Public Input No. 207-NFPA 70-2019 [Global Input]

"no less than"

change to

"not less than"

Statement of Problem and Substantiation for Public Input

The term "no less than" is used approximately 6 times in the NEC.
The term "not less than" is used approximately 881 times in the NEC.

Reason for the global change is for consistency, and to comply with the style manual. The "no less than's" can be found in:

Definitions, Overcurrent Protective Device, Branch-Circuit.
240.21(B)(4)(9)
430.109(F)
600.32(A)(4) [appears twice in this section]
691.1

Submitter Information Verification

Submitter Full Name: Nick Sasso
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Street Address:
City:
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Submittal Date: Thu Dec 26 19:34:36 EST 2019
Committee: NEC-P01

Public Input No. 259-NFPA 70-2020 [Global Input]

"unless permitted by..."   or   "unless permitted by Article..."
change to
"unless permitted in..."

Statement of Problem and Substantiation for Public Input

Basically this is just clean up language, and to be in accordance with section 4.1.2 of the style manual. Let's pick one or the other. I believe that the correct language should be "unless permitted in..."

The unless permitted by's are located in:

300.13(A)

348.20(A)

356.20(A)

411.5(B)

625.46

626.26

725.136(A)

760.136(A)

The unless permitted in's are located in

225.30

230.2

348.20

356.20

411.5(B)

625.46

626.26

725.136(A)

760.136(A)

Submitter Information Verification

Submitter Full Name: Nick Sasso
Organization: Clark County Building and Fire
Street Address:
City:
State:
Zip:
Submittal Date: Wed Jan 08 14:31:09 EST 2020
Committee: NEC-P01

Copyright Assignment

Public Input No. 276-NFPA 70-2020 [Global Input]

(capable of being) locked in the open position

to

(capable of being) lockable open

Statement of Problem and Substantiation for Public Input

There are approximately 21 references to, "capable of being locked in the open position..."
and
there are approximately 26 references to, "capable of being lockable open..."

Let's pick one. Reason for change is consistency throughout NEC

Submitter Information Verification

Submitter Full Name:	Nick Sasso
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State:	
Zip:	
Submittal Date:	Sat Jan 11 17:27:37 EST 2020
Committee:	NEC-P01

Public Input No. 277-NFPA 70-2020 [Global Input]

(capable of being) lockable open

change to

(capable of being) locked in the open position

Statement of Problem and Substantiation for Public Input

There are approximately 26 references to, "capable of being lockable open..."

and

there are approximately 21 references to, "capable of being locked in the open position..."

Let's pick one. Reason for change is consistency throughout NEC. Personally, I prefer "capable of being locked in the open position."

Submitter Information Verification

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Submittal Date: Sat Jan 11 17:33:21 EST 2020

Committee: NEC-P01

Public Input No. 368-NFPA 70-2020 [Global Input]

Please provide page headers with the appropriate identifiers to make use of the code less confusing.

Example 1: Chapter 1 Article 100 - Definitions - PART III - Haz Locs

Example 2: 110.31 Article 110 - Reqs for Electrical Installations -Part III - OVER 1000 VOLTS nom

Example 3: Annex C- Tables Informative Annex C - Table C-3 (FMC) cont.

Statement of Problem and Substantiation for Public Input

Earlier versions of the document included shorthand page headers that greatly improved user ease of finding the correct code sections. As written now the document is confusing with important distinctions hard to ferret out. For example the sections that are limited in application to certain voltages or locations may run for pages but the transition to that distinction is hard to find, and any page after the initial distinguishing information is not notated in any way to indicate that a limitation of scope applies.. Identifiers such as Part III Over 1000 volts is not prominently distinguished in the body of the text and is not reflected in the page heading on latter pages, leading to much confusion when using the document in the field. (Earlier versions also had the PART III or similar transitions prominently bold to make finding them easier.) Please accept my apology if this is submitted in the incorrect format or to the incorrect panel or group. This would appear to be a style request more than a code request but I did not find any public input option for style or page headers.

Submitter Information Verification

Submitter Full Name: Joe Kunkel

Organization: NU Electric Co

Street Address:

City:

State:

Zip:

Submittal Date: Sun Jan 26 12:24:46 EST 2020

Committee: NEC-P01

Public Input No. 454-NFPA 70-2020 [Global Input]

Type your content here: I would like to see one of the two things I have listed happen; either put all definitions in article 100 no matter how many times the term is used throughout the NEC or keep the NEC at the current format limiting article 100 for definitions of terms used more than twice in the NEC and using xxx.2 for definitions that are only used in that particular article. Do not use xxx.2 for anything besides definitions. Currently if an article does not contain any definitions, xxx.2 is used for anything. Example; 90.2 SCOPE, 110.2 APPROVAL, 200.2 GENERAL, plus many other articles, although this change would not in essence save lifes, it would add consistincey to the NEC, ...

Statement of Problem and Substantiation for Public Input

This would add consistency to the NEC,

Submitter Information Verification

Submitter Full Name: Ray Pritchett
Organization: NJATC
Affiliation: Evansville Electrical Training Center IBEW Local 16
Street Address:
City:
State:
Zip:
Submittal Date: Sun Feb 09 22:55:07 EST 2020
Committee: NEC-P01

Public Input No. 988-NFPA 70-2020 [Global Input]

abovegrade

change to:

above grade

Statement of Problem and Substantiation for Public Input

This purpose of this PI is just for clean up and also for consistency throughout the NEC. As far as I can research, the term abovegrade simply isn't a word. Merriam Webster does not contain this word. The correct phrase is "above grade." It's easier to see in the opposite - would a person ever use the phrase, "belowgrade?" No - the proper term is below grade.

Abovegrade can be found in the following Articles:
300.9
362.10(2) Exception to 2
382.10(C)
410.30(B) Exception No. 1
410.30(B) Exception No. 3
426.41
555.13(B)(2)

It will need to be fixed in the Style Manual, as well.

Note: The terms
aboveground
and
belowground
are contained within Merriam Webster

Articles that use the correct phrase "above grade" include but are not limited to:
210.52(E)(1)
210.52(E)(2)
300.38
314.23(H)(2)
362.10(1)
362.10(2)
362.10(5)
425.8(C)
Table 514.3(B)(1) Class I Locations (a total of six times)
514.8
Table 515.3 (a total of six times)
547.9(A)(2)
547.9(A)(8)
550.13(D)(7)
555.34(B)(2)
625.102(B)
680 Definitions - Through-Wall Lighting Assembly
680.42(B)(3)

Submitter Information Verification

Submitter Full Name: Nick Sasso
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Zip:
Submittal Date: Wed May 06 17:52:36 EDT 2020
Committee: NEC-P03

Public Input No. 2989-NFPA 70-2020 [Global Input]

Regarding the division of NEC Articles into “Parts”;

Where "Parts" are used to sub-divide NEC Articles by topic, it is proposed to amend the Part description text with a set of brackets that enclose the span of paragraph numbers that is encompassed by the respective Part category.

For example, NEC Chapter 2, Article 210, Part III.

This "Part" text string is represented as;

Part III. Over 1000 Volts

The proposal is to revise this "Part" text string to;

Part III. Over 1000 Volts (210.50-.70)

And, to do the same for all "Parts" of all NEC Articles.

Statement of Problem and Substantiation for Public Input

BASIS FOR CODE REVISION: to facilitate quicker more efficient code searches by providing a context clue via association of the paragraphs that are correlated to the "Part" sub-category. Page-by-page code searches that miss seeing the keyword "Part" somewhere on the page, could now be less prone to such erroneous mis-associations

Submitter Information Verification

Submitter Full Name: John Blissett
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Submittal Date: Thu Sep 03 19:32:38 EDT 2020
Committee: NEC-P01

Public Input No. 3013-NFPA 70-2020 [Global Input]

Move all definitions in the code to Article 100, arrange them in alphabetical order and without any subdivisions.

Statement of Problem and Substantiation for Public Input

The National Electrical Code has definitions in multiple parts in Article 100 and many definitions scattered through out the code many of them in the .2 section of the articles.
Most of the other standards under NFPA have their definitions in one location and this will allow the NEC the same requirement. The Revisions to the NEC Style require all the definitions to be moved to Article 100.

Submitter Information Verification

Submitter Full Name: David Williams
Organization: Delta Charter Township
Street Address:
City:
State:
Zip:

Submittal Date: Thu Sep 03 21:41:22 EDT 2020
Committee: NEC-P01

Public Input No. 3141-NFPA 70-2020 [Global Input]

Move all definitions in current (2020) NEC text to Article 100. Insert those definitions in alphabetical order. For definitions that apply in only one article, the article number in parentheses shall follow the definition. The CMP responsible for the definition shall be identified in parentheses at the end of the definition following any extract or article information.

Type your content here ...

Statement of Problem and Substantiation for Public Input

This revision provides a more usable code by providing a uniform process to find definitions. Users are currently required to look in multiple locations to determine if a term is defined. Other NFPA codes and standards utilize a single location for all definitions.

Submitter Information Verification

Submitter Full Name: Donald Cook

Organization: Shelby County Department of De

Affiliation: Self

Street Address:

City:

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Zip:

Submittal Date: Sat Sep 05 15:11:40 EDT 2020

Committee: NEC-P01

Public Input No. 3327-NFPA 70-2020 [Global Input]

Review the revisions to the new NEC Style Manual and make changes to comply with the Style Manual.

Statement of Problem and Substantiation for Public Input

The NEC Style Manual has been revised and every code making panel needs to review the manual and make changes to their code articles to comply with the Style Manual revisions.

Submitter Information Verification

Submitter Full Name:	David Williams
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Street Address:	
City:	
State:	
Zip:	

Submittal Date:	Tue Sep 08 07:31:11 EDT 2020
Committee:	NEC-P01

Public Input No. 3328-NFPA 70-2020 [Global Input]

Review the Articles with multiple parts to comply with the revisions made to the NEC Style Manual. Make changes based on the Style Manual revisions.

Statement of Problem and Substantiation for Public Input

Section 2.1.4 was revised by adding the last two sentences. Where an article contains multiple parts and includes general installation requirements, such requirements shall be located in the first part titled “Part I. General”. Part titles shall be descriptive and as concise as possible.

Submitter Information Verification

Submitter Full Name: David Williams
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Submittal Date: Tue Sep 08 07:34:42 EDT 2020
Committee: NEC-P01

Public Input No. 3329-NFPA 70-2020 [Global Input]

Revise the Definition Title Structure to comply with the NEC Style Manual.

Statement of Problem and Substantiation for Public Input

Review the Style Manual Revisions in 2.2.2.3 Definition Title Structure. Definitions that have sub-parts shall be listed alphabetically by the base term, with a comma and then the modifying descriptor.

Submitter Information Verification

Submitter Full Name:	David Williams
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Zip:	
Submittal Date:	Tue Sep 08 07:36:42 EDT 2020
Committee:	NEC-P01

Public Input No. 3330-NFPA 70-2020 [Global Input]

Verify that all exceptions are written in completed sentences.

Statement of Problem and Substantiation for Public Input

The NEC Style Manual requires that all exceptions are written as complete sentences in accordance with 3.1.4.1.

Submitter Information Verification

Submitter Full Name:	David Williams
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City:	
State:	
Zip:	
Submittal Date:	Tue Sep 08 07:40:56 EDT 2020
Committee:	NEC-P01

Public Input No. 3331-NFPA 70-2020 [Global Input]

Revise the definitions in Article 100 to include an acronym, as desired, for subsequent use in the NEC without having to state the term.

Statement of Problem and Substantiation for Public Input

The permitted use of acronyms in the NEC has changed with the Style Manual revisions in 3.2.3. When a term is defined in Article 100 and includes an acronym, that acronym is permitted to be used elsewhere through out the code.

Submitter Information Verification

Submitter Full Name:	David Williams
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Zip:	
Submittal Date:	Tue Sep 08 07:43:12 EDT 2020
Committee:	NEC-P01

Public Input No. 3332-NFPA 70-2020 [Global Input]

Review the structure of all Informational Notes to comply with the revised NEC Style Manual.

Statement of Problem and Substantiation for Public Input

Sections 3.1.3.1 and 4.1.3 of the revised NEC Style Manual includes designed structure for references in Informational Notes.

Submitter Information Verification

Submitter Full Name:	David Williams
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Zip:	
Submittal Date:	Tue Sep 08 07:48:58 EDT 2020
Committee:	NEC-P01

Public Input No. 3333-NFPA 70-2020 [Global Input]

Review all references to articles or parts of articles to comply with the Style Manual.

Statement of Problem and Substantiation for Public Input

Section 4.1.4 References to a Part Within an Article. Except for Article 100, references shall not be made to an entire article. References to parts within articles shall be permitted.

Submitter Information Verification

Submitter Full Name:	David Williams
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City:	
State:	
Zip:	
Submittal Date:	Tue Sep 08 07:50:17 EDT 2020
Committee:	NEC-P01

Public Input No. 3335-NFPA 70-2020 [Global Input]

Review the use of Parts within an article and the section number for parts of an article.

Statement of Problem and Substantiation for Public Input

The code panels need to review the sections under their purview to comply with the revisions made to the NEC Style Manual. 2.4.2.1 Parts. If an article is subdivided into parts, it is recommended that the section numbering within each part start with the next decade as a minimum to allow for future growth. New or significantly reorganized articles shall follow this numbering convention. Where an article has multiple parts, Part I. shall be titled “General”.

Submitter Information Verification

Submitter Full Name:	David Williams
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Street Address:	
City:	
State:	
Zip:	

Submittal Date:	Tue Sep 08 08:02:00 EDT 2020
Committee:	NEC-P01

Public Input No. 3336-NFPA 70-2020 [Global Input]

More than one informational note in a section or subdivision shall be consectutively numbered.

Statement of Problem and Substantiation for Public Input

The numbering of informational notes need to comply with the changes made to the revised Style Manual.
2.4.3. Numbering Informational Notes. If there are two or more informational notes in a definition, section or subdivision, consecutive numbering of the informational notes shall only occur in that definition, section or subdivision.

Submitter Information Verification

Submitter Full Name:	David Williams
Organization:	Delta Charter Township
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Submittal Date:	Tue Sep 08 08:10:27 EDT 2020
Committee:	NEC-P01

Public Input No. 3490-NFPA 70-2020 [Global Input]

100 Definitions

Defined terminology associated with Manufacture and Construction activities.

1. The term “Construction” shall be defined as the process of deploying product or installation of a device, material, or item of equipment in accordance to its designated purpose. An owner or owner's agent (e.g. contractor) implements construction at a specific worksite location for either a permanent installation, or a temporary application as permitted by code. Installation shall comply with manufacturer terms and ratings unless permitted otherwise in this code. All code delegated responsibilities for testing, marking, labeling, identification, documentation, etc., which are not the clear accomplished responsibility of the manufacture production process, shall be the due diligence responsibility of those involved with the construction process, unless approved otherwise by the authority having jurisdiction.

Informational Note: construction applications include, but are not limited to, activities associated with activities involved with: install, field installed, field applied, field tested, field assembled, field evaluation, field wiring, field marking, field conversion, and field labeled.

2. The term “Fabricated” shall be defined to apply to equipment or an assembly that is neither necessarily listed nor mass-produced. For example, custom equipment, a custom assembly, or equipment that is altered from its original listing. Fabrication may occur in whole or part onsite or offsite. Component parts and materials may be listed, or may be required to be listed by this code or by the authority having jurisdiction. Generally, where fabricated products are permitted by this code, code compliant product qualification shall be by a Field Evaluation Body, where duties typically include: product testing, marking, labeling, identification, standards compliance, product documentation and instructions sufficient for the safe operation appropriate per the application criteria. Fabricated applications also include reconditioned equipment and retrofit equipment, as permitted by this code, wherever equipment is functionally restored to other than conformance to the original manufacturer's equipment ratings and life cycle projections. Fabricated equipment and systems that encompass, in part or whole, any associated construction activities and elements, shall absorb the associated due diligence responsibilities involved, except as approved otherwise by the authority having jurisdiction.

Informational Note: fabrication applications generally include, but are not limited to, activities associated with pre-fabricated equipment and systems: electrical system assemblies, mechanical system assemblies, and modular building assemblies. Where the assembly is listed as a unit, then the manufacture application responsibilities apply.

3. The term “Pre-fabricated” shall be defined to apply to those fabricated equipment assembly activities that occur at a site other than the permanent installation location.

4. The term “Manufacture” shall be defined as the factory assembly of a product, characteristically mass produced and distributed. Examples include: equipment, wire, devices, material, and compounds. The manufacture process includes production activities including: factory testing, marking, labeling, identification; NRTL Listing where applicable; standards compliance, product document publication for sales and designer specifications including those used for: shipping, install, field

testing, owner use, and maintenance. By definition, final assembly or other in-field activites of a product at its permanently installed location will not constitute an aspect of manufacture, unless performed by the manufacturer.

Informational Note 1: applications where a product's permanent or temporary installation occurs at a point-of-use location under direct supervision of the manufacturer, the requirement duties of both the manufacture process(es) and associated construction process shall be the responsibility of the manufacturer, except as approved otherwise by the authority having jurisdiction.

Informational Note 2: manufacture applications shall include modular equipment, where an assemblage of different products has been hybridized into a singular unit, when the unitized equipment is listed. Where the unitized equipment is not listed as a unit, then the fabricated application responsibilities apply.

Statement of Problem and Substantiation for Public Input

BASIS FOR CODE REVISION:
The term "construction" is used throughout NEC in reference to code requirements that are aimed at typically different segments of industry, which only occasionally overlap each other's general task sets. Product construction during manufacture is one application, versus product install during site construction. The code text describes both contexts as construction. Where practicable, it would improve functional clarity in code text requirements to employ distinct construction-like terms wherever reasonable and appropriate. The terms and definitions proposed are suggestions; to serve as a basis to move this discussion and consensus forward.
Where code requirements clearly intend compliance fulfillment to be about the product's activities prior to leaving the factory, distinct terminology can communicate this with added clarity. Similarly, where code compliance fulfillment clearly applies to the implementation of a product, as regards its permanent installation, a distinctly defined term for 'construction' will yield improved comprehension as to intended context. A third distinct category can also be established by definition that encompasses fabrication, to serve to encompass custom fabrication assemblies, reconditioned equipment, and retrofits.
Applications where the code responsibility can fall into gray areas for accountability between the three, can be attended to by a default assignment of responsibility. This explicit clarity helps ensure that enforceable code compliance responsibilities are clearly stated. Allowance for an exception, per AHJ acceptance, provides a mechanism to formally transfer an obligation of responsibility.
Where the code speaks to putting an identifying mark, or information, or color onto a cable or item of equipment, it more often refers to those which would intend to be understood as the responsibility of the manufacturer. The following two sets of code citations illustrate where the manufacturer is to provide a mark or color (first set) versus where the installer is to provide a mark or color. The third set of code citations is where it is intuitively apparent that either the manufacturer or installer could either be involved (or both involved) in providing a mark or color on the electrical equipment.
Example requirements for manufacturer marks or color include but are not necessarily limited to; 110.14(D), 110.28, 200.4(B), 200.6, 200.7, 200.9, 200.10(B), 200.10(D), 215.12(A), 215.12(B), 225.30(A)(7), 230.46, 230.66(A), 230.70(B), 230.77, 240.50(C), 240.81, 240.82, 240.83(A&B), 240.83(D), 240.85, 250.28(B), 250.110 Ex3, 250.119, 250.119(A), 250.119(B), 250.119(C), 250.126, 250.28(B), 250.112, 250.114, 250.119, 250.126, 300.11(B)(1), 300.11(B)(2), 310.3(D), Table 310.4(A), 310.6(ABC), 310.8(C)&(D), 310.10(C), 310.10(D), 311.14, 311.16(A), 311.16(B)(1&2)), 311.16(B4&C), 311.32, 314.16(C)(2), 322.56(B), 322.120(C), 336.120, 338.120, 368.12(E), 386.70, 388.70, 406.3(D), 406.3(E), 406.10(B), 406.13 (A-D), 409.110, 430.52(C)(5), 500.8, 501.5, 501.17, 501.105(B)(1), 501.130(A)(1, 502.6, 502.130(B)(1), 502.130(B)(2), 503.130(A), 504.80(C), 505.8, 505.20(B&C), 505.22, 505.26, 506.9(C)(1), 506.9(C)(2), 506.9(D), 517.18(A), 517.19(A), 517.61(C)(2), 530.21(B), 530.22(B), 545.22(A), 551.77(A), 552.10(B)(3), 552.10(E)(2), 555.8, 555.33(B)(2), 600.23(F), 600.33(A)(3), 600.33(A)(4), 690.12(C), 690.51, 694.22(A), 700.10(A), 705.12(D), 705.20, 706.15(C), 708.10(A)(2), 712.37, 725.3(P), 725.179, 760.3(O), 760.30, 760.176(G), 760.179(G)(1), 770.179, 800.182, 805.179, 820.179, 830.90(A)(2), 830.179(C&D), 840.170(B), and 840.170(E).
Example requirements for the installer to do the marks or color indications include but are not necessarily limited to; 200.4(B), 200.6, 210.5(C)(1), 210.5(C)(2), 210.12, 215.12(A), 215.12(C)(1), 215.12(C)(2), 225.30(B), 225.38(C), 225.52(D&E), 230.72(A), 300.5(D)(3), Table 300.50, 310.6(ABC), 311.14, 406.3(E),

406.10(B), 408.3(E)(2), 408.3(F)(1), 408.3(F)(2), 408.3(F)(3), 408.3(F)(4), 408.3(F)(5), 517.18(A), 517.19(A), 517.160(A)(5), 530.21(B), 530.22(B), 547.9(A)(10, 550.33(A), 552.43(C), 620.53, 620.55, 647.4(C), 647.7(A)(4), 668.21(C), 690.54, 690.55, 700.10(A), 712.25, 712.55, 725.124, 760.30, and 770.179(F).

Example requirements for either the manufacturer and/or the installer to do the marks or color indications include but are not necessarily limited to; 230.56, 250.21(C), 250.167(C), 408.3(E)(1), 409.102(B), 430.97(B), 430.109(A)(6), 430.109(E), 517.31(C)(1), 517.31(E), 517.42(E), 520.44(C)(3), 520.54(C), 520.54(J)(1), 520.54(K), 530.21(B), 530.22(B), 550.10(I), 690.1, 690.31(B)(1), 690.31(D)(2), 770.179(G), 805.90(A)(2), and 805.170(A).

As regards reconditioned equipment and retrofit equipment, the code is in its developing infancy as regards code requirements for marks, as they are few, yet likely to grow in upcoming code cycles. Having distinct groups for manufacture, installation, and fabrication also serves to help make obvious, the places in code that similar code requirements between them may be missing but warranted.

Similar to the topic above for equipment marks between manufacture, installation, and fabrication, are topics for labels and signage which are beyond marks.

In NEC Chapter 3,4 and 7 the term “manufacture specifications” can substituted for “construction specifications”. And in NEC Chapter 5 and 6, where specifications have other terminology variations based on product qualities, “manufacture specifications” can be used with such term descriptors for NEC consistency to augment transparency when a code specification is intended to apply to manufacture apart from installation criterion.

Another example benefit from having a distinction between manufacture, installation, and fabrication are for the code required documentation and whom is to provide it. Such as; instructions for shipping, install, or maintenance, versus installer instructions for operation sequence, equipment ratings guidance or site-specific diagnostic protocols.

Where an entity assumes multiple roles of manufacture, installation, and/or fabrication, they are intended to assume the respective responsibilities. And, what those responsibilities are will have improved certainty, when there are improvements to distinctions of terminology and nomenclature. Inspections and commissioning processes will similarly be improved for the same basis of improved enforceable clarity.

SIDEBAR: a supplemental suggestion, in the earnest of minimizing code text where practicable, is to utilize a letter or symbol icon, for use in NEC margins, that correlates to each of the three definitions for, manufacture, versus fabricated, versus construction. For example, a symbol icon for manufacturer (e.g. Hex Note enclosing an 'M'), versus those affiliated with the product install construction process (e.g. Hex Note with 'C'), versus the symbol for the fabrication process (e.g. Hex Note with 'F'). One example of benefit of deploying a symbolic nomenclature is the topic of labels, signage, and markings; which are often able to be grouped by: manufacturer, fabricated, or installer. Each instance in code for label, mark, or sign can include one or more of these three symbols in the margin alongside the code text without adding pages to the code. A raised bar of label and signage compliance is likely the result, plus an improved ease and capacity for enforcement by way of inspection or commissioning.

Submitter Information Verification

Submitter Full Name:	John Blissett
Organization:	Bernhard TME
Street Address:	
City:	
State:	
Zip:	
Submittal Date:	Tue Sep 08 17:16:57 EDT 2020
Committee:	NEC-P01

☑ By checking this box I affirm that I am John Blissett, 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 Input No. 4390-NFPA 70-2020 [Global Input]

When an Article has Parts the revised Style Manual requires the following in 2.1.4.

Part titles shall be descriptive and as concise as possible.

Example:

Part I. General

Part II. Installation

Part III. Construction

Statement of Problem and Substantiation for Public Input

The revised Style Manual requires Article Part titles to be descriptive and concise as possible and provides examples for the code panels to use.

Submitter Information Verification

Submitter Full Name: David Williams

Organization: Delta Charter Township

Street Address:

City:

State:

Zip:

Submittal Date: Thu Sep 10 11:45:05 EDT 2020

Committee: NEC-P01

Public Input No. 4707-NFPA 70-2020 [Global Input]

Globally revise the use of term "Listed", and revise use of the term "Labeled"

To distinguish the NRTL (testing lab) context for the term "labeled" and "listed" from other NEC context uses of these words in all their forms; label, labels, labeling and labeled, it recommended to apply capitalization to the word "Labeled" and "Listed" when intended for this particular context of a testing organization. Capitalization as proper nouns will make this context more readily recognizable.

For additional distinctive clarity for this context of these terms 'listed' and "labeled", apply them with their "NRTL" modifier; and deploy "NRTL Listed" and "NRTL Labeled" throughout the Code text. Of course, all variants formed for grammatical correctness would also be amended and capitalized, such as "NRTL Listing" and "NRTL Label" etc.

In the definitions, it is appropriate to associate NRTL to "Nationally Recognized Testing Laboratory", which is generally the type of testing agency. Any other testing agency, where approved by an AHJ, is allowed. It is also appropriate to include a reference to the industry standard organization that acknowledged to govern this industry acceptance standard for each NRTL, the Occupational Safety and Health Administration (OSHA). With OSHA acknowledged as the official agency, it becomes a Code-legitimized reference, able to facilitate any follow-up enquiries regarding code compliance. To help facilitate back-checks has never been more suitable than in this age of ever-increasing pirating of product and other pretenders to suitability.

Wherever the term 'Labeled' is used as part of 'NRTL Listed and Labeled', it shall refer to the equipment mounted labeling that is pertinent to all of the equipment item's application-specific Listing(s) and shall include the equipment ratings.

Wherever the term 'Marked' is used as part of 'NRTL Listed and Marked' or 'NRTL Listed and Labeled and Marked', 'marked' shall refer to the marking or labeling that is associated with the Listing and shall include the specific qualification of use mentioned in code. E.g. listed and labeled and marked as being suitable for use as service equipment.

Statement of Problem and Substantiation for Public Input

BASIS FOR CODE REVISION:

The term 'Listing' and 'Listed' will be capitalized and treated as a proper noun; short for 'NRLT Listing' and 'NRTL Listed'. The term 'Labeled' will also be capitalized as a proper noun when used to indicate 'NRTL Labeled' or 'Manufacturer Labeled' as regards the manufacturer's terms of use for the equipment. NFPA codes does not capitalize these three terms generally so they are indistinguishable from the other contexts for a list or label. Manufacturer terms of use regarding labeling can include ratings, Listing types, or other declarations of compliance to particular industry standards.

There Code text of NEC 110.3, Part (C) may have intended for equipment generally to be Listed, but technically it is not ever stated. All that is stated is the terms for who will do the testing and evaluation as regards a Listing.

The Occupational Safety and Health Administration (OSHA) is the official agency that recognizes qualified testing laboratories, of which there are 23 approved labs to date. OSHA confirms that NEC's "electrical" sub-distinction of labs in NEC 110.3, Part (C) doesn't formally exist as an industry recognized group. The 'electrical' testing laboratory distinction is an obscure reference used in two other places in the NEC [90.7, 490.48(A)], but not in the NEC's other (14) references of a testing laboratory. Underwriter Laboratories (UL) is the only distinct NRTL lab whose standards are cited in the NEC and there are hundreds of UL citations (see. NEC Informative Annex A). One relevant ATS example is cited in NEC; UL1008 for transfer switches up to 600V. And one relevant ATS example is not cited in NEC; UL1008A for 750V-46kV ATSs. Whether another NRTL lab other than UL may qualify NEC's intent as an "electrical lab" is unknown. The NEC requirements are functional without the "electrical" sub-distinction, and so this likely warrants deletion of "electrical" in an upcoming NEC code revision.

Though these code articles infer an expectation that an ATS shall be used, an ATS is not overtly mandated as required. Only when an ATS is used, then definitive code requirements apply, like a Listing for emergency use.

NEC Article 705 applies to Interconnected Power Production Sources that parallel with the normal source, which is typically the utility supplied power source. There is an incongruence of code due to what NEC 705 allows. That is whenever the 705 code language is interpreted as an absolute permission due to the omission of disallowances of use as an essential-class power system. The code requirement variance compared to similar applications is a risk, because it then grants an emergency power distribution topology absolution because the code language allows it. NEC Article 705 has no requirements for equipment to be Listed for any aspect.

NEC 705 applies to distribution gear that interconnects normal power (e.g. utility) with an alternate source of power (e.g. generator). The 705 distribution gear may serve in place of an automatic transfer switch because the code does not disallow that use. Yet code does not require it be listed for emergency use, nor does it even require the automated switching mechanisms to be electrically operated and mechanically held. The NEC 705 gear has latitude to have more than two sources and more than one load. The function of NEC 705 gear may be no less critical but it is more susceptible to dysfunction than an ATS. It is arguably more important even than any single automatic transfer switch as it can perform the duty of multiple transfer switches or be the power source to many ATSs. It is like using a string to support a chain. This example illustrates how language of one NEC article (705) can permit use of a power distribution topology that is inconsistent to all other instances of code text regarding transfer switching of emergency power, which would otherwise be fairly consistent.

