonding and grounding requirements for all types of metal gas piping systems and is in response to resolved PI-1081. By including this information into the NEC, code users will have access to the bonding requirements for all gas piping systems. NFPA 54, National Fuel Gas Code, has purview over the grounding and bonding of gas piping systems and unfortunately, not all gas piping systems can be bonded in accordance with 250.104(B) in the NEC. Electrical contractors are typically the responsible party for bonding these types of gas piping systems even though the fuel gas contractor installed the piping system and it is technically their responsibility for compliance. NEC code users should have access to the information, but it should exist in the Annex and not be enforceable under the NEC.

Related Item

• PI-1081 NFPA 70-2017

Submitter Information Verification

Submitter Full Name: Brian Baughman
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Committee: NEC-P05

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The provisions cited in Informative Annex K are intended to assist the users of this *Code* in properly bonding and grounding gas piping systems, and are part of NFPA 54, *National Fuel Gas Code* -2018. They are the same provisions as those found in ANSI/ICC Z223.1-2018 *International Fuel Gas Code.*

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K.8 Lightning Protection Systems. Where a lightning protection system is installed, the bonding of the gas piping system shall be in accordance with NFPA 780, *Standard for the Installation of Lightning Protection Systems* – 2020.

Public Comment No. 1543-NFPA 70-2018 [Definition: Bonding Jumper, Equipment.]

Bonding Jumper, Equipment.

The connection between two or more portions of the ~~equipment grounding conductor~~ effrective ground-fault current path . (CMP-5)

Statement of Problem and Substantiation for Public Comment

The definition, as written, is not always correct. For example; an equipment bonding jumper that connects a bonding bushing, in a panel, to the ground bar in the panel. In this case, the equipment bonding jumper is connecting an equipment grounding conductor to an enclosure. The enclosure is not defined as an equipment grounding conductor but it is a part of the effective ground-fault current path.

Related Item

• 3198-NFPA 70-2017

Submitter Information Verification

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