Application Specific Code Requirements

A summary of code findings on power source selection for emergency applications is as follows;

1. FOR ALL CODIFIED POWER SYSTEM TYPES OTHER THAN NORMAL: An ATS shall be NRTL Listed for Emergency Use (and also identified for Standby Use). Exceptions are:

A. Optional Standby Power System (NEC 702; other Listing requirements may apply)

B. Fire Pump (NEC 695; other Listing applies)

C. Interconnected Power Production Sources (NEC 705)

D. Medium Voltage (see caveats below)

2. MEDIUM VOLTAGE CAVEATS:

A. NFPA 99 indicates an ATS <600V must be Listed for the purpose. No mention of requirements for other voltages >600V. Allowance for ATS >600V to not be Listed is one logical inference.

B. NFPA 110 states MV transfer of central plant or mechanical equipment is allowed using electrically interlocked medium voltage circuit breakers; but the equipment branch MV transfer switch is not to include life safety (LS), emergency (RE), or critical branch (CR) loads. By mention of critical branch this code regards healthcare but is not correlated by any healthcare code; neither by NFPA 99 nor by NEC 517. Allowance by Listing omission may be logically inferred for power system types not mentioned; SEPSS (NFPA 111), RSPSS (NEC 701), EQ (NEC 517), FPPSS (NEC 695), FCPSS (NEC 692), and EPSS (NFPA 110). Note that an MV transfer equipment is not disallowed for LS, RE, or CR if the MV switch is separated from mechanical loads. Also, there is no disallowance to separate loads if the MV ATS is Listed.

C. NFPA 70 (NEC) does not mandate a Listing requirement specific to distribution gear generally, including medium voltage (MV) equipment. NEC makes no mention of MV ATSs, nor provides any specific exemption for an MV ATS. That paralleling gear has no Listing requirement at all would apparently extend to MV types of paralleling gear.

3. FOR FIRE PUMP APPLICATIONS: A fire pump's local ATS and/or controller shall be NRTL Listed for electric motor-driven fire pump service. Other transfer equipment upstream of a fire pump ATS does not qualify it as a fire pump ATS also; so only the lower level ATS must meet these 'Fire Pump ATS' requirements.

4. GENERAL REQUIREMENTS: NRTL Listing types compound for each condition of use that applies; 'emergency', 'wet location', etc; whenever the NRTL Listed Use is an available product offering. An ATS must be NRTL Listed for all of the load types to be served. Field labeling by a Field Evaluation Body is an alternate compliance path for a Listing requirement generally, except where a Listing is overtly stated as the only compliance path such as for an ATS and select other NEC applications.

5. OPTIONAL STANDBY APPLICATIONS: Transfer equipment shall be NRTL 'Listed as Transfer Equipment' wherever supplemental circuit protection devices (CPD) are integral to the transfer equipment. No other Listing requirements apply for Optional Standby transfer equipment.

6. INTERCONNECTED POWER PRODUCTION SOURCES are a recognized transfer switch application apart from an ATS. NEC 705 scope only applies to multiple sources if the normal source (e.g. utility) is one of the sources. Where field labeling is provided, the NEC does not mandate any requirement for a Listing of any kind. Even if it is Listed, NEC doesn't require the gear to be NRTL 'Listed as Transfer Equipment' (as CPD optional standby transfer equipment must do), nor 'Listed for Emergency Use' (as all other emergency power transfer equipment must do). Where NEC 705 is applied to critical grade topologies, NEC suffers a glaring omission for any code-required NRTL type validation for a failsafe style of integrity, suitable for essential-class loads.

7. PARALLELING GEAR for automatic transfer switching of multiple sources (apart from an Article 705 type system) has no code article that governs its performance requirements. Only if the paralleling gear is connected to a normal (utility) source must it then comply with NEC 705. But even then the 705 requirements are not up to the usual code standards for critical or emergency gear and so it does not impose any failsafe standard for integrity including associated Listings.

Ironically, NEC 110.3(B) does state (by omission) that only the Listed or Labeled equipment needs to be used in accordance with the equipment manufacturer's instructions. Because the NEC makes no similar requirement of equipment that is not Listed nor Labeled, this equipment category escapes the stipulation to comply with the manufacturer's terms of use. This however is recognizable as nonsense, and an intonation of NEC intent must be interpolated.

NEC 110.3, Part (C) fails to identify that multiple Listings may be required for a product, and that one Listing may not be adequate. An individual separate Listing for each specific category of use is required whenever such Listing categories apply to the conditions of the equipment use.

NEC 110.3, Part (C) also fails to identify NEC's own exemptions for its general requirement that everything be Listed, and whether there are terms for when these exceptions are permitted or disallowed. One category is custom fabricated equipment, of which certain field assemblies may qualify as hybrid sub-category. One other category is equipment that has been reconditioned, refurbished or remanufactured. One final category is non-Listed equipment where NEC has outlined the specific terms of permitted use based on application. The problems arising from potential distinctions of allowances for non-Listed equipment is much more pronounced when the inconsistencies of Listing requirements by specific application are attempted to be put into a proper context (more on this in Chapter 8).

A best practice default for equipment selection is to choose a Listed product whenever one is available, and include each Listing application type that applies. Only when a Listed product cannot meet the design requirement should an alternative be considered; such as a custom fabricated product. Even then, such non-Listed applications shall be responsibly managed to best show coherence to all other code intent toward trustworthy integrity of; the components, the assembly work, and the resultant functionality. And where NEC outlines terms for use specific to "non-Listed" equipment (as done in Chapter 8), it shall be considered an acceptable form of compliance.

The NEC variations of terminology for Listed and for Labeled is diverse but the reason for this inconsistency is not always evident. The numeral in parenthesis is the number of occurrences found for each term in the NEC.

SIDEBAR: As the deadline for 2020 Public Comment is impending, the values and citations from here forward were not back-checked to 2020 NEC from the v2017 they were derived from .

1. Listed (1715), Listing (247), List (9)

2. Approved (473), Approving (2), Approval (44)

3. Labeled (65), Labeling (30), Labels (57), Label (55), Field Labeled (3), clearly Labeled (1)

4. Identified (2), Identifying (35), Identify (41)

5. Marked (647), Marking (555), Mark (31), Marks (3)

6. " Listed for" (332)

7. "Listed and Labeled" (21)

8. "Listed and Labeled for" (2)

9. "Listed or Labeled" (6)

10. "Listed, Labeled, and identified" (18)

11. "Listed, Labeled, or identified" (1)

12. "Prominently Labeled" (2)

13. "Listed, Labeled, and marked" (1)

14. "Listed and Labeled or field identified" (1)

Situation specific NEC requirements for equipment to be "Listed" vary case-by-case, whether by code article, or by site application type, or by equipment category. The way the requirements varied indicate that either code intent is not always consistent, or that the manner in which NEC requirements are written are a mixed bag of inconsistencies. In actuality, it is both.

The code citations below are selected to indicate general requirements and the requirements specific to switch transfer of emergency power sources. Other unrelated code citations are included to illustrate how the code may show consistency and how it shows inconsistency.

1. Listing Requirements by NEC Article

Every material item used for Trailer Parks (NEC 552), RVs (NEC 551), and mobile homes (NEC 550) must be Listed. But not a thing is mandated as needing to be Listed for hospitals (NEC 517), floating buildings (NEC 553), and certain other applications in NEC such as; Cablebus (370), Multioutlet Assemblies (380), Underfloor Raceways (390), Concealed Knob and Tube Wiring (394), Open Wiring on Insulators (398), Outdoor Overhead Conductors Over 1000V (399), Flexible Cords and Flexible Cables (400; though only nearly nil), Fixture Wires (402), Industrial Control Panels (409), Fixed Industrial Heating Equipment (455), Capacitors (460), Resistors and Reactors (470), Equipment Over 1000V (490), Integrated Electrical Systems (685), Interconnected Power Production Sources (705; aka paralleling gear), Circuits and Equipment Under 50V (720), and Energy Management Systems (750).

2. Listing Requirements by Equipment Category

For other NEC articles, the requirements for Listed equipment amounts to an honorable mention of oddities in bits and pieces; not because those bits are especially significant, or associated with criticality. NEC will mention a Listing requirement for the parenthetically consequential 1% and miss the more essential 99%. Switchgear (408) requires that insulated conductors are Listed, but NEC invokes no other requirements of anything else to do with switchgear to be Listed. There are times that NEC chapters or paragraphs only apply technically for any equipment which is Unlisted.

Most all raceways and cabling, but one, are required to be Listed from the 300 series articles of NEC. But at many points amongst the other code articles, only the fittings are indicated as needing to be Listed. The singular 300-series article for cablebus that was inadvertently skipped, is likely an oversight.

3. Listing Requirements by Application Type

Some aspects of Listings are meant to apply categorically, like a Wet Location Listing for any equipment in wet locations; but NEC consistency is sporadic and omissions prolific where they should apply. This inconsistency is similar to the requirements mentioned for sun exposure considerations.

At some points of code there are common applications with common importance factors but they are treated with uncommon requirements.

4. Observations of Inconsistent and Irrelevant Text

The terminologies for similar types of Listings has aspects of inconsistency, such as the five different terms used for an ATS to be Listed for Emergency Use. The verbiage variations could infer that these refined differences in text vary for good reason (with potentially varying requirements), but under scrutiny they do not.

There are code sentences that are superfluous because the Listing requirement for a subcomponent item being mentioned was already imposed generally at some other NEC article prior. Such as for particular conduit fittings to be Listed. To make matters worse, the requirements at one location in code doesn't always match the other location.

Other code text is a waste of language as the statement is redundant unto itself. Such as stating that use of equipment is okay if the Listing says it's okay. Or employing a double-negative to state that equipment is not to be used in a way that the Listing doesn't say is okay. As a side issue, such statements infer that there are "Listing Instructions" to follow for each Listing type. That such instructions exist and are published respective to Listing types is not affirmed to be an industry accepted understanding. How is it proposed that such reference materials are to be captured with consistent integrity by electrical system designers?

At times one or two specifications or features of the Listing itself, are mentioned with the NEC code text. But the exclusion of the other Listing features beckons follow-up questions as to why a partial redundant mention is relevant for some features of the Listing but not the others.

Some NEC text has inferences that a Listing requirement exists without an actual requirement of a Listing ever being stated overtly, only as an inference that the requirement already exists. Conditional statements employing logical grouping sometimes miss clear meaning due to commas missing at relevant points of the sentence.

The benefit that the above comments hope to achieve is in universal applications of Listing requirements as a categorical default wherever practicable, with caveats to follow as to exceptions or specialty additions, such that taken together, the Code edits would amount to less text and simpler forms of clarity. It would be an aide, perhaps suited to Chapter 9 indexes if nowhere else, to have a running list of all potential types of Listings that may be suited to electrical applications governed by NEC. Of course, such a reference list would be subject to on-going updates, but to see them all is perhaps the opportune way to know them.

Related Public Inputs for This Document

Related Input	Relationship
Public Input No. 4586-NFPA 70-2020 [Definition: Labeled.]	similar topic
Public Input No. 4591-NFPA 70-2020 [Definition: Listed.]	similar topic

Public Input No. 4619-NFPA 70-2020 [Section No. 110.3(B)]	similar topic
Public Input No. 4624-NFPA 70-2020 [Section No. 110.3(C)]	similar topic

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Public Input No. 175-NFPA 70-2019 [Global Input]

I would like to add in a section to cover disconnecting means for Article 410.30 (B). I would like to see wording that would include all new Pole lighting that a means of disconnect be required at each pole location. This would make troubleshooting and repair of Pole lighting safer, more productive and more cost effecient for the industry.

Statement of Problem and Substantiation for Public Input

Employee & Public safety, efficiency and cost savings to consumer.

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Public Input No. 2691-NFPA 70-2020 [Definition: Attachment Fitting.]

Attachment Fitting, Weight Supporting (WSAF) .

A device that, by insertion into a ~~locking support and mounting~~ weight supporting ceiling receptacle, establishes a connection between the conductors of the attached utilization equipment and the branch-circuit conductors connected to the ~~locking support and mounting~~ weight supporting ceiling receptacle. (CMP-18)

Informational Note: ~~An~~ A weight supporting attachment fitting is different from an attachment plug because no cord is associated with the fitting. ~~An~~ A weight support attachment fitting in combination with a ~~locking support and mounting~~ weight supporting ceiling receptacle secures the associated utilization equipment in place and supports its weight.

Statement of Problem and Substantiation for Public Input

This revised definition is to clearly differentiate the specific application of weight supporting ceiling receptacles (WSCR) and associated weight supporting attachment fittings from general purpose receptacles and related attachment plugs. This will eliminate confusion in applying Code requirements to this specific receptacle when they do not apply. The acronym (WSAF) is created to assist in communications similar to the use of the acronym GFCI.

Please see the following related public inputs 2690 and 3423 as cross references to this public input.

Related Public Inputs for This Document

Related Input	Relationship
Public Input No. 2690-NFPA 70-2020 [New Definition after Definition: Receptacle.]	The weight supporting attachment fitting is used with the weight supporting ceiling receptacle to connect the utilization equipment
Public Input No. 2690-NFPA 70-2020 [New Definition after Definition: Receptacle.]	
Public Input No. 2693-NFPA 70-2020 [Section No. 210.8(A)]	
Public Input No. 2694-NFPA 70-2020 [Section No. 406.9(C)]	

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Public Input No. 375-NFPA 70-2020 [Definition: Multioutlet Assembly.]

Multioutlet Assembly.

~~A type of surface, flush, or freestanding~~ An enclosure or raceway designed to hold conductors and receptacles, assembled in the field or at the factory that provides power for the connection of utilization equipment . (CMP-18)

Statement of Problem and Substantiation for Public Input

This language is more in line with the UL description below

Multioutlet assemblies consist of an enclosure or raceway and outlet wiring devices that provide power for connection of utilization equipment.

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Public Input No. 3906-NFPA 70-2020 [Definition: Receptacle Outlet.]

Receptacle Outlet.

An outlet where one or more receptacles are installed <u>in individual enclosures</u> . (CMP-18)

Statement of Problem and Substantiation for Public Input

The term receptacle outlet as currently worded could indicate a single, duplex, quad or more receptacle in an outlet. The receptacle outlet needs to be clearly identified as a single enclosure. One area that is vague with the current wording is in article 210.60(B) receptacle placement in guest rooms. It specifically states that two receptacle outlets shall be readily accessible. I have had 4 inspectors recently and two interpreted that as one duplex receptacle in a single box meets the requirement, the other two interpreted it as two separate enclosures which could contain at least a simplex outlet were required. I believe the intent is to have two separate enclosures required, however the current wording does not specify that.

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Public Input No. 2690-NFPA 70-2020 [New Definition after Definition: Receptacle.]

Receptacle, Weight Supporting Ceiling (WSCR)

A contact device installed at the outlet box for the connection and support of luminaries and paddle fans using a weight support attachment fitting.

Statement of Problem and Substantiation for Public Input

This new definition is to clearly differentiate the specific application of weight supporting ceiling receptacles (WSCR) from general purpose receptacles. This will eliminate confusion in applying Code requirements to this specific receptacle when they do not apply. The acronym is created to assist in communications similar to the use of the acronym GFCI. The location of this definition is intended to be a subset definition to the present definition of receptacle. This is a receptacle but is a special configuration of a receptacle meriting its own definition.

Please see the following related public inputs 2691 and 3423 as cross references to this public input.

Related Public Inputs for This Document

Related Input	Relationship
Public Input No. 2691-NFPA 70-2020 [Definition: Attachment Fitting.]	The weight supporting ceiling receptacle is applied with the weight supporting attachment fitting to connect the utilization equipment.
Public Input No. 2691-NFPA 70-2020 [Definition: Attachment Fitting.]	
Public Input No. 2693-NFPA 70-2020 [Section No. 210.8(A)]	
Public Input No. 2694-NFPA 70-2020 [Section No. 406.9(C)]	

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Public Input No. 1701-NFPA 70-2020 [Article 393]

Article 393 Extra- Low-Voltage Suspended Ceiling Power Distribution Systems

Part I. General

393.1 Scope.

This article covers the installation of extra- low-voltage suspended ceiling power distribution systems.

393.2 Definitions.

The definitions in this section shall apply only within this article.

Busbar.

A noninsulated conductor electrically connected to the source of supply and physically supported on an insulator providing a power rail for connection to utilization equipment, such as sensors, actuators, A/V devices, extra- low-voltage luminaire assemblies, and similar electrical equipment.

Busbar Support.

An insulator that runs the length of a section of suspended ceiling bus rail that serves to support and isolate the busbars from the suspended grid rail.

Connector.

A term used to refer to an electromechanical fitting.

Connector, Load.

An electromechanical connector used for power from the busbar to utilization equipment.

Connector, Pendant.

An electromechanical or mechanical connector used to suspend extra- low-voltage luminaire or utilization equipment below the grid rail and to supply power to connect from the busbar to utilization equipment.

Connector, Power Feed.

An electromechanical connector used to connect the power supply to a power distribution cable, to connect directly to the busbar, or to connect from a power distribution cable to the busbar.

Connector, Rail to Rail.

An electromechanical connector used to interconnect busbars from one ceiling grid rail to another grid rail.

Grid Bus Rail.

A combination of the busbar, the busbar support, and the structural suspended ceiling grid system.

Extra- Low-Voltage Suspended Ceiling Power Distribution System.

A system that serves as a support for a finished ceiling surface and consists of a busbar and busbar support system to distribute power to utilization equipment supplied by a Class 2 power supply.

Power Supply.

A Class 2 power supply connected between the branch-circuit power distribution system and the busbar low-voltage suspended ceiling power distribution system.

Rail.

The structural support for the suspended ceiling system typically forming the ceiling grid supporting the ceiling tile and listed utilization equipment, such as sensors, actuators, A/V devices, and extra- low-voltage luminaires and similar electrical equipment.

Reverse Polarity Protection (Backfeed Protection).

A system that prevents two interconnected power supplies, connected positive to negative, from passing current from one power source into a second power source.

Suspended Ceiling Grid.

A system that serves as a support for a finished ceiling surface and other utilization equipment.

393.6 Listing Requirements.

Suspended ceiling power distribution systems and associated fittings shall be listed as in 393.6(A) or (B).

(A) Listed System.

~~Low~~

Extra - low- voltage suspended ceiling distribution systems operating at 30 volts ac or less or 60 volts dc or less shall be listed as a complete system, with the utilization equipment, power supply, and fittings as part of the same identified system.

(B) Assembly of Listed Parts.

~~A~~

An extra- low-voltage suspended ceiling power distribution system assembled from the following parts, listed according to the appropriate function, shall be permitted:

(1) Listed extra- low-voltage utilization equipment

(2) Listed Class 2 power supply

(3) Listed or identified fittings, including connectors and grid rails with bare conductors

(4) Listed extra- low-voltage cables in accordance with 725.179 , conductors in raceways, or other fixed wiring methods for the secondary circuit

Part II. Installation

393.10 Uses Permitted.

~~Low~~

Extra - low- voltage suspended ceiling power distribution systems shall be permanently connected and shall be permitted as follows:

(1) For listed utilization equipment capable of operation at a maximum of 30 volts ac (42.4 volts peak) or 60 volts dc (24.8 volts peak for dc interrupted at a rate of 10 Hz to 200 Hz) and limited to Class 2 power levels in Chapter 9, Table 11(A) and Table 11(B) for lighting, control, and signaling circuits.

(2) In indoor dry locations.

(3) For residential, commercial, and industrial installations.

(4) In other spaces used for environmental air in accordance with 300.22(C) , electrical equipment having a metal enclosure, or with a nonmetallic enclosure and fittings, shall be listed for use within an air-handling space and shall have adequate fire-resistant and low-smoke-producing characteristics and associated wiring material suitable for the ambient temperature.

Informational Note: One method of defining adequate fire-resistant and low-smoke-producing characteristics for electrical equipment with a nonmetallic enclosure is in ANSI/ UL 2043-2013, *Fire Test for Heat and Visible Smoke Release for Discrete Products and Their Accessories Installed in Air-Handling Spaces* .

393.12 Uses Not Permitted.

Suspended ceiling power distribution systems shall not be installed in the following:

(1) In damp or wet locations

(2) Where subject to corrosive fumes or vapors, such as storage battery rooms

(3) Where subject to physical damage

(4) In concealed locations

(5) In hazardous (classified) locations

(6) As part of a fire-rated floor-ceiling or roof-ceiling assembly, unless specifically listed as part of the assembly

(7) For lighting in general or critical patient care areas

393.14 Installation.

(A) General Requirements.

Support wiring shall be installed in a neat and workmanlike manner. Cables and conductors installed exposed on the surface of ceilings and sidewalls shall be supported by the building structure in such a manner that the cable is not damaged by normal building use. Such cables shall be supported by straps, staples, hangers, cable ties listed and identified for securement and support, or similar fittings designed and installed so as not to damage the cable.

> Informational Note: Suspended ceiling low-voltage power grid distribution systems should be installed by qualified persons in accordance with the manufacturer's installation instructions.

(B) Insulated Conductors.

Exposed insulated secondary circuit conductors shall be listed, of the type, and installed as described as follows:

(1) Class 2 cable supplied by a listed Class 2 power source and installed in accordance with Parts I and III of Article 725

(2) Wiring methods described in Chapter 3

393.21 Disconnecting Means.

(A) Location.

A disconnecting means for the Class 2 supply to the power grid system shall be located so as to be accessible and within sight of the Class 2 power source for servicing or maintenance of the grid system.

(B) Multiwire Branch Circuits.

Where connected to a multiwire branch circuit, the disconnecting means shall simultaneously disconnect all the supply conductors, including the grounded conductors.

393.30 Securing and Supporting.

(A) Attached to Building Structure.

A suspended ceiling extra- low-voltage power distribution system shall be secured to the mounting surface of the building structure by hanging wires, screws, or bolts in accordance with the installation and operation instructions. Mounting hardware, such as screws or bolts, shall be either packaged with the suspended ceiling low-voltage lighting power distribution system, or the installation instructions shall specify the types of mounting fasteners to be used.

(B) Attachment of Power Grid Rails.

The individual power grid rails shall be mechanically secured to the overall ceiling grid assembly.

393.40 Connectors and Enclosures.

(A) Connectors.

Connections to busbar grid rails, cables, and conductors shall be made with listed insulating devices, and these connections shall be accessible after installation. A soldered connection shall be made mechanically secure before being soldered. Other means of securing leads, such as push-on terminals and spade-type connectors, shall provide a secure mechanical connection. The following connectors shall be permitted to be used as connection or interconnection devices:

(1) Load connectors shall be used for power from the busbar to listed utilization equipment.

(2) A pendant connector shall be permitted to suspend extra- low-voltage luminaires or utilization equipment below the grid rail and to supply power from the busbar to the utilization equipment.

(3) A power feed connector shall be permitted to connect the power supply directly to a power distribution cable and to the busbar.

(4) Rail-to-rail connectors shall be permitted to interconnect busbars from one ceiling grid rail to another grid rail.

Informational Note: For quick-connect terminals, see UL 310, *Standard for Electrical Quick-Connect*, and for mechanical splicing devices, see UL 486A-486B, *Standard for Wire Connectors*.

(B) Enclosures.

Where made in a wall, connections shall be installed in an enclosure in accordance with Parts I, II, and III of Article 314.

393.45 Overcurrent and Reverse Polarity (Backfeed) Protection.

(A) Overcurrent Protection.

The listed Class 2 power supply or transformer primary shall be protected at not greater than 20 amperes.

(B) Interconnection of Power Sources.

Listed Class 2 sources shall not have the output connections paralleled or otherwise interconnected unless listed for such interconnection.

(C) Reverse Polarity (Backfeed) Protection of Direct-Current Systems.

A suspended ceiling extra- low-voltage power distribution system shall be permitted to have reverse polarity (backfeed) protection of dc circuits by one of the following means:

(1) If the power supply is provided as part of the system, the power supply is provided with reverse polarity (backfeed) protection; or

(2) If the power supply is not provided as part of the system, reverse polarity or backfeed protection can be provided as part of the grid rail busbar or as a part of the power feed connector.

393.56 Splices.

A busbar splice shall be provided with insulation and mechanical protection equivalent to that of the grid rail busbars involved.

393.57 Connections.

Connections in busbar grid rails, cables, and conductors shall be made with listed insulating devices and be accessible after installation. Where made in a wall, connections shall be installed in an enclosure in accordance with Parts I, II, and III of Article 314, as applicable.

393.60 Grounding.

(A) Grounding of Supply Side of Class 2 Power Source.

The supply side of the Class 2 power source shall be connected to an equipment grounding conductor in accordance with the applicable requirements in Part IV of Article 250.

(B) Grounding of Load Side of Class 2 Power Source.

Class 2 load side circuits for suspended ceiling low-voltage power grid distribution systems shall not be grounded.

Part III. Construction Specifications

393.104 Sizes and Types of Conductors.

(A) Load Side Utilization Conductor Size.

Current-carrying conductors for load side utilization equipment shall be copper and shall be 18 AWG minimum.

Exception: Conductors of a size smaller than 18 AWG, but not smaller than 24 AWG, shall be permitted to be used for Class 2 circuits. Where used, these conductors shall be installed using a Chapter 3 wiring method, shall be totally enclosed, shall not be subject to movement or strain, and shall comply with the ampacity requirements in Table 522.22 .

(B) Power Feed Bus Rail Conductor Size.

The power feed bus rail shall be 16 AWG minimum or equivalent. For a busbar with a circular cross section, the diameter shall be 1.29 mm (0.051 in.) minimum, and, for other than circular busbars, the area shall be 1.32 mm^2 (0.002 $in.^2$) minimum.

Statement of Problem and Substantiation for Public Input

Coordinate with proposed new definitions for low voltage and extra-low voltage.

Related Public Inputs for This Document

Related Input	Relationship
Public Input No. 1695-NFPA 70-2020 [New Definition after Definition: Voltage (of a circuit).]	Go together
Public Input No. 1695-NFPA 70-2020 [New Definition after Definition: Voltage (of a circuit).]	

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Public Input No. 3593-NFPA 70-2020 [Section No. 393.2]

(Relocate all definitions in the 393.2 to Article 100, arrange them in alphabetical order and without any subdivisions.)

393. 2 Definitions.

The definitions in this section shall apply only within this article.

Busbar.

A noninsulated conductor electrically connected to the source of supply and physically supported on an insulator providing a power rail for connection to utilization equipment, such as sensors, actuators, A/V devices, low-voltage luminaire assemblies, and similar electrical equipment.

Busbar Support.

An insulator that runs the length of a section of suspended ceiling bus rail that serves to support and isolate the busbars from the suspended grid rail.

Connector.

A term used to refer to an electromechanical fitting.

Connector, Load.

An electromechanical connector used for power from the busbar to utilization equipment.

Connector, Pendant.

An electromechanical or mechanical connector used to suspend low-voltage luminaire or utilization equipment below the grid rail and to supply power to connect from the busbar to utilization equipment.

Connector, Power Feed.

An electromechanical connector used to connect the power supply to a power distribution cable, to connect directly to the busbar, or to connect from a power distribution cable to the busbar.

Connector, Rail to Rail.

An electromechanical connector used to interconnect busbars from one ceiling grid rail to another grid rail.

Grid Bus Rail.

A combination of the busbar, the busbar support, and the structural suspended ceiling grid system.

Low-Voltage Suspended Ceiling Power Distribution System.

A system that serves as a support for a finished ceiling surface and consists of a busbar and busbar support system to distribute power to utilization equipment supplied by a Class 2 power supply.

Power Supply.

A Class 2 power supply connected between the branch-circuit power distribution system and the busbar low-voltage suspended ceiling power distribution system.

Rail.

The structural support for the suspended ceiling system typically forming the ceiling grid supporting the ceiling tile and listed utilization equipment, such as sensors, actuators, A/V devices, and low-voltage luminaires and similar electrical equipment.

Reverse Polarity Protection (Backfeed Protection).

A system that prevents two interconnected power supplies, connected positive to negative, from passing current from one power source into a second power source.

Suspended Ceiling Grid.

A system that serves as a support for a finished ceiling surface and other utilization equipment.

Statement of Problem and Substantiation for Public Input

"The National Electrical Code has definitions in multiple parts in Article 100 and many definitions scattered through out the code many of them in the .2 section of the articles.
Most of the other standards under NFPA have their definitions in one location and this will allow the NEC the same requirement. The revisions to the NEC Style Manual require all the definitions to be relocated to Article 100. "

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Committee: NEC-P18

Public Input No. 1349-NFPA 70-2020 [Section No. 393.60]

393.60 Equipment Grounding Conductor .

(A) ~~Grounding of~~ Supply Side ~~of Class 2 Power Source~~ . ~~The supply side of the Class 2 power source shall be connected to an equipment grounding conductor in accordance with the applicable requirements in Part IV of Article 250.~~

(B)

~~Grounding of~~

Load Side

~~of Class 2 Power Source.Class 2 load side circuits for suspended ceiling low-voltage power grid distribution systems~~

. The load side of the Class 2 power source shall not be required to be grounded.

Statement of Problem and Substantiation for Public Input

No. 1. According to the NFPA Style Manual, the Section Title needs to reflect the content of the rule. The rule is about the equipment grounding conductor, not about 'Grounding.'

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Public Input No. 3623-NFPA 70-2020 [Section No. 406.2]

(Relocate all definitions in the 406. 2 to Article 100, arrange them in alphabetical order and without any subdivisions.)

406. 2 Definitions.

The definitions in this section shall apply only within this article.

Child Care Facility.

A building or structure, or portion thereof, for educational, supervisory, or personal care services for more than four children 7 years old or less.

Outlet Box Hood.

A housing shield intended to fit over a faceplate for flush-mounted wiring devices, or an integral component of an outlet box or of a faceplate for flush-mounted wiring devices. The hood does not serve to complete the electrical enclosure; it reduces the risk of water coming in contact with electrical components within the hood, such as attachment plugs, current taps, surge protective devices, direct plug-in transformer units, or wiring devices.

Statement of Problem and Substantiation for Public Input

"The National Electrical Code has definitions in multiple parts in Article 100 and many definitions scattered through out the code many of them in the .2 section of the articles.
Most of the other standards under NFPA have their definitions in one location and this will allow the NEC the same requirement. The revisions to the NEC Style Manual require all the definitions to be relocated to Article 100. "

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Committee: NEC-P18

Public Input No. 664-NFPA 70-2020 [Definition: Child Care Facility.]

Child Care Facility.

A building ~~or structure~~ , or portion thereof, for educational, supervisory, or personal care services for more than four children 7 years old or less.

Statement of Problem and Substantiation for Public Input

A structure as a child care facility dose not exist

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Committee:	NEC-P18

Public Input No. 3259-NFPA 70-2020 [Section No. 406.3]

406.3 Receptacle Rating and Type.

(A) Receptacles.

Receptacles shall be listed and marked with the manufacturer's name or identification and voltage and ampere ratings. Receptacles shall not be permitted to be reconditioned.

(B) Rating.

Receptacles and cord connectors shall be rated not less than 15 amperes, 125 volts, or 15 amperes, 250 volts, and shall be of a type not suitable for use as lampholders.

> Informational Note: See 210.21(B) for receptacle ratings where installed on branch circuits.

(C) Receptacles for Aluminum Conductors.

Receptacles rated 20 amperes or less and designed for the direct connection of aluminum conductors shall be marked CO/ALR.

(D) Receptacles with Push-in Terminals. Push-in terminals of receptacles rated 15 amperes shall be directly connected solely to 14 AWG solid copper conductors. For receptacles rated 15 amperes and having push-in terminals that are identified additionally, and so marked, as suitable for 14 AWG solid copper-clad aluminum conductors, the push-in terminals shall be permitted to be directly connected to 14 AWG solid copper-clad aluminum in accordance with 240.4(D)(3).

(E) Isolated Ground Receptacles.

Receptacles incorporating an isolated equipment grounding conductor connection intended for the reduction of electromagnetic interference as permitted in 250.146(D) shall be identified by an orange triangle located on the face of the receptacle.

(1) Isolated Equipment Grounding Conductor Required.

Receptacles so identified shall be used only with equipment grounding conductors that are isolated in accordance with 250.146(D).

(2) Installation in Nonmetallic Boxes.

Isolated ground receptacles installed in nonmetallic boxes shall be covered with a nonmetallic faceplate.

Exception: Where an isolated ground receptacle is installed in a nonmetallic box, a metal faceplate shall be permitted if the box contains a feature or accessory that permits the connection of the faceplate to the equipment grounding conductor.

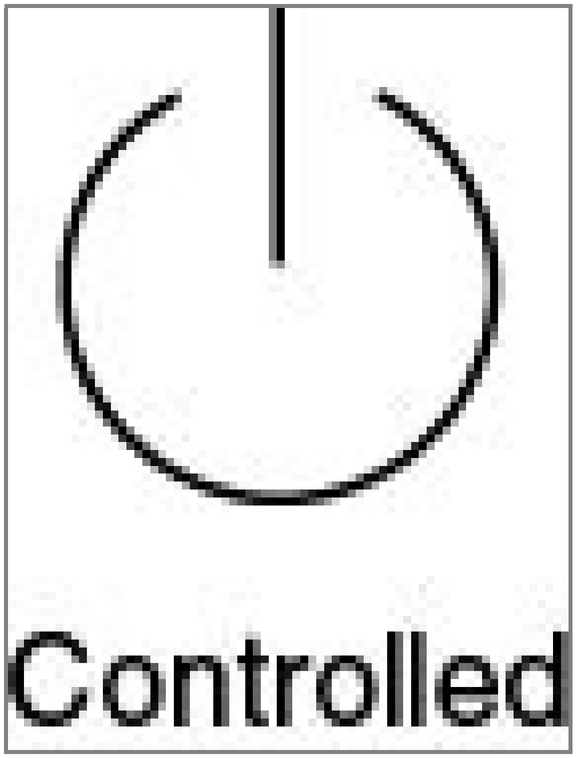
(~~E~~ F) Controlled Receptacle Marking.

All nonlocking-type, 125-volt, 15- and 20-ampere receptacles that are controlled by an automatic control device, or that incorporate control features that remove power from the receptacle for the purpose of energy management or building automation, shall be permanently marked with the symbol shown in Figure 406.3(E) and the word “controlled.”

For receptacles controlled by an automatic control device, the marking shall be located on the receptacle face and visible after installation.

In both cases where a multiple receptacle device is used, the required marking of the word “controlled” and symbol shall denote which contact device(s) are controlled.

Figure 406.3(E) Controlled Receptacle Marking Symbol.



Exception: The marking shall not be required for receptacles controlled by a wall switch that provide the required room lighting outlets as permitted by 210.70.

(~~F~~ G) Receptacle with USB Charger.

A 125-volt 15- or 20-ampere receptacle that additionally provides Class 2 power shall be listed and constructed such that the Class 2 circuitry is integral with the receptacle.

Additional Proposed Changes

File Name	Description	Approved
Proposed_406.3_D_Draft_Fnl.docx	Word file attached for clarity.	
Terminal_and_Conductor_Temperature_Testing_Part_I_Fnl.pdf	Terminal temperature static heating report as requested by task group	

Statement of Problem and Substantiation for Public Input

Task Group Statement

This public input is submitted on behalf of the task group formed in accordance with the direction of the NFPA Standards Council in their Decisions D#19-2 and D#19-23. This task group was appointed to identify potential proposed changes to the 2020 edition of the NEC in the form of proposed Tentative Interim Amendments (TIAs) or to the 2023 edition of the NEC in the form of Public Inputs (PIs) that within the Task Group's scope of activity as specified by the Standards Council.

These proposed PIs relate to new requirements covering the use of copper-clad aluminum conductors throughout the NEC as a coordinated set of new or revised requirements. These Public Inputs should not be misconstrued by the CMPs as precluding consideration of other Public Inputs, with supporting test data, submitted now or in the future, for other potentially eligible conductor materials or sizes.

The task group members are; David Hittinger-Chair, Todd Crisman, Roland Deike, Thomas Domitrovich, Peter Graser, Christel Hunter, Chuck Mello, Ken Riedl, Susan Newman Scearce, Susan Stene, George Straniero, Frank Tse and Brian Rock. This task group of balanced interests provided the expertise to develop these public inputs covering the use of copper-clad aluminum conductors.

Public Inputs are being submitted in the following sections: Article 100, definition of "copper-clad aluminum", 210.12, 210.18, 210.21(B)(1), 210.23, 210.24, 210.52(B), 240.4(D), 240.6, 310.3(A), 310.3(B), Table 310.16, Table 310.17, 330.104, 334.104, 336.104, 340.104,404.14(D), and 406.3(D).

Technical Substantiation

The UL standard and associated guide information under category code RTRT for receptacles with push in terminals permits only 14 AWG solid copper conductors to be used at this time.

"Screwless terminal connectors of the conductor push-in type (also known as "push-in-terminals") are restricted to 15 A branch circuits and are for connection with 14 AWG solid copper wire only. They are not intended for use with aluminum or copper-clad aluminum wire, 14 AWG stranded copper wire, or 12 AWG solid or stranded copper wire."

The change to this section is to highlight this limitation for receptacles that may have push-in terminals provided. The introduction of 14 AWG copper-clad aluminum into the NEC for branch circuit wiring needs this limitation to ensure push-in terminals on wiring devices are being installed in accordance with their listing.

Related Public Inputs for This Document

Related Input	Relationship
Public Input No. 2864-NFPA 70-2020 [Section No. 210.18]	Branch circuit ratings added 10 amps
Public Input No. 2866-NFPA 70-2020 [Section No. 210.21(B)]	Individual branch circuit receptacle applications and limitations
Public Input No. 3261-NFPA 70-2020 [Section No. 210.23]	Branch circuit applications and limitations added 10 amps
Public Input No. 3940-NFPA 70-2020 [Section No. 210.24]	Summary branch circuit applications and limitations added 10 amps
Public Input No. 3241-NFPA 70-2020 [Section No. 310.3(A)]	Branch circuit conductors added 14 AWG copper-clad aluminum
Public Input No. 3247-NFPA 70-2020 [Section No. 330.104]	14 AWG copper-clad aluminum added for cables
Public Input No. 3248-NFPA 70-2020 [Section No. 334.104]	14 AWG copper-clad aluminum added for cables
Public Input No. 3249-NFPA 70-2020 [Section No. 336.104 [Excluding any Sub-Sections]]	14 AWG copper-clad aluminum added for cables
Public Input No. 3251-NFPA 70-2020 [Section No. 340.104]	14 AWG copper-clad aluminum added for cables

Public Input No. 3256-NFPA 70-2020 [Section No. 404.14]	Applications and limitations for snap switches
Public Input No. 2864-NFPA 70-2020 [Section No. 210.18]	
Public Input No. 2865-NFPA 70-2020 [Section No. 210.12]	
Public Input No. 2866-NFPA 70-2020 [Section No. 210.21(B)]	
Public Input No. 3237-NFPA 70-2020 [Section No. 210.52(B)(1)]	
Public Input No. 3238-NFPA 70-2020 [Section No. 240.4(D)]	
Public Input No. 3241-NFPA 70-2020 [Section No. 310.3(A)]	
Public Input No. 3248-NFPA 70-2020 [Section No. 334.104]	
Public Input No. 3249-NFPA 70-2020 [Section No. 336.104 [Excluding any Sub-Sections]]	
Public Input No. 3251-NFPA 70-2020 [Section No. 340.104]	
Public Input No. 3256-NFPA 70-2020 [Section No. 404.14]	
Public Input No. 3261-NFPA 70-2020 [Section No. 210.23]	
Public Input No. 3940-NFPA 70-2020 [Section No. 210.24]	
Public Input No. 3960-NFPA 70-2020 [Section No. 310.21]	

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Committee:	NEC-P18

Terminal and Conductor Temperature Testing of 14 AWG Copper-Clad Aluminum and 14 AWG Copper Conductors

Part I – Static Heating and Flexing Tests

For

Bimetallics Task Group

Conducted at

Eaton Laboratories
Menomonee Falls, Wisconsin

Report by

Chuck Mello
on behalf of Bimetallics Task Group

Report Date

August 28, 2020

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1.0 Introduction and Purpose

At the direction of the NFPA Standards Council in their Decisions D#19-2 and D#19-23, a Bimetallics Task Group of balanced interest was appointed. The scope was to review the proposed changes to the 2020 edition of the *NEC®* that relate to copper-clad aluminum conductors and recommend changes through tentative interim amendment(s) and/or to provide public inputs for the next revision cycle.

As the task group conducted the work, it was determined that testing data had been provided substantiating the ampacity of 14 AWG copper-clad aluminum but a number of related questions about 14 AWG copper-clad aluminum applications arose regarding terminal temperatures when applied to circuit breakers, wire splicing devices and device terminals. A testing plan was developed, reviewed over several task group meetings, and accepted by the task group to address the terminal temperature questions. This testing was completed at the Eaton Corporation laboratory facilities in Menomonee Falls, Wisconsin. The helpful assistance of Mr. Tom Domitrovich, Mr. Kevin Arnold, Mr. James Parrett, and Mr. Steve Averbeck with Eaton Corporation is greatly appreciated in arranging for and executing the testing.

This test report provides the testing arrangement, testing procedures and results for the static heating and the flexing tests. The Part I testing detailed in this report commenced July 30, 2020 and completed on August 26, 2020. Thermocycling testing is presently being conducted and those test results will be provided in a separate report. The separation of the reports is necessary to meet the NFPA deadline of September 10, 2020 to submit public inputs and any supporting data.

The purpose of this testing is to provide data, as requested by the Bimetallics Task Group, to understand certain installation and operating conditions when considering the application of 14 AWG copper-clad aluminum conductors at the proposed ampacity for branch circuits. The testing being completed also includes 14 AWG copper conductors at its *NEC®* ampacity for comparison and performance. The basis for comparison is at the 60ºC ampacity rating for copper (15 amps) and the proposed 60ºC ampacity rating for copper-clad aluminum (10 amps). This testing is designed to represent a typical installation to determine the following:

1) The temperature (temperature rise) on the terminals and conductor immediately adjacent to a 10 Amp and 15 Amp molded case circuit breaker, under normal and identified abnormal conditions
2) The temperature (temperature rise) on wire-splicing devices (e.g., Ideal Wire Nuts® or similar), and conductor immediately adjacent, commonly used for splicing in junction or device boxes or attaching leads from utilization equipment, under normal and abnormal conditions
3) The temperature (temperature rise) on wiring devices (single receptacle as representative) and conductor immediately adjacent under normal and abnormal conditions
4) Conductor retention on wiring devices after abnormal thermal-cycling
5) The flexing durability of 14 AWG copper-clad aluminum when installed and removed from a single-gang device box

Since the various product standards do not presently have requirements, procedures or parameters for 14 AWG copper-clad aluminum, the testing being conducted is based on the 10-ampere branch circuit rating at 60°C and percentage multipliers taken from the applicable standards. Where the standard does not provide a percentage value, then the current for the testing was interpolated from the values for relative copper and/or aluminum conductors from the standard. The values for testing of 14 AWG copper are taken from the applicable product safety standards with an ampacity basis of 15 Amps at 60°C

It is to be understood this testing is only being conducted to provide specific performance data and information as requested by the task group. The testing does not provide performance or data for certification of any of the components used for the testing. If 14 AWG copper-clad aluminum is accepted into the 2023 *NEC*®, then numerous UL standards will need to be revised and testing completed under the requirements established in those standards. This testing for certification could be more extensive and take much more time to complete than what is provided here. The goal again is to provide information for a typical installation specific to terminal temperatures. The changes to UL standards will not begin to occur until 14 AWG copper-clad aluminum is recognized for installation in the *NEC*®.

To provide a basis to consider the test results for 14 AWG copper-clad aluminum, duplicate test set ups were constructed using 14 AWG copper conductors. The only difference in the setup for 14 AWG copper is the circuit breaker was rated 15 Amps and the testing values were based on the 15 Amp ampacity. This additional testing data provides a direct comparison in the same environment at the 60ºC ampacity values for these two conductor types and assemblies.

2.0 Testing Arrangement and Setup

The test was conducted in a suitable facility with environmental controls and documented monitoring. The facility was free from extraneous changes in ambient temperature and from having random air flow (drafts) through the testing area. Ambient temperature was maintained between 20ºC and 25°C and recorded with thermocouples positioned in the testing area while temperature testing was completed.

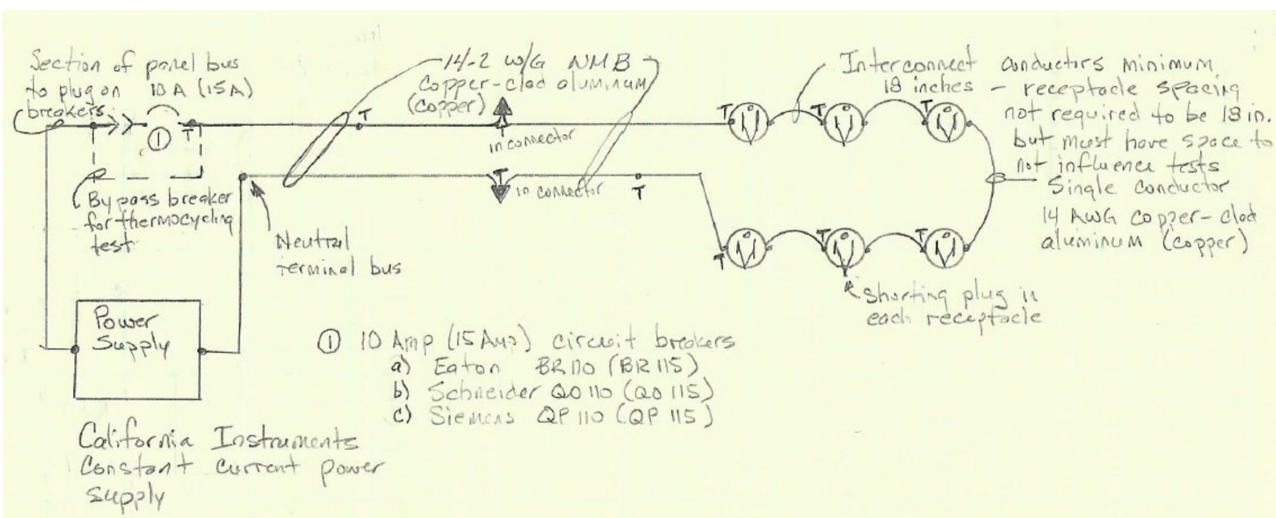


Figure 1 – Typical Test Circuit Diagram

The Eaton facility, being a division within a manufacturing company of wiring devices and circuit breakers, has laboratory technicians that are very familiar with testing of circuit components and equipment to UL standards.

The test circuit diagram shown in figure 1 above provides the basic layout of one (1) testing circuit consisting of one (1) circuit breaker, the conductor (14 AWG copper-clad aluminum or copper NM-B cable) two wire-splicing devices, and six (6) single receptacles. To complete tests 1 through 4 as described below, three (3) of these test circuits were assembled at a time. Photos 1 through 3 in Appendix A show the general test setup for completing the static heating testing. Each of the three (3) circuits have one of the manufacturer's (mfg. 1, mfg. 2, and mfg. 3) circuit breaker, the wire splicing devices on the black and white wire as described below, and three (3) each of receptacles from two of the manufacturers. Photos 4 through 7 show each of the setups with a sign indicating the circuit breaker, conductor material, wire splicing devices, and receptacles in that circuit.

For example, a setup had three (3) circuits with:

- Three different 10-amp circuit breakers (one each mfg. 1, mfg. 2, and mfg. 3)
- 14 AWG copper-clad aluminum NM-B conductors
- Mfg. 4 and mfg.5 wire splicing devices respectively, on the black and white conductors
- Three each of the mfg. 8 and mfg. 9 receptacles, and
- 14 AWG THHN copper-clad aluminum conductors for interconnection of the receptacles

These components were connected together to form a complete circuit. The second setup for 14 AWG copper-clad aluminum were same circuit breakers but with mfg.6 and mfg.7 wire spicing devices and with mfg. 10 and mfg.11 receptacles. The third and fourth setups were the same as 1 and 2 except using 15-amp circuit breakers and 14 AWG copper conductors.

Due to testing of several different circuit breakers, receptacles, and wire-splicing devices, the test arrangement was different than what may be used for certification testing of a single type of device. The test purpose was to approximate an actual installation under laboratory type conditions and not to establish certification type testing for any one device.

For tests 1 through 4 the three power supplies used were programmable constant current power supply sources. Each power supply was connected to one of the circuits and provided the current level specified for the tests being conducted.

For each of the four setups the following description is provided, see circuit diagram in figure 1 and Appendix A photos 1 through 7:

1) The three (3) circuits were mounted on an insulating sheet approximately 4 feet high and 8 feet wide. The partition had suitable framing to provide structural support for the partition to be in a vertical orientation to the floor.

2) During all testing, suitable barrier tape, safety cones, barriers, or other means was in place in accordance with the laboratory safety procedures to keep unauthorized persons out of the area and away from exposed live parts.

3) The individual conductors and devices were arranged horizontally with approximately 12 inches of vertical spacing between each horizontal assembly. Staples, or other fastening devices, such as cable ties, were used to keep the NM-B cable aligned with the respective test assembly.

4) For the circuit breaker testing the following was assembled:

   a) For the copper-clad aluminum conductors, three (3) 10-amp plug-on type panelboard circuit breakers were installed on sections of panelboard bus that are mounted onto the insulating board partition.

   b) For the copper conductors, three (3) 15-amp plug-on type panelboard circuit breakers were installed on sections of panelboard bus that are mounted onto the insulating board partition. The panelboard bus had a terminal for connection of one conductor from the power supply.

5) From the circuit breaker approximately 4 feet of 14-2 NM-B cable was installed and supported as provided above. From this center junction another 2 feet of 14-2 NM-B cable (copper-clad aluminum or copper as applicable) was installed. The junction in the middle had approximately 6 inches of exposed conductor and a splice completed with yellow wire-splicing devices as provided for the black, white and equipment grounding conductors. The following was applied to the two setups for the copper-clad aluminum conductors respectfully and repeated for the copper conductor setups.

   a) The black wire for the first circuit set of three used a mfg. 4 yellow wire-splicing devices

   b) The white wire for the first circuit set of three used an mfg. 5 yellow Wire Nuts®

   c) The black wire of the second circuit set of three used a mfg. 6 yellow wire-splicing devices

   d) The white wire of the second circuit set of three used a mfg. 7 yellow wire-splicing devices

   The manufacturer and location of the wire-splicing devices used was recorded for each test setup.

6) Six (6) receptacles were installed at the end of each horizontal assembly.

   a) The first set of circuits of copper-clad aluminum or of copper had three (3) mfg. 11 receptacles and then three (3) receptacles from mfg. 8 all connected in series.

   b) The second circuit of copper-clad aluminum or of copper had three (3) receptacles from mfg. 10 and then three (3) receptacles from mfg. 9 all connected in series.

   The receptacles were spaced a minimum of six (6) inches apart horizontally and/or vertically and were interconnected with a minimum of eighteen (18) inches of 14 AWG solid THHN copper-clad aluminum or copper conductors respectfully.

   The receptacles were mounted to the wall surface with screws, so that the face of the receptacle was approximately 1 1/2 inches from the insulating board partition surface.

   For each manufacturer the receptacles were connected to terminals as follows:

   a) One receptacle had the conductors installed at each wire binding screw and the conductors were wrapped counter-clockwise around the screw shank under the screw head, for 2/3 to 3/4 of wire binding screw circumference.

b) The second receptacle had the conductors installed into one side back terminal (entry hole) of the pressure plate terminal.

c) The third receptacle had two conductors installed into each back-side pressure plate terminal as follows: one conductor of the test circuit into each side (hot and neutral) of the pressure plate terminal and one additional short conductor of equal diameter and material into the other side (entry hole) of the same pressure plate terminal. The second conductor was to fill the slot only and is not required for any other purpose than to balance the mechanical clamping forces applied.

Each receptacle had a shorting plug installed as follows:

a) The ungrounded (BLACK) and grounded (WHITE) contacts of each receptacle being tested were connected together by a mated attachment plug having rigidly-attached solid blades.

b) The terminals of each attachment plug were short-circuited by the shortest feasible length of 14 AWG stranded copper conductor from type SJ flexible cord.

c) The flexible cord shorting conductor was mechanically terminated into the pressure plate terminals and the connection torqued to the manufacturer's specification.

7) The conductor from the neutral terminal of the last receptacle in the series was routed back using the white wire in the NM-B cable, through the wire-splicing devices and terminated at a terminal bar mounted to the support board for connection back to the power supply.

8) All connections were tightened as follows. Torquing tools were calibrated and calibration documented:

a) The circuit breaker terminals were torqued as specified on the circuit breaker nameplate.

b) The wire-splicing devices were torqued to the manufacturer's specification in the instructions. If there was no specification, then the 14 AWG copper-clad aluminum conductors were torqued to 2.47 lbf-in and the 14 AWG coper conductors were torqued to 4.11 lbf-in [Specification from UL 486C – 9.1.9.4]

c) The terminals of the receptacles and of the attachment plugs were torqued to the manufacturer's specification in the installation instructions. If there was no torque specification provided, then the terminals were torqued to 9 lbf-in.

9) Thermocouples were connected as shown in the diagram, figure 1 and as shown in Appendix A photos 8 and 11 through 14.

a) Thermocouples were installed on device terminals so that it did not interfere with the terminal.

For the wire-splicing devices, the thermocouples were attached into the wire bundle within the wire-splicing devices.

b) The thermocouples that measured center wire temperatures had a flap of the NM-B jacket and the conductor insulation peeled back to expose the conductor. The thermocouple was attached with thermo-cement to the conductor and the conductor insulation and jacket flap folded back to the original position with two wraps of black electrical tape wrapped to hold the flap in place.

c) A thermocouple was positioned midway in elevation to the test setup for each circuit and recorded the ambient temperature as testing was completed.

10) The power supply was a programable constant current power supply. The current was monitored and recorded by the data logger along with the temperature recordings. The power supply was connected to the lug on the panelboard bus serving the circuit breaker and to the neutral terminal bar where the return white conductor from the NM-B cable was terminated.

3.0 Materials for Testing

The generous support with the supplying of materials by Copperweld, Eaton, Hubbell, Legrand, Leviton, and Siemens are acknowledged and appreciated. The following materials were used to complete the setups as described above.

1) The circuit breakers for the copper-clad aluminum testing were single pole 10 Amp 120/240 Volt, 10,000 interrupting rating with five (5) each of the following (two (2) breakers to be used and the others as backup):

   a) Eaton BR110,

   b) Schneider QO110, and

   c) Siemens QP110.

2) The circuit breakers for the copper testing were single pole 15 Amp 120/240 Volt, 10,000 interrupting rating with five (5) each of the following (two (2) breakers to be used and the others as backup):

   a) Eaton BR115,

   b) Schneider QO115, and

   c) Siemens QP115.

3) The yellow wire-splicing devices were as follows:

   a) Gardner-Bender Ultra WingGard

   b) Ideal Wing-Twist

   c) 3M Performance Plus Red/Yellow+

   d) Commercial Electric WT4

4) The receptacles for both the copper-clad aluminum and copper testing were:
    a) Eaton (Cooper) model TR6250W, 5-15R single receptacle with wire binding screw and pressure plate terminals (back and side wired)
    b) Hubbell model HBL 5261, 5-15R single receptacle with both wire binding screw and pressure plate terminals (back and side wired)
    c) Legrand (Pass & Seymour) model TR 5251, 5-15R single receptacle with both wire binding screw and pressure plate terminals (back and side wired)
    d) Leviton model T 5015, 5-15R single receptacle with both wire binding screw and pressure plate terminals (back and side wired)
5) Thermocouples, UL calibrated, model UL 3055, with sufficient length to connect and route to datalogger recording device.
6) Datalogger recording device and laptop or another required device for the datalogger.
7) Programable power supplies from Eaton laboratory. Maximum current for the copper was 30 Amps and for the copper-clad aluminum was 20 amps.
8) Approximately 50 feet each of 14-2 w/ground copper-clad aluminum NM-B cable and of 14-2 w/ground copper NM-B cable.
9) Approximately 50 feet each of 14 AWG solid THHN copper-clad aluminum and 14 AWG solid THHN copper single conductors.

4.0 Test Procedures

4.1 Conductor Material Testing

A sample of each the 14-2 NM-B and 14 AWG THHN copper-clad aluminum conductors used for the testing was returned to the Copperweld factory laboratory for analysis. The testing was performed to confirm the conductors that were used for the testing at Eaton were in fact 14 AWG and met the requirements for copper-clad aluminum as specified in UL 83 Annex E and ASTM B566. The packaging was photo documented from the Eaton laboratory and the opening of the package at the Copperweld laboratory photo documented.

The Copperweld laboratory technician, who routinely performs the full ASTM B566 battery of testing, completed all the testing and documented it on a Copperweld laboratory test data sheet.

Standard materials testing was completed by Copperweld laboratory technicians including:

- DC resistance
- Copper thickness
- Copper Volume
- Tensile strength
- Elongation
- Adhesion
- Cohesion

The following tests, as completed by the Copperweld laboratory technician, were witnessed and documented by the UL Field Representative that normally completes follow-up inspections of copper-clad aluminum conductors as part of the recognized component program, under category DVVU2:

- DC resistance
- Copper thickness
- Tensile strength
- Elongation

4.2 Terminal Temperature Testing

The following test procedures, except the flexing test, used references from parts of UL 486(A)(B); UL 486(C); UL 489; UL 20; and UL 498.

As stated, the tests 1 through 4 were completed with all three (3) manufacturer’s circuit breakers in three circuits at one time. These tests are identified with the test number from below with an “a”, “b” or “c’ representing the representative circuit breaker used:

a. mfg. 1 circuit breaker

b. mfg. 2 circuit breaker

c. mfg. 3 circuit breaker

This same nomenclature is used in the data sheets found in Appendix C. To minimize test setups, and the number of times terminations are completed or taken apart, all four (4) static heating tests were completed for the “a”, “b”, and “c” circuit setups. After these tests were completed, then the next setup was assembled by changing the wire splicing devices and receptacles or changing the conductors from copper-clad aluminum to copper as applicable.

All static heating tests, tests 1 through 4 commenced with all components at ambient temperature.

For all testing temperature equilibrium is three consecutive readings taken at no less than 5-minute intervals indicating no further rise in temperature above the ambient temperature. For tests where the circuit breaker trips, which may be before temperature equilibrium was attained, the last three recorded temperatures were recorded onto the data sheets.

Test #1 – Rated Current Temperature

Each circuit was operated at 100% of the branch circuit rating (CCA - 10 Amps or Cu - 15 Amps) until temperature equilibrium was achieved. The final temperatures were recorded. All terminations were inspected for evidence of thermal damage. Temperature measurements were recorded at one-minute intervals.

Test #2 – Circuit Breaker Overload Temperature

Each circuit was operated at 135% of the branch circuit rating (CCA - 13.5 Amps or CU - 20.25 Amps) until temperature equilibrium was achieved or the circuit breaker tripped whichever came first. The circuit breaker elapsed trip time was recorded. Table 1, in section 4.3 below, provides the expected circuit breaker trip times from the manufacturer's time current curves. If the circuit breaker tripped, the last three recorded temperatures of the conductor, wire-splicing devices and wiring device were recorded on the datasheet. All terminations were inspected for evidence of thermal damage. Temperature measurements were recorded at 20-second intervals.

Test #3 – Wiring Device Overload Temperature

Each circuit was operated at 150% of the branch circuit rating (CCA - 15 Amps, or CU - 22.5 Amps) until temperature equilibrium was achieved or the circuit breaker tripped whichever came first. The circuit breaker elapsed trip time was recorded. Expected circuit breaker trip times are in a table 1 below in section 4.3 of procedure. If the circuit breaker tripped, the last three recorded temperatures of the conductor, wire-splicing devices and wiring device were recorded on the datasheet. All terminations were inspected for evidence of thermal damage. Temperature measurements were recorded at 10 second intervals.

Test #4 – Circuit Breaker Overload Temperature

Each circuit was operated at 200% of the branch circuit rating (CCA - 20 Amps, or CU 30 Amps) until temperature equilibrium was achieved or the circuit breaker trip tripped whichever came first. The circuit breaker elapsed trip time was recorded. Expected circuit breaker trip times are in a table 1 below in section 4.3 of procedure. If the circuit breaker tripped, the last three recorded temperatures of the conductor, wire-splicing devices and wiring device were recorded on the datasheet. All terminations were inspected for evidence of thermal damage. Temperature measurements were recorded at 7 second intervals.

Test #5 – Wiring Device Thermal Cycling

The thermocycling testing is underway at the time this report is being written. In order to meet NFPA public input deadlines, this report is for all testing completed at this time. A subsequent report will be written for the thermocycling testing.

Test # 6 – Conductor Flexing Test

a) A standard 2 x 3 device box was mounted to a wood stud fixed to a table for support. See Appendix A photo 15. The device box was mounted with screws through the back of the box.

b) A length of 14-2 AWG copper-clad aluminum NM-B cable was installed into the device box using NM cable clamps. The NM-B had a minimum of 1/4 inch of cable jacket projecting into the box past the clamping device.

c) The outside end of the NM-B cable was connected to a digital multimeter to indicate continuity of the circuit through the receptacle, see Appendix A photo 16.

d) The NM-B cable jacket was stripped and cut to length so that 6 inches of conductor projected beyond the cable entry to the box and 3 inches beyond the front edge of the device box. A receptacle was terminated to the NM-B cable conductors and the conductors shaped to fit back in the box so the receptacle yoke mated with the box front edge.

e) For the first test, the NM-B conductors were installed using the wire binding screw with the conductors wrapped counter-clockwise around the screw shank under the screw head, for 2/3 to 3/4 of wire binding screw circumference.

f) A shorting plug was installed into the receptacle.

g) The 6-32 screws were removed and approximately 4-inch-long 10-32 screws were fixed to the device box ears and through the yoke of the receptacle providing a guideway for repeated insertion and removal. The 10-32 screws had nuts installed in the inside and outside of the device box ears to make rigid to the box, see Appendix A photo 15.

h) With the assembly complete, the receptacle was pushed into and retracted from the box for 10 cycles and the continuity monitored on the digital multimeter, see Appendix A photos 17 through 19.

i) Steps 'b' through 'h' were repeated two more times with new lengths of 14-2 NM-B copper-clad aluminum cable.

    - For the second test the receptacle was assembled with the back-wiring pressure plate terminal and a single conductor.
    - For the third test the receptacle was assembled with the back-wiring pressure plate terminal and two conductors for mechanical balance on the wiring terminal.

4.3 Bimetallics Testing Circuit Breaker Trip Times

The below table provides the expected trip times based on the manufacturers time current curves at 40°C. The testing for this project was completed at about 22°C, based on the ambient temperatures recorded. Therefore, the trip times recorded from this testing may be somewhat higher but should not exceed the limits set in the UL Standard.

The UL standard specifies that calibration testing be competed at an ambient temperature of 25°C. The UL standard calibration testing at 25°C specifies that at:

- 135% of rating the maximum trip time for a 0 - 50-amp circuit breaker is 1 hour
- 200% of rating the maximum trip time for a breaker 0 – 30 amps is 2 minutes.

Table 1

Manufacturer	Catalog No.	Trip Time Range in Seconds @ 40°C			
		100% rated current	135% rated current	150% rated current	200% rated current
Eaton	BR110	No trip	35 - 3600	20 - 500	12 - 40
	BR115	No trip	35 - 3600	20 - 500	12 - 40
Schneider	QO110	No trip	40 - 500	26 - 240	10 - 60
	QO115	No trip	30 - 210	21 - 100	8 - 28
Siemens	QP110	No trip	60 -800	40 - 450	19 - 150
	QP115	No trip	30 - 250	20 - 100	9 - 38

5.0 Test Results

5.1 Copper-Clad Aluminum Conductor Material Testing

After the static heating testing was completed, Eaton laboratory technicians packed and shipped samples of the copper-clad aluminum conductor, NM-B cable and THHN single conductor, that had been used for the testing to Copperweld's laboratory for verification testing. Appendix A photos 22 to 24 show the samples the Eaton laboratory technicians packaged into the bag and shipped to the Copperweld laboratory. Note the date on these photos as August 24, 2020. Appendix B pages B1 and B2 show photos of the received package and opening of that package with these samples for the testing.

The samples of the 14 AWG copper-clad aluminum NM-B cable and the 14 AWG copper-clad aluminum THHN single conductors were tested in the Copperweld factory laboratory on August 27, 2020. The Copperweld laboratory testing data is provided in Appendix B page B3 and the calibration of the test equipment on pages B4 through B6.

The UL field engineer that routinely completes the quarterly follow-up inspections for the copper-clad aluminum conductor witnessed the testing required under the UL standard follow-up program that was completed on August 27, 2020. As shown in Appendix B, page B7, the UL field engineer confirmed that "*the 14 Awg from the NMB and THHN samples passed the UL tests for DVVUs, including Tensile, Elongation, copper thickness and DC resistance*"

The test results for the copper-clad aluminum confirm that the conductors used for this testing were 14 AWG and that the material tested met the requirements in ASTM B566.

5.2 Test Setup and Torquing

The test setups were as described in Section 2.0 of this report and shown with photographs in Appendix A. The terminations were tightened to the applicable torque value with a calibrated torque wrench. For the static heating testing the following tables show the torque values applied for each setup and device terminal.

Copper-Clad Aluminum conductors with mfg. 11 and mfg. 8 Receptacles

Torques applied:

Item being torqued	in/lbs	mfr. spec	default
mfg. 1 brkr	20	yes	no
mfg. 2 brkr	36	yes	no
mfg. 3 brkr	25	yes	no
mfg. 4 wire splicing device	2.47	no	yes
mfg. 5 wire splicing device	2.47	no	yes
mfg. 11 receptacles	9	no	yes
mfg. 8 receptacles	12	yes	no

Copper-Clad Aluminum conductors with mfg. 10 and mfg. 9 Receptacles

Torques applied:

Item being torqued	in/lbs	mfr. spec	default
mfg. 1 brkr	20	yes	no
mfg. 2 brkr	36	yes	no
mfg. 3 brkr	25	yes	no
mfg. 6wire splicing device	2.47	no	yes
mfg. 7 wire splicing device	2.47	no	yes
mfg. 10 receptacles	9	no	yes
mfg. 9 receptacles	9	no	yes

Copper conductors with mfg. 11 and mfg. 8 Receptacles

Torques applied:

Item being torqued	in/lbs	mfr. spec	default
mfg. 1 brkr	20	yes	no
mfg. 2 brkr	36	yes	no
mfg. 3 brkr	25	yes	no
mfg. 4 wire splicing device	4.11	no	yes
mfg. 5 wire splicing device	4.11	no	yes
mfg. 11 receptacle	9	no	yes
mfg. 8 receptacle	12	yes	no

Copper conductors with mfg. 10 and mfg. 9 Receptacles

Torques applied:

Item being torqued	in/lbs	mfr. spec	default
mfg. 1 brkr	20	yes	no
mfg. 2 brkr	36	yes	no
mfg. 3 brkr	25	yes	no
mfg. 6wire splicing device	4.11	no	yes
mfg. 7 wire splicing device	4.11	no	yes
mfg. 10 receptacle	9	no	yes
mfg. 9 receptacle	9	no	yes

5.3 Static Heating Test

The following are the results of the static heating testing, tests 1 through 4 with references to the applicable appendix pages. For all the testing data, the final three recorded temperature values are shown at either temperature equilibrium or the final three temperatures recorded before a circuit breaker tripped. All testing commenced with all test measurement points at ambient temperature. Also shown in the tables in the appendix are:

- The elapsed time from the start of the test,
- The ambient temperature recorded at the time of the recorded values, and
- The current at the time of the recorded values.

Since the UL standards reference temperature rise for most of the devices, those calculated values are shown immediately adjacent to the recorded values. The temperature rise was calculated by taking the recorded temperature and subtracting the ambient temperature recorded for that time.

Since the method of termination on each the three receptacles from one manufacturer was different (wire binding screw, back wired with pressure plate with one conductor and back wired with pressure plate with two conductors) exact data comparison of terminal temperature needs to be done line by line. For example, from appendix page C1 – 1, the line 1a for copper-clad aluminum, top table, needs to compare with line 1a for copper, bottom table.

Otherwise, data in general for terminal temperatures of specific devices, circuit breakers, wire splicing devices and receptacles as well as the conductor, can be compared in general. To facilitate ease of comparison, the pages in appendices C1 though C4 have been arranged so that each page has the copper-clad aluminum data in the top table and the related copper data in the bottom table.

5.3.1 Static Heating at 100% Rated Current

The data for the static heating testing at 100 percent of rated current are shown in Appendix C1. The recorded values are all after the temperatures being recorded had achieved temperature equilibrium. As can be seen in line by line or with general comparisons, the terminal and conductor temperatures for the copper-clad aluminum were less than those recorded for copper when operating at rated current. All temperatures recorded were less than the allowances in the applicable UL standards.

5.3.2 Static Heating at 135% Rated Current

The data for the static heating testing at 135 percent of rated current are shown in Appendix C2. The 135 percent current level is a calibration point for circuit breakers, rated up to 50 amps, where they are required to trip within 1 hour. The recorded values are the last three recorded temperatures before the circuit breaker tripped.

In doing analysis consideration must be given to the fact the temperatures recorded were still rising when the circuit breaker tripped. Therefore, when doing line by line or general comparisons, the circuit breaker trip time must be considered. It is noted the mfg. 1 10-amp circuit breaker tripped approximately twice as fast as the 15-amp circuit breaker, 8 vs. 19 seconds, and this resulted in higher recorded temperatures for copper. The test results with the mfg. 2 circuit breakers was reversed with the 15-amp breaker tripping in approximately half the time of the 10-amp circuit breaker, 3.5 vs. 5.5 seconds. Even with this time disparity the copper-clad aluminum with the longer time recorded lower temperatures than the copper. The trip times for the mfg. 3 circuit breakers had the 10-amp breaker tripping 3 times longer than the 15-amp breaker, but the copper-clad aluminum terminal temperatures still were less than or near to the copper terminal temperatures.

All temperatures recorded were less than the allowances in the applicable UL standards.

5.3.3 Static Heating at 150% Rated Current

The data for the static heating testing at 150 percent of rated current are shown in Appendix C3. The 150 percent current level is a static heating test current for wiring devices. The recorded values are the last three recorded temperatures before the circuit breaker tripped.

In doing analysis consideration must be given to the fact the temperatures recorded were still rising when the circuit breaker tripped. Therefore, when doing line by line or general comparisons, the circuit breaker trip time must be considered. The test data results shown in appendix C3 generally follow that same pattern as occurred with the 135 percent testing.

All temperatures recorded were less than the allowances in the applicable UL standards.

5.3.4 Static Heating at 200% Rated Current

The data for the static heating testing at 200 percent of rated current are shown in Appendix C4. The 200 percent current level is a calibration point for circuit breakers, rated up to 30 amps, where they are required to trip within 2 minutes. The recorded values are the last three recorded temperatures before the circuit breaker tripped.

In doing analysis consideration must be given to the fact the temperatures recorded were still rising when the circuit breaker tripped. Therefore, when doing line by line or general comparisons, the circuit breaker trip time must be considered. The test data results shown in appendix C4 generally follows the same pattern as occurred with the 135 percent and 150 percent testing.

All temperatures recorded were less than the allowances in the applicable UL standards.

5.3.5 Static Heating at 135% Rated Current – Circuit Breaker Did Not Trip

The first attempt at the 135 percent testing found the mfg. 2 10-amp circuit breaker not to trip within the required 1-hour time. The data for this static heating test at 100 percent and at 135 percent of rated current are shown in Appendix C5. The top table on this appendix page is the 100 percent test data and the bottom table is the 135 percent test data. As stated before, the 135 percent current level is a calibration point for circuit breakers, rated up to 50 amps, where they are required to trip within 1 hour.

Since the circuit breaker failed to trip the test was stopped shortly after the 1-hour time had elapsed. Analysis of the 135 percent data recorded found that after 1-hour at this current level, above the proposed rated current, none of the terminal or conductor temperatures had risen above UL standards allowances.

5.3.6 Flexing Tests

The data for the flexing testing is shown in Appendix D. There is no UL or other known industry standard for this specific test and the test process used was established and agreed to by the task group to represent an installation condition. Three tests were conducted, one with the receptacle terminated with the 14 AWG copper-clad aluminum wrapped around the wiring binding screw, the second with a single conductor back wired into the pressure plate and the third with two conductors back wired into the pressure plate.

The test results found that after 10 cycles of fully inserting and removing the receptacle to the full extended position, the copper-clad aluminum conductors for the back wired assemblies did not break and therefore passed this test.

For the wire binding screw termination, the first test found the flexing for the 10 cycles passed where the conductors did not break. But when the conductors were being removed both the black and white conductors broke off near the end of the insulation, see Appendix A photo 20. A second test was conducted and the black conductor was found to break off near the end of the insulation on the eighth cycle. A third test was completed, using a 14 AWG NM-B sample from another coil, and this assembly passed the 10 cycles and removal of conductors with no breaking or signs of weakening in the stripped portion of the conductor, see Appendix A photo 21.

As stated, there is no industry standard for completing this flexing test and the test was conducted due to specific questions asked by members of the task group. The results demonstrate that there may be limits to the amount of flexing these conductors can withstand, but it should be noted that in normal installations the insertion and removal of a wiring device occurs far less than the eight to ten times as conducted in this test.

6.0 Conclusions

The results from the temperature testing conducted in this project found the 14 AWG copper-clad aluminum to have terminal and conductor temperatures generally less than copper when tested at the 60°C ampacity values. In all cases, the temperature and temperature rise recorded were below those provided in the referenced UL standards. The flexing testing found that there may be some limitations to the number of flexing operations a 14 AWG copper-clad aluminum conductor can withstand, but the number of flexing operations to breakage is above those normally encountered in any installation.

As stated in the introduction, this testing project was to answer specific questions raised by the Bimetallics Task Group regarding temperature performance of 14 AWG copper-clad aluminum compared with 14 AWG copper in typical applications. **While testing conducted followed parts of several UL standards, it is to be understood the testing was only conducted to provide specific performance data and information as requested by the task group. The testing does not provide performance or data for certification of any of the components used for the testing.**

7.0 Test Equipment and Calibration

The following test and measurement equipment was used for the testing. The certificates of calibration for each of the above items is provided in Appendix E.

Description	manufacturer	Eaton Asset #	Cal Date	Cal Due
Thermocouples	Pacific Test and Measurement	N/A	7/10/2020	N/A
DACQ datalogger	Agilent (HP)	EM7054	7/16/2020	7/16/2021
DVM	Fluke	EM4437	7/16/2020	7/16/2021
DVM	Fluke	EM7014	7/16/2020	7/16/2021
DVM	Fluke	EM7024	7/16/2020	7/16/2021
CT	AEMC	EM6996	7/16/2020	7/16/2021
CT	AEMC	EM6997	7/16/2020	7/16/2021
CT	AEMC	EM8032	7/16/2020	7/16/2021
Torque wrench	CDI	EM8363	7/14/2020	7/14/2021
Tape measure	Stanley	EM6927	7/16/2020	7/16/2021

Appendix A - Photos

Photo 1 – Laboratory View

Photo 2 – Test Board and Test Equipment Arrangement

Appendix A - Photos

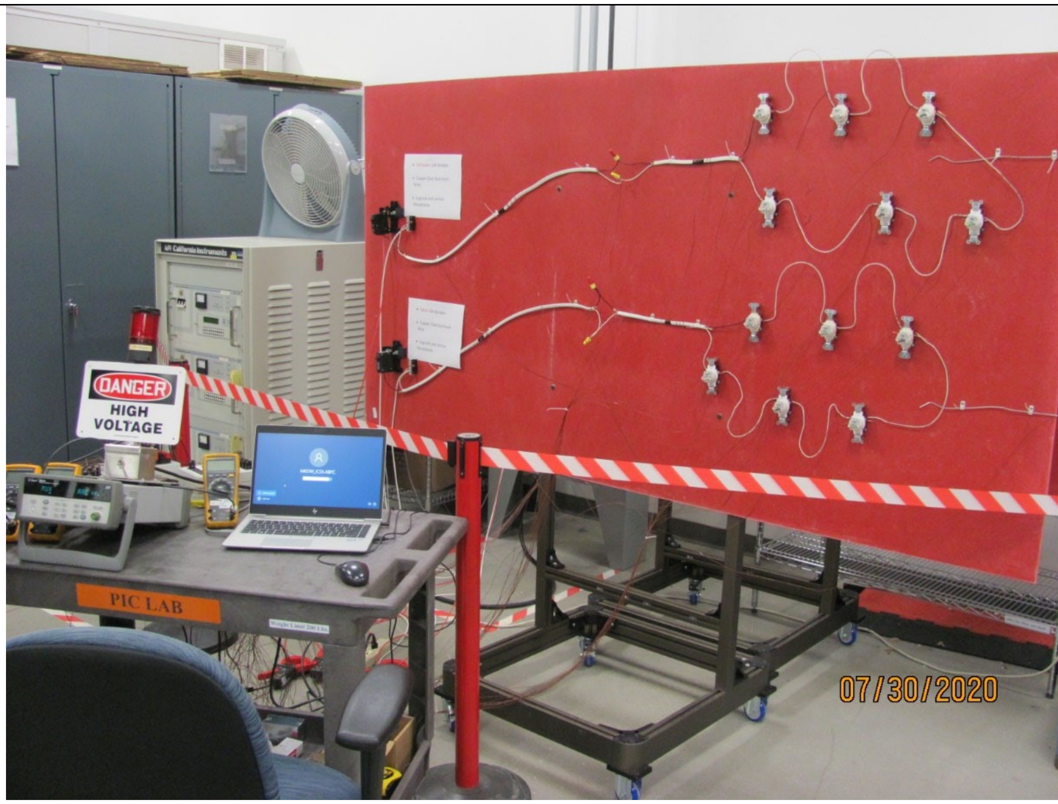


Photo 3 – Test Board and Test Equipment Arrangement

Photo 4 – Copper-Clad Aluminum with Eaton and Hubbell Receptacles

Appendix A - Photos

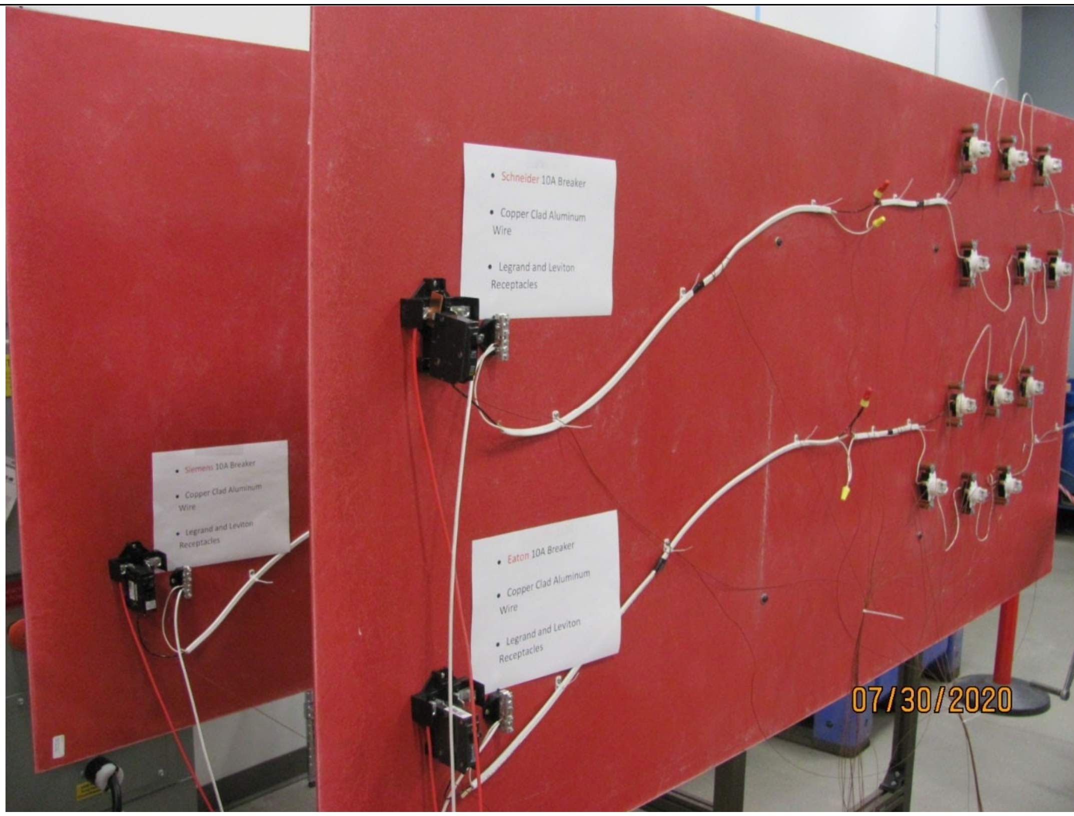


Photo 5 – Copper-Clad Aluminum with Legrand and Leviton Receptacles

Photo 6 – Copper with Eaton and Hubbell Receptacles

Photo 7 – Copper with Legrand and Leviton Receptacles

Photo 8 – Copper-Clad Aluminum NM-B Cable

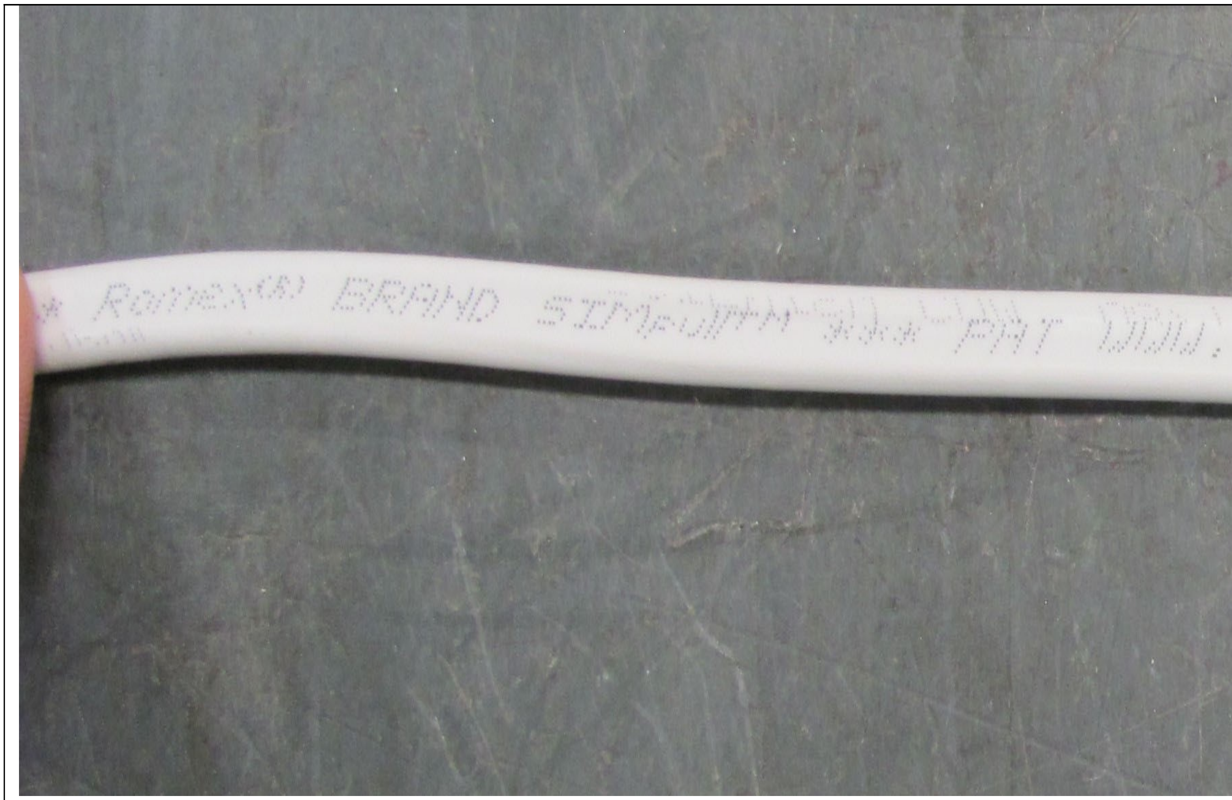


Photo 9 – Copper NM-B Cable

Photo 10 – Copper NM-B Cable Packaging

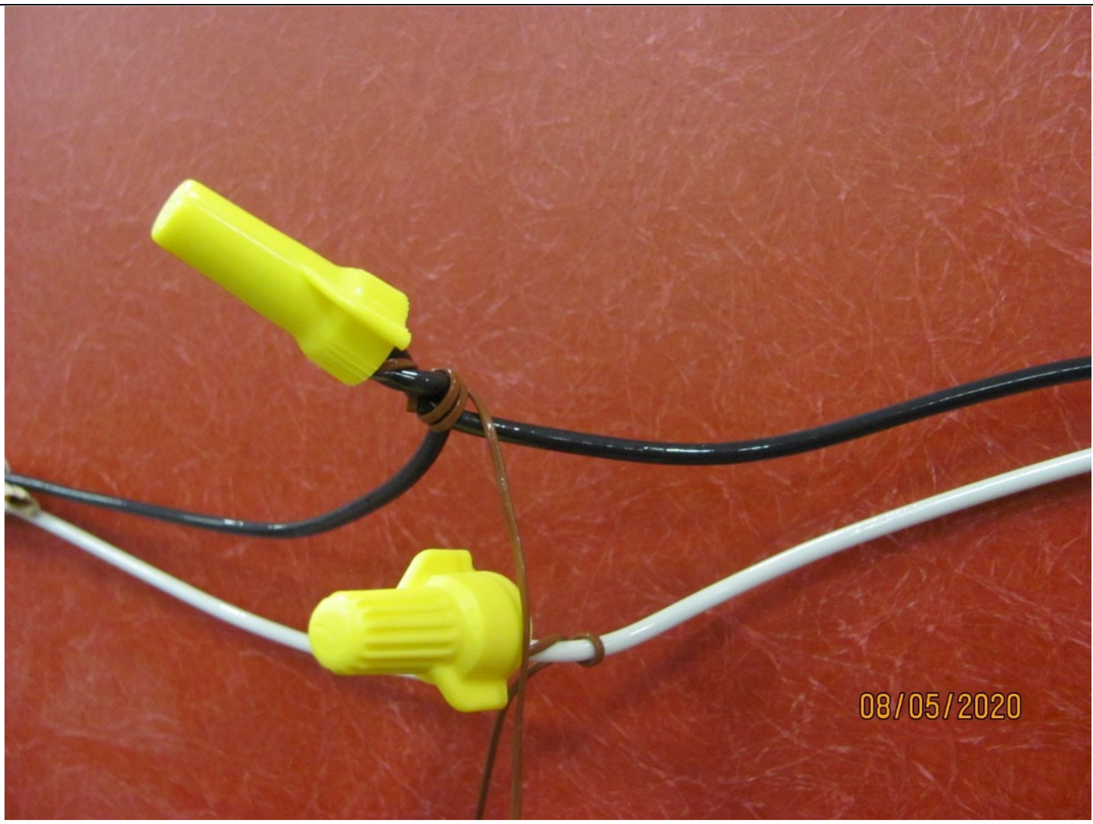


Photo 11 – Typical Installation of Wire Splicing Devices with Thermocouple

Photo 12 – Typical Installation of Receptacle using Wire Binding Screw

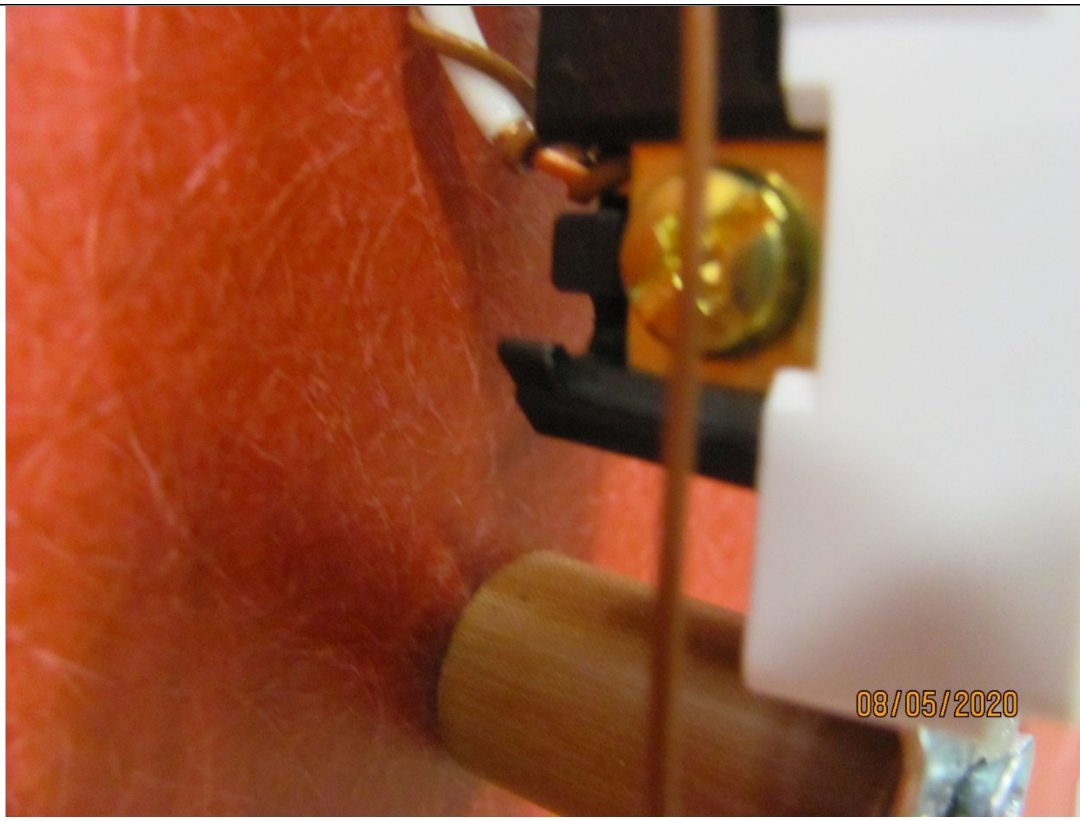


Photo 13 – Typical Installation of Receptacle Since Conductor Back Wired

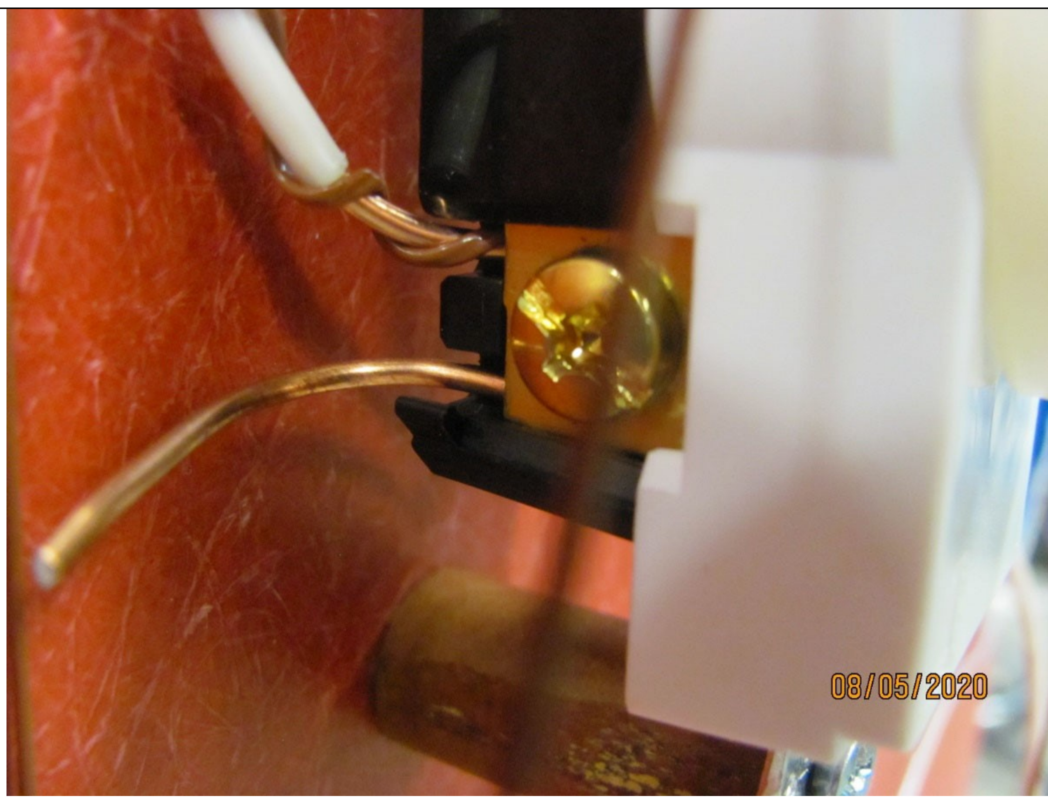


Photo 14 – Typical Installation of Receptacle Two Conductors Back Wired

Appendix A - Photos

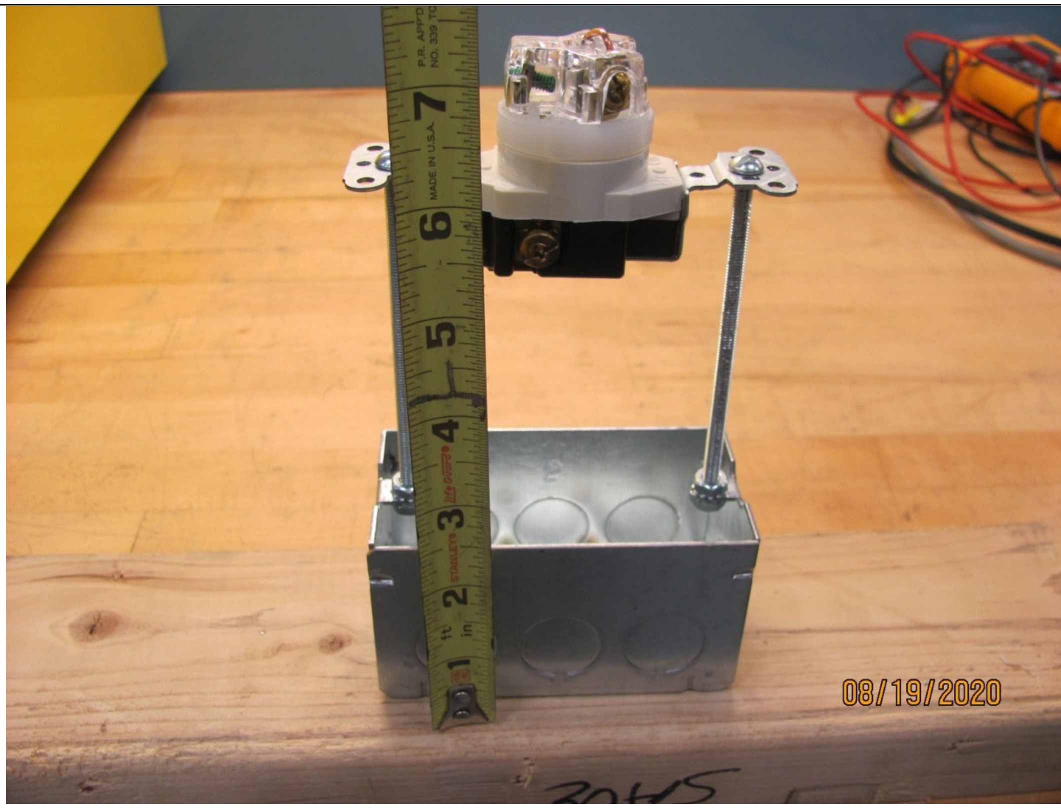


Photo 15 – Flexing Test Setup

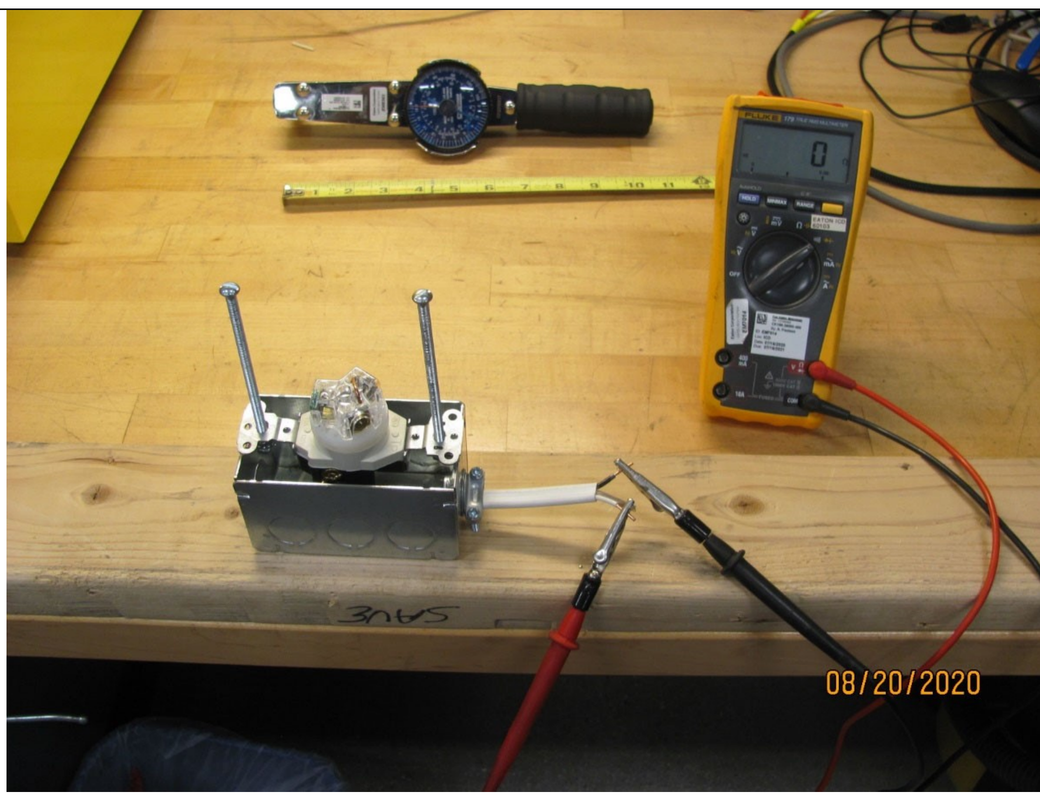


Photo 16 – Flexing Test Setup

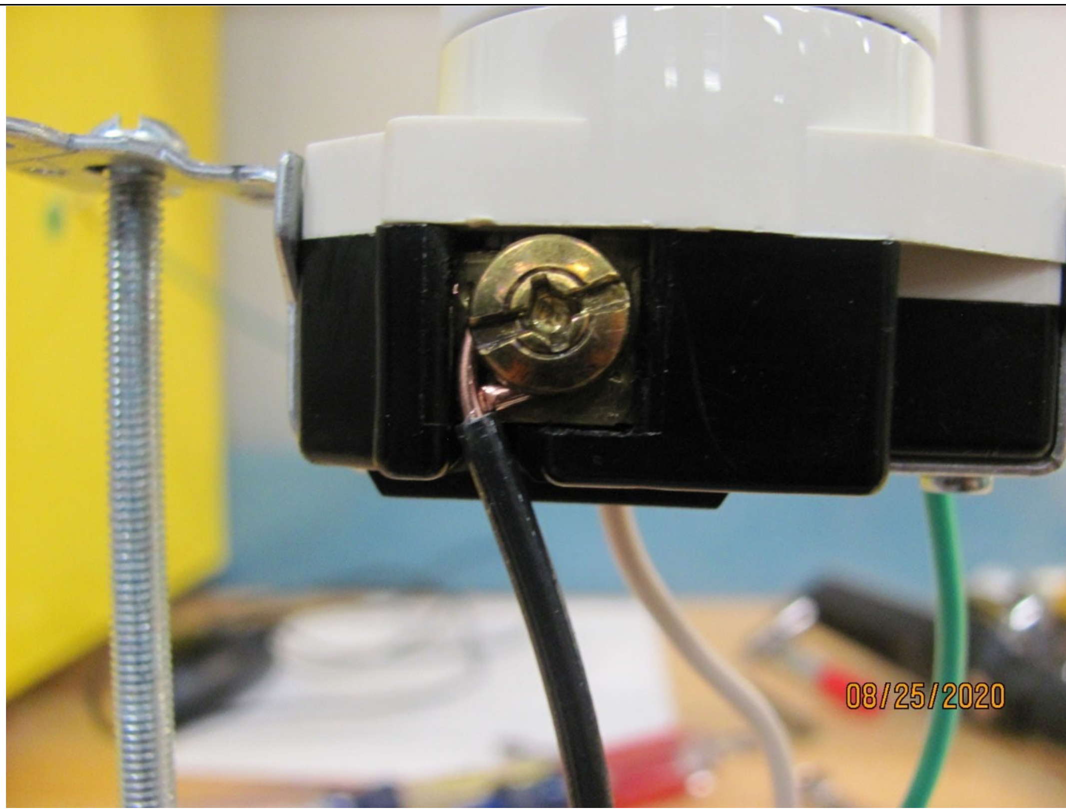


Photo 17 – Flexing Test Fully Extended

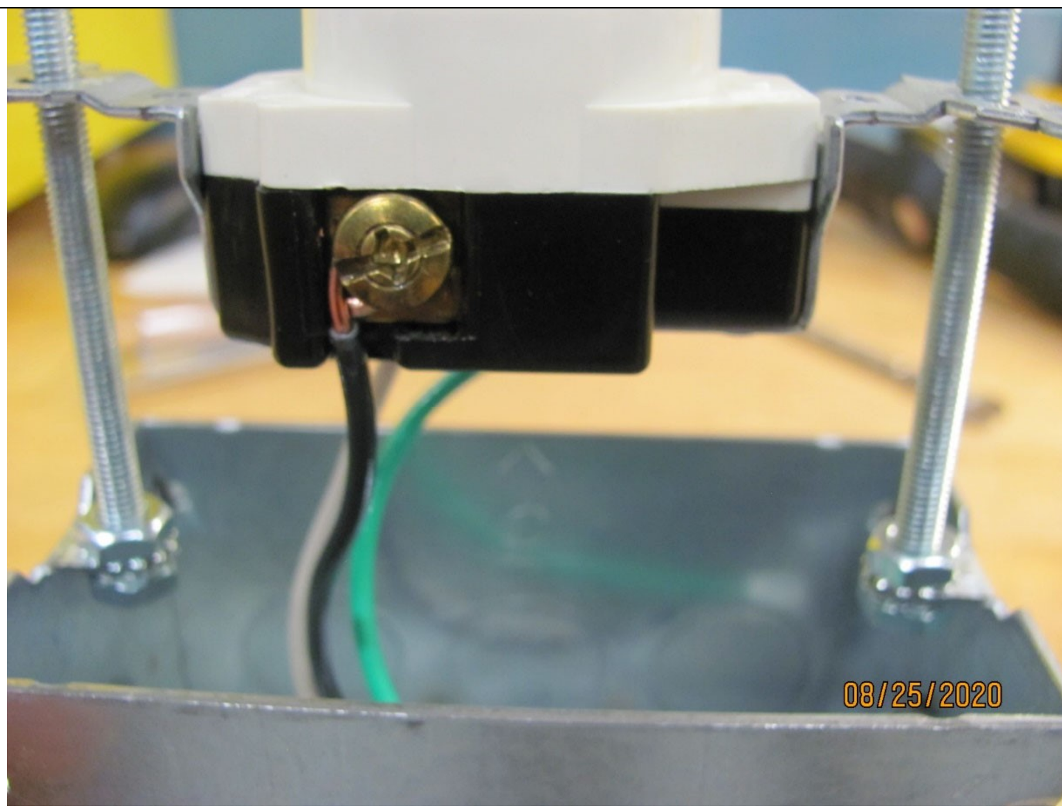


Photo 18 – Flexing Test Partial Insertion

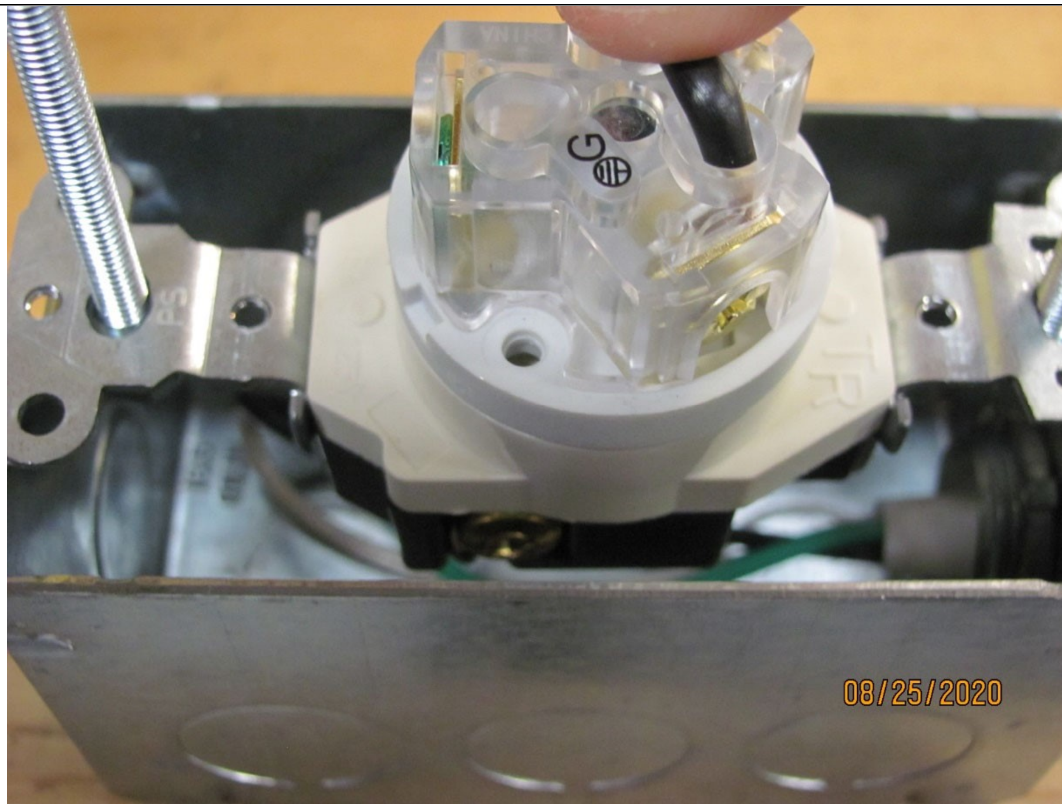


Photo 19 – Flexing Test Fully Inserted

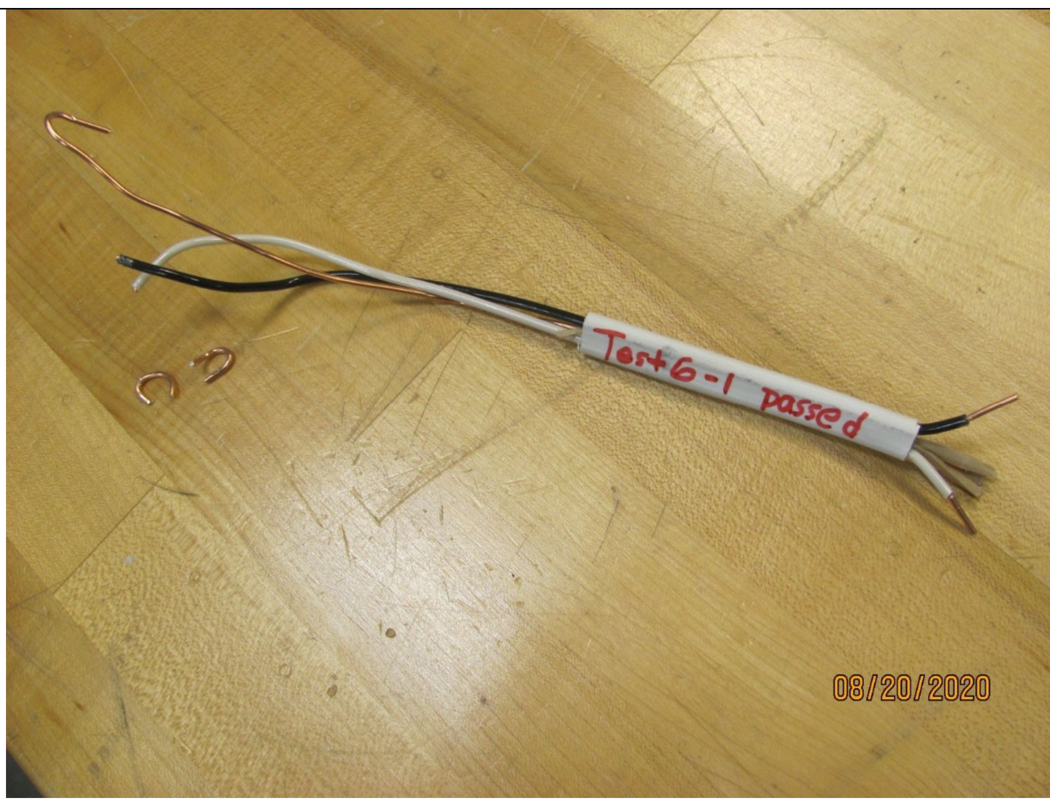


Photo 20 – Flexing Test Broken Conductors When Removing

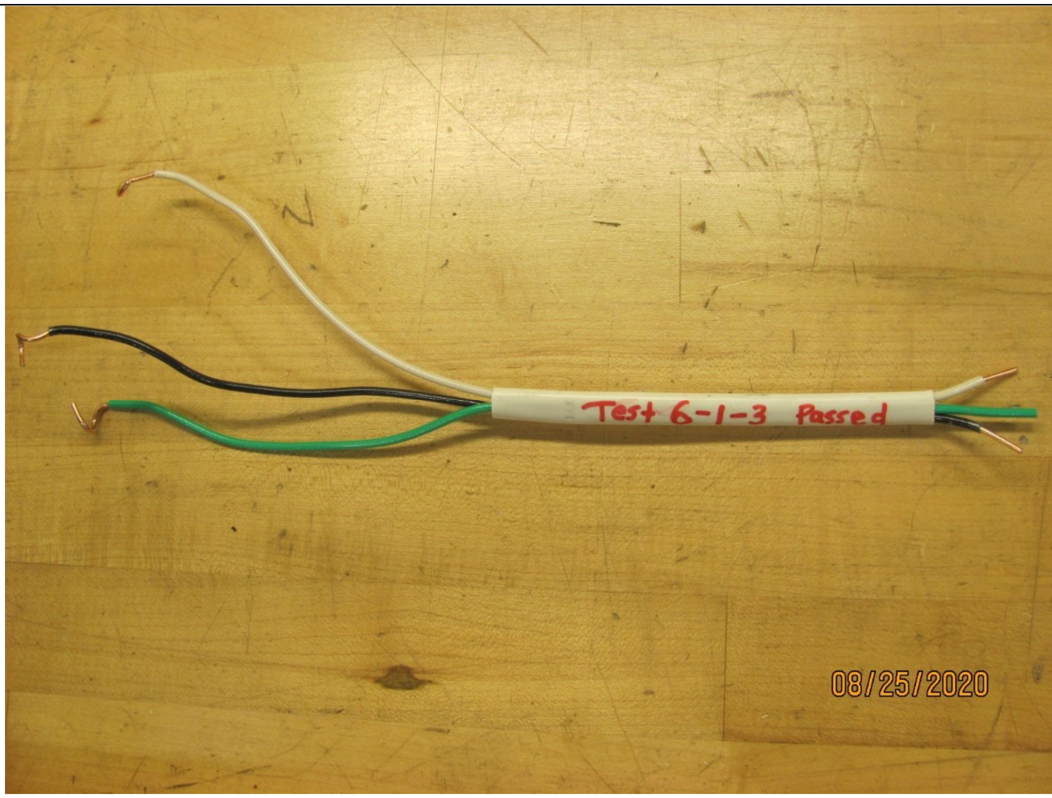


Photo 21 – Flexing Test Repeat No Conductor Breakage

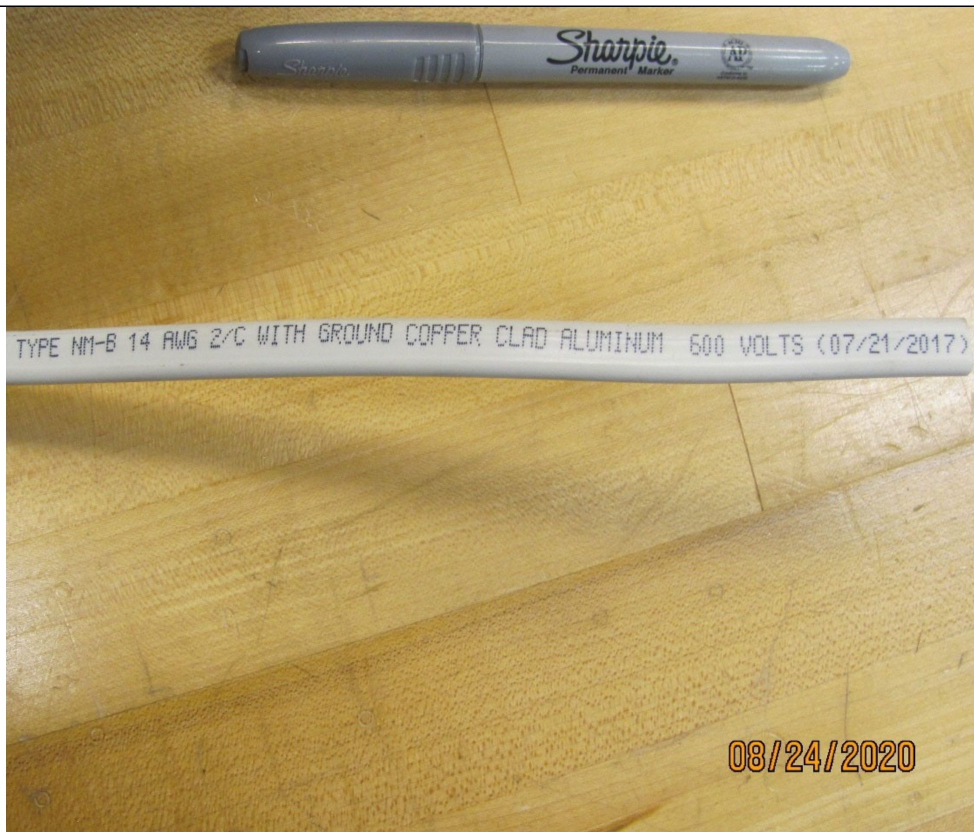


Photo 22 – Copper-Clad Aluminum NM-B Sample Packaging at Eaton

Photo 23 – Copper-Clad Aluminum THHN Sample Packaging at Eaton

Photo 24 – Copper-Clad Aluminum Sample Packaging at Eaton

Appendix B - Copper-Clad Aluminum Lab Report

The power of two

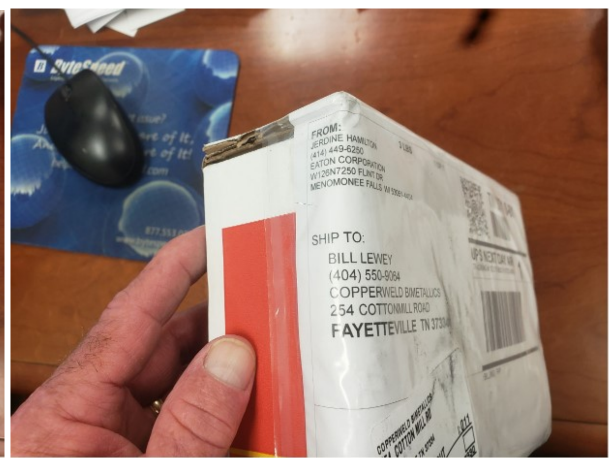
Metallurgical Laboratory Report

Customer:	**NEC Bimetallics Task Group**		
Subject:	**14 AWG Building Wire—NMB and THHN**		
Date:	**8-27-2020**	**Report No:**	**456**

Analysis By:	**Sammy Hampton --Metallographer**
Authored By:	**Sammy Hampton –Metallographer**
Approved By:	**Bill Lewey– QA Manager**

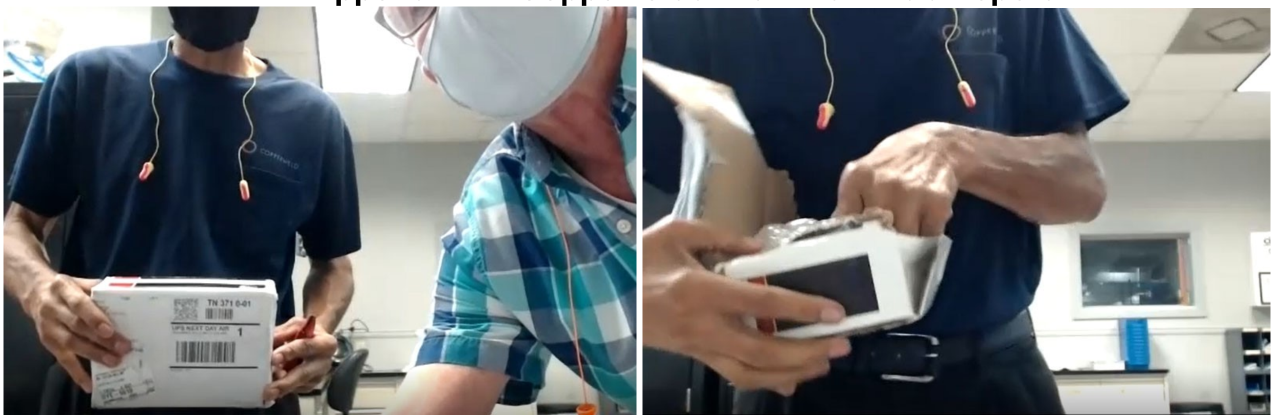
Tested to ASTM Designation: B 566-- 04a

The NM and THHN class samples in this report were sent to Copperweld via a sealed package by Eaton Menomonee Falls test lab. The chain of custody was not broken. The testing was witnessed by a third party as part of routine auditing service. The witnessing session was recorded. The copper clad aluminum conductor material from these samples that was tested on August 27, 2020 by the Copperweld Metallurgical Lab was manufactured by Copperweld Bimetallics to ASTM B566 standards.



Package as received from Eaton

Appendix B - Copper-Clad Aluminum Lab Report



Opening the Package

Package Contents

Appendix B - Copper-Clad Aluminum Lab Report

The wire consists of a core of aluminum with a continuous outer cladding of copper metallurgically bonded to the core throughout and meets the requirements of this specification (5.1).

Test required	**Test result**	**ASTM B 566 requirement**	**Result**
Diameter	**0.0641”**	**± 0.0001 0.0640” minimum 0.0642” maximum**	**Pass**
Break load (lbs.)	55 pounds	64.4 pounds maximum	**Pass**
Tensile strength (psi)	17195 psi	20000 (psi) maximum	**Pass**
% elongation	22.78%	15.0% minimum	**Pass**
Copper thickness (minimum)	0.00148” = 4.6% of wire radius	minimum copper thickness= 3.5% of wire radius	**Pass**
Copper volume	10.05%	8% minimum 12% maximum	**Pass**
Adhesion test	No separation (see attached image 1)	The wire shall be repeatedly reverse bent to fracture by any convenient means. The copper clad aluminum wire shall be free from cladding delamination.	**Pass**
Cohesion test	No seams or splits (see attached images 2 and 3)	The copper clad aluminum wire shall be free from seams or splits	**Pass**

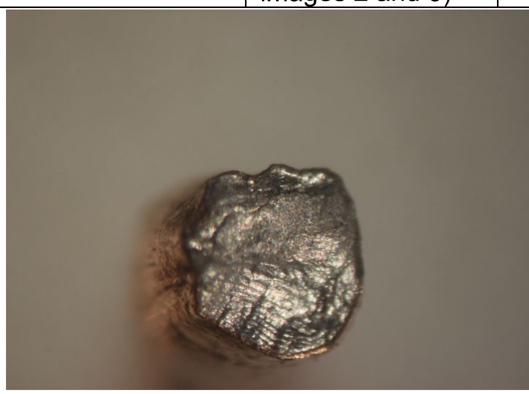


Image 1: adhesion test

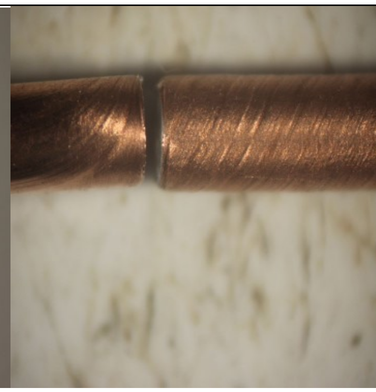


Image 2: cohesion test (torsion)

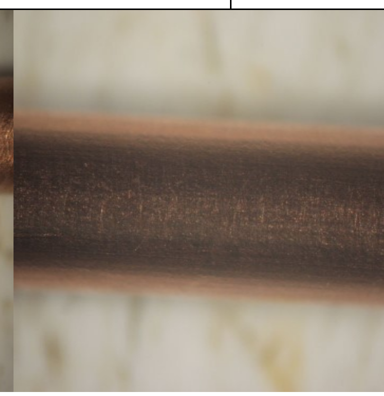


image 3: cohesion test (reverse torsion)

Test and measurement equipment

Equipment	**Gauge ID**	**In calibration**	**Next due calibration**
Micrometer	**CP-01**	**Yes**	**April 2021**
Tensile tester	**1755-2000**	**Yes**	**January 2022**
Ohmmeter	**62-1625**	**Yes**	**December 2020**
Calibration Certificates Attached below			

PRECISION CALIBRATION SYSTEMS

107 N Porter St
Winchester, TN 37398
E-mail: info@pcsllctn.com
Phone: 866-521-3823
Website: www.pcsllctn.com

INSTRUMENT CALIBRATION REPORT

PJLA Calibration Accreditation# 73403

Copperweld

Instrument ID CP-01
Description Micrometer
Calibrated 8/3/2020
Performed At Customer Location

Manufacturer Mitutoyo
Model Number 293-344-30
Serial Number 66936496
Cal Procedure QS0003JB2010

Location Main
Building 254 Cotton Mill Rd. Fayetteville, TN 37334
Department Quality
Status In Service

Frequency Semi-Annual
Certificate # CO080320JM-03
Temp 73°F
Humidity 59%

Calibration Specifications

Group # 1
Group Name OD

Nom In Val / In Val	In Type	Std Accy	Acc %	+/-	Out Val	Out Type	Fnd As	Lft As	In Tol
0.25000 / 0.25000	Inch	Plus / Minus	0.000000	±0.00010	0.25000	Inch	0.25000	0.25000	Yes
0.50000 / 0.50000	Inch	Plus / Minus	0.000000	±0.00010	0.50000	Inch	0.50000	0.50000	Yes
1.00000 / 1.00000	Inch	Plus / Minus	0.000000	±0.00010	1.00000	Inch	1.00000	1.00000	Yes

Test Instruments Used During the Calibration

Test Instrument ID	Description	Manufacturer	Model Number	Serial Number	(As Of Cal Entry Date) Last Cal Date	Next Cal Date
Z-GA-010 GAGE BLCK SET STD SHOP	Gage Block 81pc Set Standard	China	Rectangular Steel	E1599	4/8/2016	4/30/2021

Notes about this calibration

Uncertainty = ± (64.9+5.2L) µin (95%CL; K=2)

Calibration Result Calibration Successful
Who Calibrated James Meadows
Finalized By James Meadows
Date Finalized 8/3/2020 9:19:05AM

Total expanded measurement uncertainties expressed are based on a confidence level of 95%; coverage factor of (k=2). Decision Rule: The statement of compliance in this certificate was issued without taking the uncertainty of measurement into consideration. The customer shall assess the results and uncertainty when determining if the results meet their needs. This is considered "shared responsibility." This calibration was conducted using standards traceable to the SI through NIST. The results on this certificate of accuracy apply only to the item described above. Accredited to ISO/IEC 17025: 2017.

Laboratory Authorized Signature

Revision Date:05/08/2020
Rev: 04

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PCS PRECISION CALIBRATION SYSTEMS
107 N Porter St
Winchester, TN 37398
E-mail: info@pcsllctn.com
Phone: 866-521-3823
Website: www.pcsllctn.com

INSTRUMENT CALIBRATION REPORT

Copperweld

Instrument ID 1755-2000
Description Tensile Tester (2 Load cells)
Calibrated 8/4/2020 **Performed At** Customer Location

Manufacturer	Thwing-Albert Instruments	**Location**	Main	**Frequency**	Semi-Annual
Model Number	EJA	**Building**	254 Cotton Mill Rd. Fayetteville, TN 37334	**Certificate #**	CO080420JM-13
Serial Number	1755-2000	**Department**	Quality	**Temp**	70°F
Cal Procedure	QS0033BG2013	**Status**	In Service	**Humidity**	57%

Calibration Specifications

Group # 1
Group Name 0-11lb Load Cell 627022

Nom In Val / In Val	In Type	Std Accy	Acc %	+/-	Out Val	Out Type	Fnd As	Lft As	In Tol
1 / 1	lbf	Pct of Range	0.500000	0.00	1.00	lbf	1.01	1.01	Yes
2 / 2	lbf	Pct of Range	0.500000	0.00	2.00	lbf	2.01	2.01	Yes
3 / 3	lbf	Pct of Range	0.500000	0.00	3.00	lbf	3.01	3.01	Yes
5 / 5	lbf	Pct of Range	0.500000	0.00	5.00	lbf	5.02	5.02	Yes
7 / 7	lbf	Pct of Range	0.500000	0.00	7.00	lbf	7.03	7.03	Yes
10 / 10	lbf	Pct of Range	0.500000	0.00	10.00	lbf	10.04	10.04	Yes

Group # 2
Group Name 0-225 lb Load cell 608236

Nom In Val / In Val	In Type	Std Accy	Acc %	+/-	Out Val	Out Type	Fnd As	Lft As	In Tol
5 / 5	lbf	Pct of Range	0.500000	0.00	5.00	lbf	5.00	5.00	Yes
20.446 / 20.446	lbf	Pct of Range	0.500000	0.00	20.45	lbf	20.48	20.48	Yes
50.414 / 50.414	lbf	Pct of Range	0.500000	0.00	50.41	lbf	50.48	50.48	Yes
88.532 / 88.532	lbf	Pct of Range	0.500000	0.00	88.53	lbf	88.64	88.64	Yes
99.044 / 99.044	lbf	Pct of Range	0.500000	0.00	99.04	lbf	99.15	99.15	Yes
117.60 / 117.60	lbf	Pct of Range	0.500000	0.00	117.60	lbf	117.73	117.73	Yes
131.71 / 131.71	lbf	Pct of Range	0.500000	0.00	131.71	lbf	131.83	131.83	Yes
151.04 / 151.04	lbf	Pct of Range	0.500000	0.00	151.04	lbf	151.22	151.22	Yes
161.19 / 161.19	lbf	Pct of Range	0.500000	0.00	161.19	lbf	161.38	161.38	Yes
207.76 / 207.76	lbf	Pct of Range	0.500000	0.00	207.76	lbf	207.99	207.99	Yes

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Phone: 866-521-3823
Website: www.pcsllctn.com

INSTRUMENT CALIBRATION REPORT

Copperweld

Instrument ID 1755-2000
Description Tensile Tester (2 Load cells)
Calibrated 8/4/2020 **Performed At** Customer Location

Test Instruments Used During the Calibration

Test Instrument ID	Description	Manufacturer	Model Number	Serial Number	(As Of Cal Entry Date) Last Cal Date	Next Cal Date
Z-LO-005 5K LOAD CELL	Load Cell, 5000lb, Tension & Compression	Futek	LSB453	575093	1/7/2020	1/31/2022
Z-WE-003 HANGING WEIGHTS	Weight Set, 1-20lbs, Cast Iron	Rice Lake	ASTM Class 6	D7-D10 (20), D1-D4 (10), D1-D2 (2), 8MD8 (1), 8MB4 (2),8MB5 (5)	3/26/2019	3/31/2021

Notes about this calibration

Uncertainty = ± 0.23% of Reading (95%CL; K=2)

Calibration Result Calibration Successful
Who Calibrated James Meadows
Finalized By James Meadows
Date Finalized 8/4/2020 1:12:08PM

Total expanded measurement uncertainties expressed are based on a confidence level of 95%; coverage factor of (k=2). Decision Rule: The statement of compliance in this certificate was issued without taking the uncertainty of measurement into consideration. The customer shall assess the results and uncertainty when determining if the results meet their needs. This is considered "shared responsibility." This calibration was conducted using standards traceable to the SI through NIST. The results on this certificate of accuracy apply only to the item described above.
Accredited to ISO/IEC 17025: 2017.

Laboratory Authorized Signature

Appendix B - Copper-Clad Aluminum Lab Report

PCS | PRECISION CALIBRATION SYSTEMS
107 N Porter St
Winchester, TN 37398
E-mail: info@pcsllctn.com
Phone: 866-521-3823
Website: www.pcsllctn.com

INSTRUMENT CALIBRATION REPORT

ilac-MRA   PJLA Calibration Accreditation# 73403

Copperweld

Instrument ID 62-1625
Description Micro Ohm Meter
Calibrated 8/4/2020
Performed At Customer Location

Manufacturer	Valhalla Scientific	**Location**	Main	**Frequency**	Semi-Annual
Model Number	4176	**Building**	254 Cotton Mill Rd. Fayetteville, TN 37334	**Certificate #**	CO080420JM-03
Serial Number	62-1625	**Department**	Quality	**Temp**	70°F
Cal Procedure	QS0011JB2010	**Status**	In Service	**Humidity**	57%

Calibration Specifications

Group # 1
Group Name Ohm - Source

Nom In Val / In Val	In Type	Std Accy	Acc %	+/-	Out Val	Out Type	Fnd As	Lft As	In Tol
1.000 / 1.000	Ohm	Pct of Reading	0.040000	0.0000	1.0000	Ohm	0.9998	0.9998	Yes
10.000 / 10.000	Ohm	Pct of Reading	0.040000	0.000	10.000	Ohm	9.999	9.999	Yes
100.000 / 100.000	Ohm	Pct of Reading	0.040000	0.00	100.00	Ohm	99.99	99.99	Yes

Test Instruments Used During the Calibration

Test Instrument ID	Description	Manufacturer	Model Number	Serial Number	Last Cal Date (As Of Cal Entry Date)	Next Cal Date (As Of Cal Entry Date)
Z-EL-020 DECADE RESISTANCE BOX	General Radio Small Decade Resistance Box	General Radio	1433-U	2545	12/18/2018	12/31/2020

Notes about this calibration

Uncertainty = ± 2 mOhm (95%CL; K=2)

Calibration Result Calibration Successful
Who Calibrated James Meadows
Finalized By James Meadows
Date Finalized 8/4/2020 12:47:33PM

Total expanded measurement uncertainties expressed are based on a confidence level of 95%; coverage factor of (k=2). Decision Rule: The statement of compliance in this certificate was issued without taking the uncertainty of measurement into consideration. The customer shall assess the results and uncertainty when determining if the results meet their needs. This is considered "shared responsibility." This calibration was conducted using standards traceable to the SI through NIST. The results on this certificate of accuracy apply only to the item described above.
Accredited to ISO/IEC 17025: 2017.

Laboratory Authorized Signature

Revision Date:05/08/2020
Rev: 04

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QF0016

Follow-up Service Inspection Report
E491185200827165202

INSPECTION DETAILS			
Date:	2020-08-27	File Number.:	E491185
Responsible Office:	Melville	Volume:	1
Inspection Center:	232	CCN:	DVVU2
Product Type:	CCA Conductor	UL Rep Name:	Gregory Cornett
Deliverable Type:	Recognized	UL Rep ID:	20708
Party Site Number:	1626131	Subscriber Factory No.:	
Manufacturer Name:	Copperweld Bimetallics LLC	Factory Rep Name	Mr. Sammy Hampton
Manufacturer Address:	254 Cotton Mill Rd Fayetteville, TN 37334	Factory Rep Phone: Factory Rep Email:	931-433-0495 shampton@copperweld.com
Nature of visit:	Regular Inspection	Sample Status:	Sample requirements fulfilled for sample period
UL Marks Used?	Yes	UL Marks Removed?	No
Variation Notice Issued?	No	Inspection Conducted Remotely?	Yes
Comments After Submission:			

PRODUCT DOCUMENTS/PRODUCTION READY VISIT			
Model	**Product**	**Section**	**Multiple Listed**
14 Awg Class 10A	Copper Clad Aluminum	1	No

SAMPLE DOCUMENTS			
If samples are required to be sent to UL, indicate below. If required samples are not sent, explain in the Comments area.			
No Samples			
Additional Comments	14 Awg conductors from the NMB and THHN samples passed the UL tests for DVVU2, including Tensile, Elongation, copper thickness and DC Resistance.		

In addition to the requirements specified in the applicable UL Services agreement and Follow-Up Service Procedure, UL further defines responsibilities, duties and requirements for both manufacturers and UL representatives in the document titled "UL Mark Surveillance Requirements" that can be located at www.ul.com/fus, and in accordance with the applicable terms and conditions of the document at www.ul.com/responsibilities. Manufacturers without Internet access may obtain the current versions of these documents from their local UL customer service representative or UL field representative.

Appendix C1 Static Heating Testing at 100% Rated Current

Test 1a - thru Mfg. 1 10-amp breaker at 100% current (10A * 100% = 10A); max temps, reading every 60s

data logger CH #	Location	Recorded Temperatures (°C)			Calculated Temperature Rise (°C)		
scan #		124	129	134			
time (HH:MM:SS)		1:53:00	1:58:00	2:03:00			
1a	Mfg. 11 - 1	28.70	28.86	28.73	6.47	6.63	6.50
2a	Mfg. 11 - 2	28.89	29.01	28.84	6.66	6.78	6.61
3a	Mfg. 11 - 3	27.88	28.00	27.72	5.65	5.77	5.49
4a	Mfg. 8 - 1	29.18	29.27	29.25	6.95	7.04	7.02
5a	Mfg. 8 - 2	28.99	29.11	28.99	6.76	6.88	6.76
6a	Mfg. 8 - 3	29.00	29.15	28.92	6.77	6.92	6.69
7a	circuit breaker	32.68	32.65	32.75	10.45	10.42	10.52
8a	line wire	32.25	32.29	32.43	10.02	10.06	10.20
9a	line wire splicing device	29.84	29.65	29.07	7.61	7.42	6.84
10a	load wire	30.67	30.92	30.94	8.44	8.69	8.71
11a	load wire splicing device	30.11	29.88	29.27	7.88	7.65	7.04
12a	room ambient	22.39	22.44	21.87			
13a	current (amps)	10.03	10.03	10.03			

Test 1a - thru Mfg. 1 15-amp breaker at 100% current (15A * 100% = 15A); max temps, reading every 60s

data logger CH #	Location	Recorded Temperatures (°C)			Calculated Temperature Rise (°C)		
scan #		80	85	90			
time (HH:MM:SS)		1:17:00	1:22:00	1:27:00			
1a	Mfg. 11 - 1	33.06	33.61	33.40	11.02	11.58	11.36
2a	Mfg. 11 - 2	33.64	33.95	33.94	11.60	11.91	11.90
3a	Mfg. 11 - 3	31.05	31.56	31.60	9.01	9.52	9.56
4a	Mfg. 8 - 1	34.10	34.15	34.23	12.06	12.11	12.19
5a	Mfg. 8 - 2	33.60	34.20	33.86	11.56	12.16	11.82
6a	Mfg. 8 - 3	32.94	33.68	33.29	10.91	11.64	11.25
7a	circuit breaker	40.86	40.44	40.64	18.82	18.41	18.60
8a	line wire	33.93	34.21	33.87	11.89	12.17	11.83
9a	line wire splicing device	36.89	37.11	36.82	14.85	15.07	14.78
10a	load wire	32.70	33.48	32.99	10.66	11.44	10.95
11a	load wire splicing device	32.72	33.49	32.70	10.68	11.45	10.66
12a	room ambient	21.84	22.27	22.01			
13a	current (amps)	15.02	15.01	15.02			

Appendix C1 Static Heating Testing at 100% Rated Current

Test 1b - thru Mfg. 2 10-amp breaker at 100% current (10A * 100% = 10A); max temps, reading every 60s

data logger CH #	Location	Recorded Temperatures (°C)			Calculated Temperature Rise (°C)		
scan #	→	124	129	134			
time (HH:MM:SS)	→	1:53:00	1:58:00	2:03:00			
1b	Mfg. 11 - 1	28.57	28.60	28.36	6.49	6.52	6.27
2b	Mfg. 11 - 2	28.65	28.68	28.48	6.57	6.60	6.40
3b	Mfg. 11 - 3	27.37	27.39	27.10	5.28	5.31	5.02
4b	Mfg. 8 - 1	29.14	29.23	29.15	7.05	7.15	7.07
5b	Mfg. 8 - 2	30.65	30.75	30.48	8.57	8.66	8.40
6b	Mfg. 8 - 3	28.04	28.10	27.73	5.96	6.02	5.64
7b	circuit breaker	36.63	36.79	37.20	14.55	14.70	15.12
8b	line wire	30.98	31.03	30.93	8.90	8.95	8.85
9b	line wire splicing device	28.97	28.69	28.06	6.89	6.61	5.98
10b	load wire	28.60	28.55	28.00	6.52	6.47	5.92
11b	load wire splicing device	28.64	28.49	27.92	6.56	6.41	5.84
12b	room ambient	22.35	22.28	21.62			
13b	current (amps)	10.00	10.00	10.00			

Test 1b - thru Mfg. 2 15-amp breaker at 100% current (15A * 100% = 15A); max temps, reading every 60s

data logger CH #	Location	Recorded Temperatures (°C)			Calculated Temperature Rise (°C)		
scan #	→	80	85	90			
time (HH:MM:SS)	→	1:17:00	1:22:00	1:27:00			
1b	Mfg. 11 - 1	33.38	33.85	33.55	11.43	11.89	11.59
2b	Mfg. 11 - 2	33.29	33.49	33.67	11.34	11.54	11.72
3b	Mfg. 11 - 3	30.94	31.47	31.45	8.99	9.52	9.49
4b	Mfg. 8 - 1	34.03	34.28	34.44	12.07	12.32	12.48
5b	Mfg. 8 - 2	33.61	34.03	33.75	11.66	12.08	11.80
6b	Mfg. 8 - 3	33.00	33.71	33.25	11.05	11.75	11.29
7b	circuit breaker	44.97	44.86	45.02	23.02	22.91	23.06
8b	line wire	33.21	33.70	33.32	11.25	11.74	11.37
9b	line wire splicing device	30.81	31.77	30.80	8.86	9.82	8.85
10b	load wire	32.53	33.49	32.83	10.58	11.54	10.88
11b	load wire splicing device	31.51	32.52	31.43	9.56	10.56	9.47
12b	room ambient	21.76	22.22	21.88			
13b	current (amps)	15.01	15.01	15.01			

Appendix C1 Static Heating Testing at 100% Rated Current

Test 1c - thru Mfg. 3 10-amp breaker at 100% current (10A * 100% = 10A); max temps, reading every 60s

data logger CH #	Location	Recorded Temperatures (°C)			Calculated Temperature Rise (°C)		
scan #		124	129	134			
time (HH:MM:SS)		1:53:00	1:58:00	2:03:00			
1c	Mfg. 11 - 1	29.46	29.56	29.18	7.40	7.50	7.12
2c	Mfg. 11 - 2	28.97	29.12	28.68	6.91	7.06	6.62
3c	Mfg. 11 - 3	27.82	28.02	27.47	5.76	5.96	5.41
4c	Mfg. 8 - 1	29.30	29.40	29.33	7.24	7.34	7.27
5c	Mfg. 8 - 2	28.68	28.72	28.43	6.62	6.66	6.37
6c	Mfg. 8 - 3	28.19	28.27	27.81	6.13	6.21	5.75
7c	circuit breaker	35.04	35.28	35.13	12.98	13.22	13.07
8c	line wire	31.23	31.27	30.87	9.17	9.21	8.81
9c	line wire splicing device	28.59	28.61	27.53	6.53	6.55	5.47
10c	load wire	30.74	30.84	30.26	8.68	8.78	8.20
11c	load wire splicing device	29.74	29.67	28.50	7.68	7.61	6.44
12c	room ambient	22.29	22.23	21.67			
13c	current (amps)	10.01	10.01	10.01			

Test 1c - thru Mfg. 3 15-amp breaker at 100% current (15A * 100% = 15A); max temps, reading every 60s

data logger CH #	Location	Recorded Temperatures (°C)			Calculated Temperature Rise (°C)		
scan #		80	85	90			
time (HH:MM:SS)		1:17:00	1:22:00	1:27:00			
1c	Mfg. 11 - 1	32.95	33.38	33.25	11.06	11.48	11.36
2c	Mfg. 11 - 2	33.50	33.89	33.73	11.61	12.00	11.84
3c	Mfg. 11 - 3	32.27	32.60	32.50	10.38	10.71	10.61
4c	Mfg. 8 - 1	33.33	33.66	33.62	11.44	11.77	11.72
5c	Mfg. 8 - 2	33.87	34.28	34.11	11.98	12.39	12.21
6c	Mfg. 8 - 3	32.50	32.88	32.80	10.61	10.99	10.91
7c	circuit breaker	42.51	42.65	42.50	20.62	20.75	20.60
8c	line wire	31.74	32.44	32.16	9.84	10.54	10.27
9c	line wire splicing device	32.46	33.55	32.53	10.57	11.66	10.64
10c	load wire	32.23	33.29	32.70	10.34	11.40	10.81
11c	load wire splicing device	29.96	31.50	30.18	8.07	9.61	8.29
12c	room ambient	21.65	22.13	21.90			
13c	current (amps)	15.02	15.02	15.02			

Appendix C1 Static Heating Testing at 100% Rated Current

Test 1a - thru Mfg. 1 10-amp breaker at 100% current (10A * 100% = 10A); max temps, reading every 60s

data logger CH #	Location	Recorded Temperatures (°C)			Calculated Temperature Rise (°C)		
scan #	→	67	72	77			
time (HH:MM:SS)	→	1:04:00	1:09:00	1:14:00			
1a	Mfg. 10 - 1	33.35	33.09	33.35	11.17	10.90	11.17
2a	Mfg. 10 - 2	29.93	29.88	29.88	7.75	7.70	7.70
3a	Mfg. 10 - 3	28.83	28.80	28.74	6.65	6.62	6.56
4a	Mfg. 9 - 1	28.96	28.89	28.94	6.78	6.71	6.76
5a	Mfg. 9 - 2	29.33	29.07	29.09	7.15	6.89	6.91
6a	Mfg. 9 - 3	28.20	28.02	27.93	6.01	5.84	5.75
7a	circuit breaker	32.75	32.55	32.65	10.57	10.37	10.47
8a	line wire	32.76	32.27	32.44	10.58	10.09	10.26
9a	line wire splicing device	29.85	29.45	29.15	7.67	7.27	6.97
10a	load wire	31.09	30.73	31.01	8.91	8.55	8.83
11a	load wire splicing device	30.90	30.16	30.15	8.72	7.98	7.97
12a	room ambient	22.53	22.20	21.82			
13a	current (amps)	10.02	10.02	10.02			

Test 1a - thru Mfg. 1 15-amp breaker at 100% current (15A * 100% = 15A); max temps, reading every 60s

data logger CH #	Location	Recorded Temperatures (°C)			Calculated Temperature Rise (°C)		
scan #	→	122	127	132			
time (HH:MM:SS)	→	2:00:00	2:05:00	2:10:00			
1a	Mfg. 10 - 1	38.41	38.10	38.31	17.09	16.78	16.99
2a	Mfg. 10 - 2	39.48	39.23	39.28	18.16	17.91	17.96
3a	Mfg. 10 - 3	34.47	34.18	34.12	13.15	12.87	12.80
4a	Mfg. 9 - 1	37.47	37.35	37.38	16.16	16.03	16.06
5a	Mfg. 9 - 2	38.46	38.17	38.12	17.14	16.85	16.80
6a	Mfg. 9 - 3	31.54	31.29	31.18	10.22	9.97	9.86
7a	circuit breaker	40.70	40.66	40.65	19.38	19.34	19.33
8a	line wire	34.07	34.00	34.12	12.75	12.69	12.80
9a	line wire splicing device	35.66	35.31	35.13	14.34	13.99	13.81
10a	load wire	32.81	32.43	32.75	11.49	11.11	11.43
11a	load wire splicing device	33.16	32.96	32.94	11.84	11.64	11.62
12a	room ambient	21.37	21.31	21.27			
13a	current (amps)	15.02	15.02	15.02			

Test 1b - thru Mfg. 2 10-amp breaker at 100% current (10A * 100% = 10A); max temps, reading every 60s

data logger CH #	Location	Recorded Temperatures (°C)			Calculated Temperature Rise (°C)		
scan #	→	129	134	139			
time (HH:MM:SS)	→	2:06:07	2:11:06	2:16:07			
1b	Mfg. 10 - 1	31.13	31.54	31.37	9.64	10.05	9.88
2b	Mfg. 10 - 2	30.12	30.39	30.44	8.63	8.90	8.95
3b	Mfg. 10 - 3	28.95	29.13	29.19	7.46	7.64	7.70
4b	Mfg. 9 - 1	28.47	28.67	28.85	6.98	7.18	7.36
5b	Mfg. 9 - 2	28.62	29.01	28.85	7.13	7.52	7.36
6b	Mfg. 9 - 3	29.94	30.21	30.11	8.45	8.72	8.62
7b	circuit breaker	41.81	41.46	41.80	20.32	19.97	20.31
8b	line wire	31.66	31.83	32.15	10.17	10.34	10.66
9b	line wire splicing device	29.57	30.02	30.13	8.08	8.53	8.64
10b	load wire	28.92	29.64	29.57	7.43	8.15	8.08
11b	load wire splicing device	30.62	31.06	31.03	9.13	9.57	9.54
12b	room ambient	21.30	21.89	21.28			
13b	current (amps)	10.01	10.01	10.01			

Test 1b - thru Mfg. 2 15-amp breaker at 100% current (15A * 100% = 15A); max temps, reading every 60s

data logger CH #	Location	Recorded Temperatures (°C)			Calculated Temperature Rise (°C)		
scan #	→	122	127	132			
time (HH:MM:SS)	→	2:00:00	2:05:00	2:10:00			
1b	Mfg. 10 - 1	39.02	38.87	38.81	17.86	17.72	17.65
2b	Mfg. 10 - 2	38.54	38.42	38.37	17.38	17.26	17.22
3b	Mfg. 10 - 3	35.00	34.94	34.56	13.84	13.78	13.40
4b	Mfg. 9 - 1	34.32	34.17	34.19	13.16	13.01	13.03
5b	Mfg. 9 - 2	33.68	33.52	33.44	12.52	12.36	12.29
6b	Mfg. 9 - 3	32.62	32.41	32.27	11.46	11.25	11.11
7b	circuit breaker	44.60	44.48	44.38	23.44	23.32	23.22
8b	line wire	33.27	33.12	33.14	12.11	11.96	11.98
9b	line wire splicing device	31.50	31.19	31.26	10.34	10.03	10.10
10b	load wire	31.96	31.65	31.72	10.81	10.49	10.56
11b	load wire splicing device	30.27	29.89	29.93	9.12	8.73	8.78
12b	room ambient	21.26	21.14	21.08			
13b	current (amps)	15.01	15.01	15.01			

Appendix C1 Static Heating Testing at 100% Rated Current

Test 1c - thru Mfg. 3 10-amp breaker at 100% current (10A * 100% = 10A); max temps, reading every 60s

data logger CH #	Location	Recorded Temperatures (°C)			Calculated Temperature Rise (°C)		
scan #	→	67	72	77			
time (HH:MM:SS)	→	1:04:00	1:09:00	1:14:00			
1c	Mfg. 10 - 1	31.05	30.92	30.45	9.04	8.91	8.44
2c	Mfg. 10 - 2	32.97	32.85	32.26	10.96	10.84	10.25
3c	Mfg. 10 - 3	29.07	28.94	28.28	7.06	6.93	6.27
4c	Mfg. 9 - 1	29.52	29.28	29.21	7.51	7.27	7.20
5c	Mfg. 9 - 2	30.06	29.90	29.40	8.05	7.89	7.39
6c	Mfg. 9 - 3	28.41	28.41	27.55	6.40	6.40	5.54
7c	circuit breaker	34.97	34.66	34.67	12.96	12.65	12.66
8c	line wire	31.77	31.18	30.88	9.76	9.17	8.87
9c	line wire splicing device	28.89	28.20	27.63	6.88	6.19	5.62
10c	load wire	31.27	30.69	30.26	9.26	8.68	8.25
11c	load wire splicing device	31.39	30.47	29.53	9.38	8.46	7.52
12c	room ambient	22.35	21.99	21.69			
13c	current (amps)	10.01	10.01	10.01			

Test 1c - thru Mfg. 3 15-amp breaker at 100% current (15A * 100% = 15A); max temps, reading every 60s

data logger CH #	Location	Recorded Temperatures (°C)			Calculated Temperature Rise (°C)		
scan #	→	122	127	132			
time (HH:MM:SS)	→	2:00:00	2:05:00	2:10:00			
1c	Mfg. 10 - 1	36.19	35.94	35.85	15.02	14.77	14.68
2c	Mfg. 10 - 2	39.95	39.76	39.70	18.78	18.59	18.53
3c	Mfg. 10 - 3	39.01	39.15	38.69	17.85	17.98	17.52
4c	Mfg. 9 - 1	33.32	33.13	33.09	12.15	11.96	11.92
5c	Mfg. 9 - 2	34.01	33.90	33.74	12.84	12.74	12.57
6c	Mfg. 9 - 3	32.95	32.95	32.64	11.78	11.78	11.47
7c	circuit breaker	41.75	41.55	41.58	20.59	20.38	20.41
8c	line wire	30.73	30.68	30.61	9.56	9.51	9.44
9c	line wire splicing device	32.20	31.82	31.87	11.04	10.65	10.70
10c	load wire	31.34	31.12	31.14	10.17	9.95	9.97
11c	load wire splicing device	29.64	29.52	29.42	8.47	8.35	8.25
12c	room ambient	21.29	21.13	21.09			
13c	current (amps)	15.01	15.01	15.01			

Appendix C2 Static Heating Tests at 135% Rated Current

Test 2a - thru Mfg. 1 10-amp breaker at 135% current (10A * 135% = 13.5A); max temps, reading every 20s

data logger CH #	Location	Recorded Temperatures (°C)			Calculated Temperature Rise (°C)		
scan # →							
time (MM:SS) →		7:20	7:40	8:00			
	Breaker trip time	8:20					
1a	Mfg. 11 - 1	30.60	30.69	30.76	8.65	8.73	8.80
2a	Mfg. 11 - 2	30.73	30.83	30.87	8.78	8.88	8.92
3a	Mfg. 11 - 3	29.72	29.82	29.85	7.76	7.87	7.89
4a	Mfg. 8 - 1	30.66	30.77	30.88	8.70	8.81	8.93
5a	Mfg. 8 - 2	30.87	30.96	31.05	8.91	9.01	9.09
6a	Mfg. 8 - 3	30.39	30.50	30.55	8.43	8.54	8.59
7a	circuit breaker	34.21	34.43	34.65	12.26	12.47	12.70
8a	line wire	38.55	38.70	38.80	16.59	16.74	16.85
9a	line wire splicing device	34.64	34.68	34.50	12.68	12.72	12.55
10a	load wire	36.44	36.44	36.36	14.49	14.48	14.40
11a	load wire splicing device	35.04	35.05	34.84	13.09	13.09	12.88
12a	room ambient	22.00	21.97	21.91			
13a	current (amps)	13.52	13.52	13.52			

Test 2a - thru Mfg. 1 15-amp breaker at 135% current (15A * 135% = 20.25A); max temps, reading every 20s

data logger CH #	Location	Recorded Temperatures (°C)			Calculated Temperature Rise (°C)		
scan # →		60	61	62			
time (MM:SS) →		18:20	18:40	19:00			
	Breaker trip time	19:20					
1a	Mfg. 11 - 1	39.87	39.91	39.90	18.05	18.09	18.08
2a	Mfg. 11 - 2	40.66	40.69	40.70	18.84	18.87	18.88
3a	Mfg. 11 - 3	36.77	36.77	36.76	14.95	14.95	14.94
4a	Mfg. 8 - 1	40.83	40.88	40.89	19.01	19.06	19.07
5a	Mfg. 8 - 2	40.41	40.45	40.47	18.59	18.63	18.65
6a	Mfg. 8 - 3	39.06	39.09	39.15	17.24	17.27	17.33
7a	circuit breaker	51.78	51.96	52.02	29.96	30.14	30.20
8a	line wire	43.47	43.51	43.49	21.65	21.69	21.67
9a	line wire splicing device	48.83	48.80	48.22	27.02	26.99	26.40
10a	load wire	41.01	41.02	41.12	19.19	19.20	19.30
11a	load wire splicing device	42.69	42.60	42.48	20.87	20.78	20.66
12a	room ambient	21.84	21.84	21.78			
13a	current (amps)	19.97	19.97	20.24			

Appendix C2 Static Heating Tests at 135% Rated Current

Test 2b - thru Mfg. 2 10-amp breaker at 135% current (10A * 135% = 13.5A); max temps, reading every 20s

data logger CH #	Location	Recorded Temperatures (°C)			Calculated Temperature Rise (°C)		
scan # →		16	17	18			
time (MM:SS) →		4:20	4:40	5:00			
	Breaker trip time	5:20					
1b	Mfg. 11 - 1	29.25	29.41	29.55	6.91	7.07	7.21
2b	Mfg. 11 - 2	28.86	29.03	29.22	6.52	6.69	6.88
3b	Mfg. 11 - 3	28.34	28.44	28.54	6.00	6.10	6.20
4b	Mfg. 8 - 1	29.37	29.59	29.79	7.03	7.25	7.45
5b	Mfg. 8 - 2	30.27	30.43	30.67	7.93	8.09	8.33
6b	Mfg. 8 - 3	28.84	28.97	29.10	6.50	6.63	6.76
7b	circuit breaker	34.99	35.63	36.29	12.65	13.29	13.95
8b	line wire	34.20	34.58	34.92	11.86	12.24	12.58
9b	line wire splicing device	33.21	33.11	33.12	10.87	10.77	10.78
10b	load wire	30.95	31.14	31.38	8.61	8.80	9.04
11b	load wire splicing device	32.76	32.73	32.78	10.42	10.39	10.44
12b	room ambient	22.40	22.34	22.29			
13b	current (amps)	13.51	13.51	13.51			

Test 2b - thru Mfg. 2 15-amp breaker at 135% current (15A * 135% = 20.25A); max temps, reading every 20s

data logger CH #	Location	Recorded Temperatures (°C)			Calculated Temperature Rise (°C)		
scan # →		13	14	15			
time (MM:SS) →		2:20	2:40	3:00			
	Breaker trip time	3:20					
1b	Mfg. 11 - 1	31.85	32.56	33.17	9.91	10.62	11.23
2b	Mfg. 11 - 2	31.27	32.00	32.64	9.33	10.05	10.70
3b	Mfg. 11 - 3	30.01	30.61	31.08	8.07	8.67	9.14
4b	Mfg. 8 - 1	31.78	32.43	33.07	9.84	10.49	11.13
5b	Mfg. 8 - 2	32.35	32.97	33.48	10.41	11.03	11.54
6b	Mfg. 8 - 3	31.74	32.37	32.83	9.80	10.42	10.89
7b	circuit breaker	36.50	38.10	39.50	14.56	16.16	17.56
8b	line wire	32.89	33.90	34.83	10.95	11.96	12.89
9b	line wire splicing device	34.98	35.61	36.11	13.04	13.67	14.17
10b	load wire	33.90	34.76	35.58	11.96	12.82	13.64
11b	load wire splicing device	35.84	36.48	37.04	13.90	14.54	15.10
12b	room ambient	21.94	21.93	21.96			
13b	current (amps)	20.28	20.27	20.27			

Test 2c - thru Mfg. 3 10-amp breaker at 135% current (10A * 135% = 13.5A); max temps, reading every 20s

data logger CH #	Location	Recorded Temperatures (°C)			Calculated Temperature Rise (°C)		
scan # →		59	60	61			
time (MM:SS) →		18:40	19:00	19:20			
	Breaker trip time	19:40					
1c	Mfg. 11 - 1	34.08	34.15	34.18	11.70	11.78	11.81
2c	Mfg. 11 - 2	33.23	33.27	33.31	10.85	10.89	10.93
3c	Mfg. 11 - 3	31.22	31.25	31.28	8.85	8.87	8.90
4c	Mfg. 8 - 1	33.48	33.50	33.56	11.10	11.13	11.19
5c	Mfg. 8 - 2	32.68	32.75	32.80	10.31	10.37	10.42
6c	Mfg. 8 - 3	31.96	32.03	32.09	9.58	9.66	9.71
7c	circuit breaker	43.05	43.08	43.19	20.67	20.71	20.81
8c	line wire	38.04	38.09	38.14	15.67	15.72	15.76
9c	line wire splicing device	33.55	33.75	33.89	11.17	11.38	11.51
10c	load wire	37.55	37.62	37.70	15.17	15.24	15.33
11c	load wire splicing device	35.83	36.09	36.28	13.46	13.71	13.91
12c	room ambient	22.51	22.28	22.34			
13c	current (amps)	13.51	13.51	13.51			

Test 2c - thru Mfg. 3 15-amp breaker at 135% current (15A * 135% = 20.25A); max temps, reading every 20s

data logger CH #	Location	Recorded Temperatures (°C)			Calculated Temperature Rise (°C)		
scan # →		20	21	22			
time (MM:SS) →		5:00	5:20	5:40			
	Breaker trip time	6:00					
1c	Mfg. 11 - 1	34.62	34.96	35.21	12.63	12.97	13.22
2c	Mfg. 11 - 2	35.65	35.96	36.17	13.65	13.97	14.18
3c	Mfg. 11 - 3	33.85	34.05	34.25	11.85	12.05	12.25
4c	Mfg. 8 - 1	34.94	35.23	35.47	12.95	13.24	13.48
5c	Mfg. 8 - 2	35.87	36.13	36.37	13.87	14.13	14.38
6c	Mfg. 8 - 3	34.38	34.60	34.74	12.38	12.61	12.75
7c	circuit breaker	42.69	43.47	44.15	20.69	21.47	22.16
8c	line wire	36.07	36.49	36.77	14.08	14.50	14.78
9c	line wire splicing device	38.93	39.23	39.49	16.94	17.24	17.49
10c	load wire	37.64	37.92	38.15	15.64	15.92	16.16
11c	load wire splicing device	35.65	35.84	35.95	13.66	13.85	13.96
12c	room ambient	21.95	22.09	21.93			
13c	current (amps)	20.19	20.19	20.17			

Test 2a - thru Mfg. 1 10-amp breaker at 135% current (10A * 135% = 13.5A); max temps, reading every 20s

data logger CH #	Location	Recorded Temperatures (°C)			Calculated Temperature Rise (°C)		
scan #		26	27	28			
time (MM:SS)		7:40	8:00	8:20			
	Breaker trip time	8:40					
1a	Mfg. 10 - 1	33.38	33.55	33.72	11.54	11.72	11.89
2a	Mfg. 10 - 2	32.41	32.50	32.60	10.58	10.67	10.77
3a	Mfg. 10 - 3	30.50	30.58	30.68	8.66	8.75	8.85
4a	Mfg. 9 - 1	30.51	30.62	30.74	8.67	8.79	8.91
5a	Mfg. 9 - 2	30.63	30.73	30.86	8.80	8.89	9.02
6a	Mfg. 9 - 3	29.45	29.52	29.63	7.62	7.69	7.79
7a	circuit breaker	34.35	34.60	34.84	12.51	12.77	13.00
8a	line wire	38.69	38.85	39.02	16.85	17.01	17.18
9a	line wire splicing device	34.03	34.11	34.24	12.19	12.27	12.40
10a	load wire	36.42	36.48	36.58	14.59	14.65	14.74
11a	load wire splicing device	36.28	36.41	36.59	14.45	14.58	14.76
12a	room ambient	21.84	21.90	21.76			
13a	current (amps)	13.52	13.52	13.52			

Test 2a - thru Mfg. 1 15-amp breaker at 135% current (15A * 135% = 20.25A); max temps, reading every 20s

data logger CH #	Location	Recorded Temperatures (°C)			Calculated Temperature Rise (°C)		
scan #		65	66	67			
time (MM:SS)		20:00	20:20	20:40			
	Breaker trip time	21:00					
1a	Mfg. 10 - 1	47.14	47.05	47.05	26.19	26.10	26.09
2a	Mfg. 10 - 2	49.33	49.35	49.30	28.38	28.39	28.35
3a	Mfg. 10 - 3	43.32	43.29	43.14	22.36	22.34	22.19
4a	Mfg. 9 - 1	45.67	45.67	45.73	24.72	24.71	24.78
5a	Mfg. 9 - 2	46.98	46.95	46.85	26.03	25.99	25.90
6a	Mfg. 9 - 3	38.91	38.80	38.65	17.95	17.84	17.69
7a	circuit breaker	52.18	52.30	52.40	31.23	31.34	31.45
8a	line wire	43.36	43.34	43.31	22.40	22.39	22.35
9a	line wire splicing device	46.95	46.94	46.87	26.00	25.99	25.91
10a	load wire	41.51	41.36	41.20	20.56	20.41	20.25
11a	load wire splicing device	42.93	42.85	42.57	21.97	21.89	21.62
12a	room ambient	20.94	20.94	20.98			
13a	current (amps)	20.29	20.28	20.28			

Appendix C2 Static Heating Tests at 135% Rated Current

Test 2b - thru Mfg. 2 10-amp breaker at 135% current (10A * 135% = 13.5A); max temps, reading every 20s

data logger CH #	Location	Recorded Temperatures (°C)			Calculated Temperature Rise (°C)		
scan # →		21	22	23			
time (MM:SS) →		5:40	6:00	6:20			
	Breaker trip time	6:40					
1b	Mfg. 10 - 1	31.86	32.13	32.38	9.94	10.21	10.46
2b	Mfg. 10 - 2	32.09	32.28	32.45	10.17	10.36	10.53
3b	Mfg. 10 - 3	30.06	30.24	30.38	8.14	8.32	8.46
4b	Mfg. 9 - 1	29.45	29.60	29.73	7.53	7.68	7.81
5b	Mfg. 9 - 2	30.16	30.32	30.49	8.23	8.40	8.57
6b	Mfg. 9 - 3	29.34	29.52	29.64	7.42	7.60	7.72
7b	circuit breaker	37.11	37.68	38.17	15.19	15.76	16.25
8b	line wire	35.37	35.59	35.81	13.44	13.67	13.88
9b	line wire splicing device	32.21	32.37	32.46	10.28	10.45	10.54
10b	load wire	31.36	31.58	31.73	9.44	9.66	9.80
11b	load wire splicing device	35.28	35.40	35.49	13.36	13.47	13.56
12b	room ambient	21.93	21.95	21.88			
13b	current (amps)	13.50	13.50	13.50			

Test 2b - thru Mfg. 2 15-amp breaker at 135% current (15A * 135% = 20.25A); max temps, reading every 20s

data logger CH #	Location	Recorded Temperatures (°C)			Calculated Temperature Rise (°C)		
scan # →		13	14	15			
time (MM:SS) →		2:40	3:00	3:20			
	Breaker trip time	3:40					
1b	Mfg. 10 - 1	34.43	35.44	36.33	13.42	14.43	15.32
2b	Mfg. 10 - 2	35.56	36.51	37.33	14.56	15.51	16.33
3b	Mfg. 10 - 3	33.00	33.73	34.31	12.00	12.73	13.30
4b	Mfg. 9 - 1	32.70	33.42	34.00	11.69	12.41	13.00
5b	Mfg. 9 - 2	32.65	33.31	33.89	11.64	12.30	12.89
6b	Mfg. 9 - 3	30.85	31.44	31.99	9.85	10.43	10.98
7b	circuit breaker	36.44	37.96	39.35	15.44	16.96	18.34
8b	line wire	32.46	33.42	34.28	11.45	12.41	13.28
9b	line wire splicing device	35.23	35.84	36.40	14.22	14.84	15.39
10b	load wire	33.42	34.26	35.03	12.42	13.26	14.02
11b	load wire splicing device	33.28	33.92	34.50	12.27	12.91	13.49
12b	room ambient	20.93	21.01	21.08			
13b	current (amps)	20.28	20.28	20.28			

Appendix C2 Static Heating Tests at 135% Rated Current

Test 2c - thru Mfg. 3 10-amp breaker at 135% current (10A * 135% = 13.5A); max temps, reading every 20s

data logger CH #	Location	Recorded Temperatures (°C)			Calculated Temperature Rise (°C)		
scan #		53	54	55			
time (MM:SS)		16:20	16:40	17:00			
	Breaker trip time	17:20					
1c	Mfg. 10 - 1	35.58	35.62	35.62	13.37	13.41	13.41
2c	Mfg. 10 - 2	36.59	36.62	36.62	14.38	14.41	14.41
3c	Mfg. 10 - 3	32.94	32.95	32.98	10.73	10.74	10.77
4c	Mfg. 9 - 1	33.08	33.07	33.07	10.87	10.86	10.86
5c	Mfg. 9 - 2	33.95	33.93	33.90	11.73	11.72	11.69
6c	Mfg. 9 - 3	31.62	31.62	31.58	9.40	9.41	9.37
7c	circuit breaker	41.72	41.81	41.92	19.51	19.60	19.71
8c	line wire	38.68	38.60	38.52	16.47	16.39	16.31
9c	line wire splicing device	33.41	33.23	33.04	11.19	11.02	10.83
10c	load wire	37.53	37.41	37.27	15.31	15.20	15.06
11c	load wire splicing device	38.23	37.83	37.38	16.01	15.62	15.17
12c	room ambient	22.28	22.22	22.14			
13c	current (amps)	13.50	13.50	13.50			

Test 2c - thru Mfg. 3 15-amp breaker at 135% current (15A * 135% = 20.25A); max temps, reading every 20s

data logger CH #	Location	Recorded Temperatures (°C)			Calculated Temperature Rise (°C)		
scan #		22	23	24			
time (MM:SS)		5:40	6:00	6:20			
	Breaker trip time	6:40					
1c	Mfg. 10 - 1	37.66	38.19	38.64	16.09	16.61	17.07
2c	Mfg. 10 - 2	44.95	45.50	45.96	23.38	23.93	24.39
3c	Mfg. 10 - 3	44.95	45.37	45.69	23.38	23.80	24.12
4c	Mfg. 9 - 1	35.48	35.83	36.20	13.90	14.26	14.63
5c	Mfg. 9 - 2	38.33	38.69	39.10	16.75	17.12	17.52
6c	Mfg. 9 - 3	36.86	37.22	37.59	15.28	15.65	16.02
7c	circuit breaker	42.83	43.50	44.14	21.26	21.93	22.56
8c	line wire	35.89	36.21	36.61	14.32	14.64	15.04
9c	line wire splicing device	40.91	41.17	41.52	19.33	19.60	19.95
10c	load wire	37.99	38.35	38.72	16.42	16.78	17.15
11c	load wire splicing device	39.30	39.51	39.86	17.72	17.93	18.29
12c	room ambient	21.55	21.59	21.59			
13c	current (amps)	20.30	20.26	20.27			

Appendix C3 Static Heating Tests at 150% Rated Current

Test 3a - thru Mfg. 1 10-amp breaker at 150% current (10A * 150% = 15A); max temps, reading every 10s

data logger CH #	Location	Recorded Temperatures (°C)			Calculated Temperature Rise (°C)		
scan # →		19	20	21			
time (MM:SS) →		2:00	2:10	2:20			
	Breaker trip time	2:30					
1a	Mfg. 11 - 1	27.90	28.21	28.45	5.51	5.83	6.06
2a	Mfg. 11 - 2	27.85	28.17	28.44	5.46	5.79	6.06
3a	Mfg. 11 - 3	27.44	27.71	27.97	5.05	5.32	5.58
4a	Mfg. 8 - 1	28.03	28.30	28.55	5.64	5.91	6.17
5a	Mfg. 8 - 2	28.67	28.93	29.21	6.28	6.55	6.83
6a	Mfg. 8 - 3	28.12	28.37	28.63	5.73	5.98	6.24
7a	circuit breaker	29.23	29.65	30.04	6.84	7.27	7.65
8a	line wire	33.45	33.99	34.55	11.06	11.60	12.16
9a	line wire splicing device	33.38	33.88	34.38	10.99	11.49	11.99
10a	load wire	32.35	32.80	33.28	9.96	10.41	10.89
11a	load wire splicing device	34.69	35.13	35.60	12.30	12.74	13.21
12a	room ambient	22.40	22.39	22.37			
13a	current (amps)	15.02	15.02	15.02			

Test 3a - thru Mfg. 1 15-amp breaker at 150% current (15A * 150% = 22.5A); max temps, reading every 10s

data logger CH #	Location	Recorded Temperatures (°C)			Calculated Temperature Rise (°C)		
scan # →		31	32	33			
time (MM:SS) →		3:40	3:50	4:00			
	Breaker trip time	4:10					
1a	Mfg. 11 - 1	36.08	36.34	36.60	13.46	13.72	13.98
2a	Mfg. 11 - 2	36.41	36.67	36.97	13.79	14.05	14.35
3a	Mfg. 11 - 3	34.72	34.88	35.08	12.10	12.26	12.46
4a	Mfg. 8 - 1	36.33	36.58	36.86	13.71	13.96	14.24
5a	Mfg. 8 - 2	37.14	37.38	37.62	14.53	14.76	15.00
6a	Mfg. 8 - 3	36.40	36.56	36.84	13.78	13.94	14.22
7a	circuit breaker	40.83	41.35	41.83	18.21	18.73	19.21
8a	line wire	39.85	40.31	40.75	17.23	17.69	18.13
9a	line wire splicing device	49.53	49.93	50.18	26.91	27.31	27.56
10a	load wire	40.21	40.60	40.99	17.60	17.98	18.37
11a	load wire splicing device	45.48	45.83	46.22	22.86	23.21	23.60
12a	room ambient	22.65	22.62	22.58			
13a	current (amps)	22.56	22.53	22.53			

Test 3b - thru Mfg. 2 10-amp breaker at 150% current (10A * 150% = 15A); max temps, reading every 10s

data logger CH #	Location	Recorded Temperatures (°C)			Calculated Temperature Rise (°C)		
scan #		19	20	21			
time (MM:SS)		2:00	2:10	2:20			
	Breaker trip time	2:30					
1b	Mfg. 11 - 1	28.11	28.40	28.72	5.67	5.96	6.28
2b	Mfg. 11 - 2	27.73	27.97	28.26	5.29	5.53	5.82
3b	Mfg. 11 - 3	27.57	27.80	28.05	5.12	5.36	5.60
4b	Mfg. 8 - 1	28.38	28.63	28.91	5.93	6.19	6.47
5b	Mfg. 8 - 2	29.23	29.50	29.82	6.79	7.06	7.37
6b	Mfg. 8 - 3	28.00	28.25	28.53	5.56	5.81	6.09
7b	circuit breaker	30.38	30.93	31.50	7.94	8.48	9.06
8b	line wire	31.30	31.79	32.30	8.85	9.34	9.86
9b	line wire splicing device	32.82	33.29	33.71	10.38	10.84	11.27
10b	load wire	28.66	29.10	29.50	6.21	6.66	7.06
11b	load wire splicing device	33.26	33.63	33.95	10.82	11.18	11.51
12b	room ambient	22.47	22.43	22.43			
13b	current (amps)	15.01	15.01	15.01			

Test 3b - thru Mfg. 2 15-amp breaker at 150% current (15A * 150% = 22.5A); max temps, reading every 10s

data logger CH #	Location	Recorded Temperatures (°C)			Calculated Temperature Rise (°C)		
scan #		13	14	15			
time (MM:SS)		:40	:50	1:00			
	Breaker trip time	1:10					
1b	Mfg. 11 - 1	26.84	27.76	28.60	4.39	5.31	6.15
2b	Mfg. 11 - 2	26.26	27.11	27.94	3.81	4.66	5.49
3b	Mfg. 11 - 3	26.03	26.75	27.44	3.58	4.30	4.99
4b	Mfg. 8 - 1	26.61	27.54	28.41	4.16	5.09	5.96
5b	Mfg. 8 - 2	27.59	28.55	29.46	5.14	6.10	7.01
6b	Mfg. 8 - 3	27.23	28.09	28.93	4.78	5.64	6.48
7b	circuit breaker	27.33	28.59	29.90	4.88	6.14	7.45
8b	line wire	26.59	27.53	28.44	4.14	5.08	5.99
9b	line wire splicing device	29.28	30.58	31.77	6.83	8.13	9.32
10b	load wire	27.88	28.93	29.91	5.43	6.48	7.46
11b	load wire splicing device	29.84	31.22	32.45	7.39	8.77	10.00
12b	room ambient	22.46	22.43	22.45			
13b	current (amps)	22.51	22.49	22.49			

Test 3c - thru Mfg. 3 10-amp breaker at 150% current (10A * 150% = 15A); max temps, reading every 10s

data logger CH #	Location	Recorded Temperatures (°C)			Calculated Temperature Rise (°C)		
scan #	→	37	38	39			
time (MM:SS)	→	5:00	5:10	5:20			
	Breaker trip time	5:30					
1c	Mfg. 11 - 1	32.34	32.46	32.62	9.83	9.96	10.12
2c	Mfg. 11 - 2	31.80	31.94	32.06	9.30	9.44	9.56
3c	Mfg. 11 - 3	29.96	30.07	30.17	7.46	7.56	7.67
4c	Mfg. 8 - 1	31.82	31.94	32.07	9.32	9.44	9.57
5c	Mfg. 8 - 2	31.64	31.77	31.86	9.13	9.26	9.36
6c	Mfg. 8 - 3	31.07	31.17	31.31	8.57	8.67	8.81
7c	circuit breaker	37.24	37.53	37.80	14.74	15.03	15.30
8c	line wire	38.50	38.75	39.00	16.00	16.25	16.50
9c	line wire splicing device	35.73	35.83	35.94	13.23	13.33	13.43
10c	load wire	37.84	38.06	38.26	15.33	15.56	15.75
11c	load wire splicing device	38.75	38.81	38.93	16.24	16.31	16.43
12c	room ambient	22.50	22.49	22.52			
13c	current (amps)	15.01	15.01	15.01			

Test 3c - thru Mfg. 3 15-amp breaker at 150% current (15A * 150% = 22.5A); max temps, reading every 10s

data logger CH #	Location	Recorded Temperatures (°C)			Calculated Temperature Rise (°C)		
scan #	→	23	24	25			
time (MM:SS)	→	2:20	2:30	2:40			
	Breaker trip time	2:50					
1c	Mfg. 11 - 1	32.80	33.29	33.73	10.40	10.89	11.33
2c	Mfg. 11 - 2	34.13	34.67	35.12	11.73	12.27	12.72
3c	Mfg. 11 - 3	32.29	32.77	33.17	9.89	10.37	10.77
4c	Mfg. 8 - 1	33.21	33.67	34.07	10.81	11.27	11.67
5c	Mfg. 8 - 2	34.62	35.08	35.48	12.22	12.68	13.08
6c	Mfg. 8 - 3	32.76	33.21	33.64	10.36	10.81	11.24
7c	circuit breaker	37.29	38.07	38.83	14.89	15.67	16.43
8c	line wire	33.28	33.93	34.55	10.88	11.53	12.15
9c	line wire splicing device	40.01	40.55	41.07	17.61	18.15	18.67
10c	load wire	36.15	36.74	37.30	13.75	14.34	14.90
11c	load wire splicing device	37.79	38.32	38.82	15.39	15.92	16.42
12c	room ambient	22.38	22.41	22.41			
13c	current (amps)	22.43	22.44	22.42			

Appendix C3 Static Heating Tests at 150% Rated Current

Test 3a - thru Mfg. 1 10-amp breaker at 150% current (10A * 150% = 15A); max temps, reading every 10s

data logger CH #	Location	Recorded Temperatures (°C)			Calculated Temperature Rise (°C)		
scan #		23	24	25			
time (MM:SS)		2:20	2:30	2:40			
	Breaker trip time	2:50					
1a	Mfg. 10 - 1	29.81	30.21	30.55	7.56	7.96	8.30
2a	Mfg. 10 - 2	29.70	30.02	30.29	7.44	7.77	8.04
3a	Mfg. 10 - 3	28.37	28.62	28.85	6.12	6.37	6.60
4a	Mfg. 9 - 1	28.22	28.46	28.69	5.97	6.21	6.44
5a	Mfg. 9 - 2	28.46	28.71	28.94	6.21	6.46	6.69
6a	Mfg. 9 - 3	27.73	27.96	28.13	5.48	5.71	5.88
7a	circuit breaker	29.83	30.21	30.53	7.58	7.96	8.28
8a	line wire	34.40	34.90	35.38	12.15	12.65	13.13
9a	line wire splicing device	32.53	32.88	33.18	10.28	10.63	10.93
10a	load wire	33.43	33.88	34.25	11.17	11.63	12.00
11a	load wire splicing device	37.25	37.47	37.66	15.00	15.22	15.41
12a	room ambient	22.28	22.24	22.24			
13a	current (amps)	15.02	15.02	15.02			

Test 3a - thru Mfg. 1 15-amp breaker at 150% current (15A * 150% = 22.5A); max temps, reading every 10s

data logger CH #	Location	Recorded Temperatures (°C)			Calculated Temperature Rise (°C)		
scan #		38	39	40			
time (MM:SS)		4:00	4:10	4:20			
	Breaker trip time	4:30					
1a	Mfg. 10 - 1	40.53	40.89	41.27	18.74	19.10	19.48
2a	Mfg. 10 - 2	42.28	42.67	43.05	20.49	20.88	21.26
3a	Mfg. 10 - 3	39.25	39.54	39.81	17.46	17.75	18.02
4a	Mfg. 9 - 1	39.03	39.37	39.68	17.24	17.58	17.89
5a	Mfg. 9 - 2	40.06	40.40	40.75	18.27	18.61	18.96
6a	Mfg. 9 - 3	35.92	36.14	36.35	14.14	14.35	14.56
7a	circuit breaker	41.66	42.13	42.62	19.87	20.34	20.83
8a	line wire	40.15	40.56	40.91	18.36	18.77	19.12
9a	line wire splicing device	47.60	47.94	48.23	25.81	26.16	26.44
10a	load wire	40.83	41.12	41.46	19.04	19.33	19.67
11a	load wire splicing device	46.50	46.62	46.74	24.72	24.83	24.95
12a	room ambient	21.81	21.79	21.76			
13a	current (amps)	22.35	22.35	22.35			

Test 3b - thru Mfg. 2 10-amp breaker at 150% current (10A * 150% = 15A); max temps, reading every 10s

data logger CH #	Location	Recorded Temperatures (°C)			Calculated Temperature Rise (°C)		
scan #	→	21	22	23			
time (MM:SS)	→	2:00	2:10	2:20			
	Breaker trip time	2:30					
1b	Mfg. 10 - 1	28.72	29.12	29.50	6.58	6.98	7.36
2b	Mfg. 10 - 2	29.55	29.94	30.33	7.41	7.80	8.19
3b	Mfg. 10 - 3	28.01	28.30	28.56	5.87	6.16	6.42
4b	Mfg. 9 - 1	27.72	28.02	28.27	5.58	5.88	6.13
5b	Mfg. 9 - 2	27.97	28.28	28.55	5.83	6.14	6.41
6b	Mfg. 9 - 3	27.58	27.82	28.09	5.44	5.68	5.95
7b	circuit breaker	30.55	31.13	31.74	8.41	8.99	9.60
8b	line wire	31.18	31.69	32.20	9.04	9.55	10.06
9b	line wire splicing device	31.46	31.83	32.14	9.32	9.69	10.00
10b	load wire	28.42	28.81	29.21	6.28	6.67	7.07
11b	load wire splicing device	36.24	36.63	36.93	14.10	14.49	14.79
12b	room ambient	22.20	22.13	22.09			
13b	current (amps)	15.00	15.00	15.00			

Test 3b - thru Mfg. 2 15-amp breaker at 150% current (15A * 150% = 22.5A); max temps, reading every 10s

data logger CH #	Location	Recorded Temperatures (°C)			Calculated Temperature Rise (°C)		
scan #	→	18	19	20			
time (MM:SS)	→	:40	:50	1:00			
	Breaker trip time	1:10					
1b	Mfg. 10 - 1	25.84	26.82	27.77	4.13	5.12	6.06
2b	Mfg. 10 - 2	29.58	31.10	32.54	7.88	9.40	10.83
3b	Mfg. 10 - 3	32.64	34.09	35.41	10.93	12.39	13.71
4b	Mfg. 9 - 1	25.84	26.77	27.65	4.14	5.07	5.94
5b	Mfg. 9 - 2	27.74	28.90	29.94	6.03	7.19	8.24
6b	Mfg. 9 - 3	27.36	28.35	29.32	5.65	6.65	7.62
7b	circuit breaker	26.69	27.90	29.05	4.98	6.20	7.35
8b	line wire	25.29	26.13	26.94	3.59	4.42	5.23
9b	line wire splicing device	28.85	30.25	31.50	7.14	8.54	9.80
10b	load wire	27.35	28.42	29.40	5.65	6.72	7.70
11b	load wire splicing device	29.03	30.42	31.68	7.33	8.71	9.98
12b	room ambient	21.68	21.70	21.73			
13b	current (amps)	22.56	22.55	22.52			

Test 3c - thru Mfg. 3 10-amp breaker at 150% current (10A * 150% = 15A); max temps, reading every 10s

data logger CH #	Location	Recorded Temperatures (°C)			Calculated Temperature Rise (°C)		
scan # →		44	45	46			
time (MM:SS) →		5:50	6:00	6:10			
	Breaker trip time	6:20					
1c	Mfg. 10 - 1	33.95	34.06	34.18	12.26	12.38	12.49
2c	Mfg. 10 - 2	34.86	35.03	35.17	13.17	13.34	13.48
3c	Mfg. 10 - 3	32.06	32.16	32.23	10.37	10.47	10.55
4c	Mfg. 9 - 1	31.67	31.77	31.89	9.98	10.08	10.20
5c	Mfg. 9 - 2	31.89	31.99	32.07	10.20	10.30	10.39
6c	Mfg. 9 - 3	30.51	30.58	30.63	8.82	8.89	8.94
7c	circuit breaker	37.51	37.73	37.94	15.82	16.04	16.25
8c	line wire	38.17	38.32	38.46	16.48	16.63	16.77
9c	line wire splicing device	33.48	33.53	33.58	11.79	11.84	11.89
10c	load wire	37.25	37.38	37.51	15.57	15.70	15.82
11c	load wire splicing device	39.05	39.08	39.09	17.36	17.39	17.40
12c	room ambient	21.68	21.69	21.69			
13c	current (amps)	15.00	15.00	15.00			

Test 3c - thru Mfg. 3 15-amp breaker at 150% current (15A * 150% = 22.5A); max temps, reading every 10s

data logger CH #	Location	Recorded Temperatures (°C)			Calculated Temperature Rise (°C)		
scan # →		28	29	30			
time (MM:SS) →		2:20	2:30	2:40			
	Breaker trip time	2:50					
1c	Mfg. 10 - 1	28.08	27.72	27.38	6.22	5.87	5.53
2c	Mfg. 10 - 2	27.85	27.43	27.08	5.99	5.58	5.23
3c	Mfg. 10 - 3	26.82	26.45	26.13	4.97	4.59	4.27
4c	Mfg. 9 - 1	26.62	26.30	26.02	4.76	4.45	4.17
5c	Mfg. 9 - 2	26.78	26.44	26.12	4.92	4.58	4.27
6c	Mfg. 9 - 3	26.00	25.71	25.47	4.15	3.86	3.62
7c	circuit breaker	30.09	29.81	29.54	8.23	7.95	7.68
8c	line wire	27.46	27.28	27.08	5.61	5.42	5.22
9c	line wire splicing device	27.03	26.55	26.12	5.18	4.69	4.26
10c	load wire	27.36	27.10	26.84	5.50	5.24	4.98
11c	load wire splicing device	27.70	27.09	26.53	5.84	5.23	4.67
12c	room ambient	21.89	21.86	21.82			
13c	current (amps)	22.40	22.39	22.39			

Appendix C4 Static Heating Tests at 200% Rated Current

Test 4a - thru Mfg. 1 10-amp breaker at 200% current (10A * 200% = 20A); max temps, reading every 7s

data logger CH #	Location	Recorded Temperatures (°C)			Calculated Temperature Rise (°C)		
scan # →		10	11	12			
time (MM:SS) →		:15	:21	:28			
	Breaker trip time	:35					
1a	Mfg. 11 - 1	24.11	24.67	25.32	2.07	2.62	3.28
2a	Mfg. 11 - 2	24.06	24.59	25.25	2.02	2.55	3.20
3a	Mfg. 11 - 3	24.07	24.57	25.16	2.03	2.52	3.12
4a	Mfg. 8 - 1	24.08	24.69	25.40	2.03	2.64	3.35
5a	Mfg. 8 - 2	24.66	25.33	26.11	2.61	3.28	4.06
6a	Mfg. 8 - 3	24.22	24.83	25.55	2.17	2.79	3.50
7a	circuit breaker	24.11	24.82	25.62	2.07	2.77	3.57
8a	line wire	27.40	28.75	30.11	5.35	6.71	8.06
9a	line wire splicing device	25.44	26.76	28.29	3.40	4.72	6.24
10a	load wire	26.61	27.77	28.96	4.57	5.72	6.91
11a	load wire splicing device	26.63	28.24	30.08	4.59	6.20	8.04
12a	room ambient	22.05	22.06	22.03			
13a	current (amps)	19.99	20.01	20.01			

Test 4a - thru Mfg. 1 15-amp breaker at 200% current (15A * 200% = 30A); max temps, reading every 7s

data logger CH #	Location	Recorded Temperatures (°C)			Calculated Temperature Rise (°C)		
scan # →		20	21	22			
time (MM:SS) →		:28	:35	:42			
	Breaker trip time	:49					
1a	Mfg. 11 - 1	27.71	28.87	30.04	5.22	6.37	7.55
2a	Mfg. 11 - 2	27.71	28.87	30.05	5.22	6.38	7.56
3a	Mfg. 11 - 3	27.95	28.97	30.04	5.46	6.47	7.54
4a	Mfg. 8 - 1	27.60	28.90	30.19	5.11	6.40	7.70
5a	Mfg. 8 - 2	28.56	29.91	31.25	6.06	7.42	8.76
6a	Mfg. 8 - 3	29.13	30.23	31.51	6.63	7.73	9.02
7a	circuit breaker	27.85	29.29	30.80	5.35	6.80	8.30
8a	line wire	29.17	30.44	31.74	6.68	7.95	9.24
9a	line wire splicing device	36.20	38.78	41.38	13.71	16.28	18.89
10a	load wire	29.69	31.07	32.48	7.20	8.58	9.98
11a	load wire splicing device	36.64	39.18	41.65	14.14	16.69	19.15
12a	room ambient	22.48	22.48	22.52			
13a	current (amps)	29.87	29.79	29.76			

Appendix C4 Static Heating Tests at 200% Rated Current

Test 4b - thru Mfg. 2 10-amp breaker at 200% current (10A * 200% = 20A); max temps, reading every 7s

data logger CH #	Location	Recorded Temperatures (°C)			Calculated Temperature Rise (°C)		
scan # →		10	11	12			
time (MM:SS) →		:15	:21	:28			
	Breaker trip time	:35					
1b	Mfg. 11 - 1	23.92	24.53	25.23	2.00	2.60	3.30
2b	Mfg. 11 - 2	23.87	24.40	25.03	1.95	2.48	3.10
3b	Mfg. 11 - 3	24.04	24.56	25.19	2.11	2.64	3.27
4b	Mfg. 8 - 1	24.03	24.67	25.43	2.11	2.74	3.51
5b	Mfg. 8 - 2	24.81	25.54	26.38	2.89	3.62	4.46
6b	Mfg. 8 - 3	24.09	24.69	25.38	2.17	2.77	3.46
7b	circuit breaker	23.99	24.68	25.52	2.07	2.75	3.60
8b	line wire	25.64	26.65	27.71	3.72	4.73	5.78
9b	line wire splicing device	25.15	26.44	27.96	3.22	4.52	6.03
10b	load wire	23.65	24.33	25.10	1.73	2.41	3.18
11b	load wire splicing device	26.05	27.55	29.19	4.13	5.63	7.27
12b	room ambient	21.94	21.92	21.90			
13b	current (amps)	20.00	20.00	20.00			

Test 4b - thru Mfg. 2 15-amp breaker at 200% current (15A * 200% = 30A); max temps, reading every 7s

data logger CH #	Location	Recorded Temperatures (°C)			Calculated Temperature Rise (°C)		
scan # →		16	17	18			
time (MM:SS) →		:00	:09	:15			
	Breaker trip time	:21					
1b	Mfg. 11 - 1	22.78	24.58	25.64	0.28	2.08	3.14
2b	Mfg. 11 - 2	22.55	23.95	24.94	0.05	1.45	2.44
3b	Mfg. 11 - 3	22.78	24.32	25.15	0.28	1.82	2.65
4b	Mfg. 8 - 1	22.67	24.22	25.26	0.17	1.72	2.76
5b	Mfg. 8 - 2	23.01	25.35	26.56	0.52	2.85	4.06
6b	Mfg. 8 - 3	23.06	25.22	26.32	0.57	2.72	3.83
7b	circuit breaker	22.89	24.64	25.66	0.39	2.15	3.17
8b	line wire	22.78	24.14	25.26	0.28	1.64	2.76
9b	line wire splicing device	22.80	25.27	27.08	0.30	2.77	4.59
10b	load wire	22.73	25.29	26.72	0.23	2.79	4.22
11b	load wire splicing device	22.84	25.76	27.75	0.34	3.26	5.26
12b	room ambient	22.49	22.49	22.51			
13b	current (amps)	29.72	29.67	29.65			

Test 4c - thru Mfg. 3 10-amp breaker at 200% current (10A * 200% = 20A); max temps, reading every 7s

data logger CH #	Location	Recorded Temperatures (°C)			Calculated Temperature Rise (°C)		
scan #		16	17	18			
time (MM:SS)		:56	1:03	1:10			
	Breaker trip time	1:17					
1c	Mfg. 11 - 1	27.91	28.45	29.02	5.96	6.50	7.07
2c	Mfg. 11 - 2	27.83	28.34	28.85	5.88	6.39	6.90
3c	Mfg. 11 - 3	26.46	26.84	27.26	4.51	4.89	5.31
4c	Mfg. 8 - 1	28.33	28.89	29.46	6.38	6.94	7.51
5c	Mfg. 8 - 2	28.77	29.28	29.81	6.82	7.33	7.86
6c	Mfg. 8 - 3	27.76	28.25	28.71	5.81	6.30	6.76
7c	circuit breaker	30.95	31.72	32.52	8.99	9.77	10.56
8c	line wire	32.07	32.86	33.68	10.12	10.91	11.73
9c	line wire splicing device	31.50	32.36	33.19	9.54	10.41	11.24
10c	load wire	32.53	33.29	34.09	10.58	11.34	12.14
11c	load wire splicing device	36.35	37.44	38.34	14.40	15.49	16.39
12c	room ambient	22.03	21.91	21.92			
13c	current (amps)	20.00	20.00	20.00			

Test 4c - thru Mfg. 3 15-amp breaker at 200% current (15A * 200% = 30A); max temps, reading every 7s

data logger CH #	Location	Recorded Temperatures (°C)			Calculated Temperature Rise (°C)		
scan #		18	19	20			
time (MM:SS)		:15	:21	:28			
	Breaker trip time	:35					
1c	Mfg. 11 - 1	24.86	25.82	26.97	2.56	3.52	4.67
2c	Mfg. 11 - 2	25.87	27.00	28.27	3.57	4.70	5.97
3c	Mfg. 11 - 3	25.45	26.38	27.49	3.15	4.08	5.19
4c	Mfg. 8 - 1	25.11	26.19	27.48	2.81	3.89	5.18
5c	Mfg. 8 - 2	26.49	27.73	29.14	4.19	5.43	6.85
6c	Mfg. 8 - 3	25.08	26.08	27.24	2.78	3.78	4.94
7c	circuit breaker	25.44	26.60	28.04	3.14	4.30	5.74
8c	line wire	24.49	25.44	26.52	2.20	3.15	4.22
9c	line wire splicing device	27.39	29.24	31.37	5.09	6.95	9.07
10c	load wire	26.18	27.74	29.43	3.88	5.44	7.13
11c	load wire splicing device	26.21	27.89	29.79	3.91	5.59	7.49
12c	room ambient	22.31	22.30	22.29			
13c	current (amps)	29.59	29.78	29.83			

Appendix C4 Static Heating Tests at 200% Rated Current

Test 4a - thru Mfg. 1 10-amp breaker at 200% current (10A * 200% = 20A); max temps, reading every 7s

data logger CH #	Location	Recorded Temperatures (°C)			Calculated Temperature Rise (°C)		
scan #		27	28	29			
time (MM:SS)		:15	:21	:28			
	Breaker trip time	:35					
1a	Mfg. 10 - 1	24.20	24.89	25.74	2.53	3.23	4.07
2a	Mfg. 10 - 2	24.11	24.81	25.65	2.45	3.14	3.99
3a	Mfg. 10 - 3	23.82	24.42	25.12	2.16	2.76	3.45
4a	Mfg. 9 - 1	23.70	24.28	24.96	2.04	2.62	3.29
5a	Mfg. 9 - 2	23.89	24.51	25.23	2.22	2.84	3.57
6a	Mfg. 9 - 3	23.66	24.22	24.90	1.99	2.55	3.23
7a	circuit breaker	23.81	24.47	25.29	2.14	2.80	3.63
8a	line wire	26.99	28.37	29.76	5.32	6.71	8.09
9a	line wire splicing device	24.05	25.15	26.46	2.39	3.48	4.79
10a	load wire	26.61	27.85	29.13	4.94	6.19	7.47
11a	load wire splicing device	28.24	30.24	32.42	6.58	8.58	10.75
12a	room ambient	21.68	21.67	21.66			
13a	current (amps)	20.02	20.03	20.03			

Test 4a - thru Mfg. 1 15-amp breaker at 200% current (15A * 200% = 30A); max temps, reading every 7s

data logger CH #	Location	Recorded Temperatures (°C)			Calculated Temperature Rise (°C)		
scan #		17	18	19			
time (MM:SS)		:28	:35	:42			
	Breaker trip time	:49					
1a	Mfg. 10 - 1	27.27	28.75	30.17	5.77	7.24	8.67
2a	Mfg. 10 - 2	28.89	30.53	32.07	7.38	9.02	10.56
3a	Mfg. 10 - 3	27.89	29.33	30.74	6.38	7.82	9.24
4a	Mfg. 9 - 1	27.16	28.54	29.90	5.66	7.04	8.39
5a	Mfg. 9 - 2	28.09	29.55	30.97	6.58	8.05	9.46
6a	Mfg. 9 - 3	27.93	29.14	30.27	6.43	7.64	8.77
7a	circuit breaker	26.82	28.27	29.71	5.32	6.77	8.20
8a	line wire	28.15	29.45	30.67	6.65	7.95	9.17
9a	line wire splicing device	34.08	36.63	38.99	12.57	15.13	17.49
10a	load wire	28.54	29.95	31.29	7.03	8.45	9.79
11a	load wire splicing device	35.97	38.68	41.18	14.47	17.17	19.67
12a	room ambient	21.49	21.52	21.51			
13a	current (amps)	29.88	29.83	29.82			

Appendix C4 Static Heating Tests at 200% Rated Current

Test 4b - thru Mfg. 2 10-amp breaker at 200% current (10A * 200% = 20A); max temps, reading every 7s

data logger CH #	Location	Recorded Temperatures (°C)			Calculated Temperature Rise (°C)		
scan #		27	28	29			
time (MM:SS)		:15	:21	:28			
	Breaker trip time	:35					
1b	Mfg. 10 - 1	23.68	24.31	25.08	2.15	2.79	3.55
2b	Mfg. 10 - 2	24.00	24.79	25.66	2.47	3.26	4.13
3b	Mfg. 10 - 3	23.96	24.59	25.27	2.43	3.06	3.74
4b	Mfg. 9 - 1	23.67	24.25	24.93	2.14	2.73	3.40
5b	Mfg. 9 - 2	23.75	24.36	25.10	2.22	2.84	3.58
6b	Mfg. 9 - 3	23.79	24.37	25.03	2.26	2.84	3.50
7b	circuit breaker	23.69	24.36	25.21	2.16	2.84	3.69
8b	line wire	25.34	26.37	27.40	3.81	4.84	5.88
9b	line wire splicing device	24.37	25.54	26.91	2.84	4.01	5.38
10b	load wire	23.38	24.06	24.84	1.86	2.54	3.32
11b	load wire splicing device	28.62	30.57	32.60	7.09	9.05	11.07
12b	room ambient	21.54	21.54	21.50			
13b	current (amps)	19.99	19.99	19.99			

Test 4b - thru Mfg. 2 15-amp breaker at 200% current (15A * 200% = 30A); max temps, reading every 7s

data logger CH #	Location	Recorded Temperatures (°C)			Calculated Temperature Rise (°C)		
scan #		13	14	15			
time (MM:SS)		0:00	:09	:15			
	Breaker trip time	:21					
1b	Mfg. 10 - 1	21.91	23.26	24.56	0.52	1.87	3.16
2b	Mfg. 10 - 2	21.93	24.79	26.37	0.54	3.40	4.97
3b	Mfg. 10 - 3	21.91	23.93	25.26	0.52	2.54	3.87
4b	Mfg. 9 - 1	21.95	24.22	25.49	0.56	2.83	4.10
5b	Mfg. 9 - 2	21.93	24.57	25.87	0.54	3.18	4.48
6b	Mfg. 9 - 3	21.90	24.12	25.30	0.51	2.73	3.90
7b	circuit breaker	22.03	23.68	24.72	0.64	2.28	3.33
8b	line wire	22.07	23.08	24.22	0.68	1.69	2.83
9b	line wire splicing device	21.89	24.14	26.27	0.50	2.75	4.87
10b	load wire	21.93	24.17	25.69	0.54	2.78	4.30
11b	load wire splicing device	21.95	26.40	28.99	0.56	5.01	7.60
12b	room ambient	21.40	21.38	21.40			
13b	current (amps)	30.03	29.98	29.94			

Test 4c - thru Mfg. 3 10-amp breaker at 200% current (10A * 200% = 20A); max temps, reading every 7s

data logger CH #	Location	Recorded Temperatures (°C)			Calculated Temperature Rise (°C)		
scan #		33	34	35			
time (MM:SS)		:56	1:03	1:10			
	Breaker trip time	1:17					
1c	Mfg. 10 - 1	28.89	29.56	30.22	7.33	8.01	8.67
2c	Mfg. 10 - 2	29.13	29.80	30.47	7.57	8.25	8.92
3c	Mfg. 10 - 3	28.24	28.82	29.43	6.69	7.27	7.87
4c	Mfg. 9 - 1	27.96	28.54	29.11	6.41	6.98	7.56
5c	Mfg. 9 - 2	27.95	28.55	29.13	6.40	6.99	7.58
6c	Mfg. 9 - 3	27.87	28.37	28.89	6.31	6.82	7.34
7c	circuit breaker	30.46	31.20	31.96	8.91	9.65	10.41
8c	line wire	31.76	32.54	33.32	10.20	10.99	11.77
9c	line wire splicing device	30.32	31.15	31.96	8.77	9.60	10.41
10c	load wire	32.17	32.94	33.69	10.62	11.39	12.14
11c	load wire splicing device	39.40	40.57	41.66	17.85	19.02	20.11
12c	room ambient	21.59	21.54	21.53			
13c	current (amps)	20.00	20.00	20.00			

Test 4c - thru Mfg. 3 15-amp breaker at 200% current (15A * 200% = 30A); max temps, reading every 7s

data logger CH #	Location	Recorded Temperatures (°C)			Calculated Temperature Rise (°C)		
scan #		16	17	18			
time (MM:SS)		:21	:28	:35			
	Breaker trip time	:42					
1c	Mfg. 10 - 1	24.57	25.84	27.05	3.19	4.45	5.67
2c	Mfg. 10 - 2	28.42	30.54	32.56	7.04	9.16	11.18
3c	Mfg. 10 - 3	33.47	35.78	37.86	12.09	14.40	16.48
4c	Mfg. 9 - 1	24.87	26.08	27.27	3.49	4.70	5.89
5c	Mfg. 9 - 2	27.04	28.63	30.11	5.66	7.25	8.73
6c	Mfg. 9 - 3	26.95	28.35	29.72	5.57	6.97	8.34
7c	circuit breaker	25.75	27.15	28.60	4.37	5.77	7.22
8c	line wire	24.57	25.65	26.68	3.19	4.27	5.30
9c	line wire splicing device	27.76	29.81	31.74	6.38	8.43	10.35
10c	load wire	26.52	28.22	29.72	5.14	6.84	8.34
11c	load wire splicing device	27.66	29.85	31.88	6.28	8.47	10.49
12c	room ambient	21.40	21.37	21.36			
13c	current (amps)	29.34	29.29	30.17			

Appendix C5 Static Heating Testing Schneider Circuit Breaker

Test 1b - thru Mfg. 2 10-amp breaker at 100% current (10A * 100% = 10A); max temps, reading every 60s

data logger CH #	Location	Recorded Temperatures (°C)			Calculated Temperature Rise (°C)		
scan #	→	67	72	77			
time (HH:MM:SS)	→	1:04:00	1:09:00	1:14:00			
1b	Mfg. 10 - 1	33.66	33.62	33.48	12.17	12.13	11.99
2b	Mfg. 10 - 2	30.46	30.56	30.61	8.97	9.07	9.12
3b	Mfg. 10 - 3	28.97	29.03	28.87	7.48	7.54	7.38
4b	Mfg. 9 - 1	28.59	28.61	28.68	7.10	7.12	7.19
5b	Mfg. 9 - 2	29.99	29.94	29.81	8.50	8.45	8.32
6b	Mfg. 9 - 3	28.44	28.40	28.15	6.95	6.91	6.66
7b	circuit breaker	41.26	41.48	41.60	19.77	19.99	20.11
8b	line wire	31.15	30.97	30.89	9.66	9.48	9.40
9b	line wire splicing device	28.63	28.27	28.01	7.14	6.78	6.52
10b	load wire	28.45	28.20	28.09	6.96	6.71	6.60
11b	load wire splicing device	30.47	29.94	29.87	8.98	8.45	8.38
12b	room ambient	22.46	22.07	21.66			
13b	current (amps)	10.01	10.01	10.01			

Test 2b - thru Mfg. 2 10-amp breaker at 135% current (10A * 135% = 13.5A); max temps, reading every 20s

data logger CH #	Location	Recorded Temperatures (°C)			Calculated Temperature Rise (°C)		
scan #	→	202	203	204			
time (MM:SS)	→	66:20	66:40	67:00			
	Breaker trip time	> 67 mins. (no trip)					
1b	Mfg. 10 - 1	40.89	40.89	40.88	18.96	18.97	18.96
2b	Mfg. 10 - 2	37.03	37.03	37.04	15.11	15.11	15.12
3b	Mfg. 10 - 3	34.24	34.26	34.21	12.31	12.34	12.29
4b	Mfg. 9 - 1	33.52	33.50	33.53	11.60	11.58	11.61
5b	Mfg. 9 - 2	35.79	35.78	35.75	13.87	13.86	13.83
6b	Mfg. 9 - 3	33.44	33.45	33.39	11.52	11.53	11.47
7b	circuit breaker	56.60	56.56	56.59	34.68	34.64	34.67
8b	line wire	38.73	38.68	38.65	16.81	16.76	16.72
9b	line wire splicing device	33.69	33.57	33.57	11.76	11.65	11.65
10b	load wire	33.57	33.50	33.50	11.65	11.57	11.58
11b	load wire splicing device	37.08	36.99	37.04	15.16	15.07	15.12
12b	room ambient	22.10	22.03	21.97			
13b	current (amps)	13.49	13.49	13.49			

Appendix D Flexing Tests

Conductor Flexing tests on 14-2 AWG copper-clad aluminum NMB cable:

test #	wire connection method	pass / fail (10x flexion)	comments
6-1	wrap around terminal screw	pass	ends of hot and neutral wires broke when removing them from their terminals after the test
6-2	single compression	pass	
6-3	double compression	pass	
6-1-1	wrap around terminal screw	failed	retest of 6-1; hot wire (black) broke on 8th flexion
6-1-2	wrap around terminal screw	pass	retest of 6-1 using copper wire
6-1-3	wrap around terminal screw	pass	retest of 6-1

NOTE: One Legrand receptacle was used for all 3 tests above and 9in/lbs was applied to all three terminal screws.

PACIFIC TEST AND MEASUREMENT

PO Box 2363, Clackamas, OR 97015
15648 114th Ave. Suite 109, Clackamas OR 97015
Phone: 503-406-4373 Fax: 503 905 0457
www.pacifictestandmeasurement.com

Certificate of Conformance

Issued to:	CDCMello Consulting LLC PO Box 872317 Vancouver, WA 98687
Customer PO:	Verbal Chuck Mello
Model:	UL3055
Lot Number:	952103-019
Report:	JK202006300-003
Description:	Type J, 30 Gauge FEP/FEP Teflon, Special Limits of Error Tolerance, 15 feet length, Thermocouple

Pacific Test and Measurement Inc certifies that the order of thermocouples meets all applicable instructions, specifications, and in accordance with DAP UL 00-OP-C0037 version 10.0. The preferred method of welding to produce a single point weld or bead using ThermX model 258B welder has been used to assemble the thermocouple junction which has been proven as reliable and repeatable through validation. The finish products were assembled from UL4047, a spool of described wire calibrated to accredited standards as described in the calibration report.

Certified by: ______________________ Date: ___7-10-2020________
(Quality Department)

ACCREDITED
CERT #2496.01

Report of Calibration

Eustis Co.,Inc./Pyrocom Calibration lab
12407-B Mukilteo Speedway #200
Lynnwood, wa 98087

Report No: JK202006300-003

Model: UL4047 Serial: 952103-019 Description: TYPE J, 30AWG, FEP/FEP	Customer: . . CDCMello Consulting LLC PO Box 872317 Vancouver, WA 98687
Calibration Range: Limited Received Condition: New Current: N/A Procedure: ECP 339/341	

The unit under test (UUT) on this certificate has been calibrated by comparison method as covered by ASTM E220-13, and calibrated against standards traceable to the National Institute of Standards and Technology (NIST). Eustis Co., Inc./Pyrocom Calibration Lab meets the requirements of ANSI/NCSL Z540-1-1994 and ISO/IEC 17025 and is accredited by A2LA via Certificate Number 2496.01 for calibrations within the scope to which it applies. The uncertainty represents an expanded uncertainty expressed at approximately the 95% confidence level using a coverage factor of k=2. All results contained within this certificate relate only to the item calibrated. Any number of factors may cause the calibrated item to drift out of calibration.

Nominal Value (Set-point) (C)	**Actual Value (Reference) (C)**	**UUT (Test Sensor) (C)**	**Error (C)**	**Measurement Uncertainty (C)**	**Method of Realization**
21.00	21.41	21.38	-0.03	+/- 0.31	COMP
40.00	40.08	40.02	-0.06	+/- 0.40	COMP
95.00	95.02	94.97	-0.05	+/- 0.40	COMP
150.00	150.02	150.10	0.08	+/- 0.50	COMP
200.00	200.01	200.23	0.22	+/- 0.50	COMP

Test Equipment

Manufacturer	Model	Description	Serial Number	Recall Date
Hart Scientific	1560	"Black Stack" Base Unit	96539	NCR
Hart Scientific	2560	SPRT Module	A25631	3/24/2021
Fluke	5628	4 Wire SPRT	4303	3/26/2021
Fluke	2566	Thermocouple Scanner	B7A380	3/24/2021
Fluke	9173	Metrology Well, 700 C	B47975	NCR
Fluke	7380	Bath, Ultra Low-Temperature	B2A527	NCR

Calibration Date: 6/18/2020
Temperature: 23.0 C
Humidity: 47%
Customer Order: 74523

Technician: Kulin
Julia Kulin

Approved By: WPaulson
Walter Paulson
QA Manager

Report of Calibration

Notes: The thermocouple wire meets or exceeds the criteria established for type "J" SPECIAL LIMITS OF ERROR per ASTM E230/E230M-17 table 1 & ISA-MC96.1-1982 Par. 2.5 Table 8 +/- 1.1°C OR +/- .4% whichever is greater. Lot calibration data supplied for your reference.
Calibrated item meets special limits of error for all results given according to the comparison of "error" reading to the specifications found in ASTM E230/E230M-17 table 1 & MC96.1-1982 table 8; acceptance determination is ultimately the responsibility of the customer, taking into account all uncertainties and other factors. The closer the results are to the specification limits, the greater the risk that the unit under test will be out of tolerance.

Report issue date: JUN 1 9 2020

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CERTIFICATE OF CALIBRATION

ilac-MRA ANAB ACCREDITED ISO IEC 17025 CALIBRATION AND TESTING LABORATORY
Certificate No. ACT-1272

Certification Number CK198-33105-466

For Eaton Corporation - ICD
W126 N7250 Flint Drive
Menomonee Falls, WI 53051

Purchase Order #	4044-671109
Test Instrument	Data Acquisition Unit
Make	Keysight
Model	34972A
Serial Number	MY49002695
Identification	EM7054
Customer Location	ICD
Condition Received	In Tolerance
Condition Returned	In Tolerance
Calibrated By	Alex Paulsen
Technical Review By	Tim Bending
Calibration Location	FVM
Calibration Conditions	67.8°F, 19.9°C, 57.3%RH
Calibration Date	07/16/2020
Recalibration Due	07/16/2021

Procedures Followed
FVE-000 rev. 2
FVE-006 rev. 2

Standards Used

Instrument	Serial Number	Trace Number	Next Cal
FVS-275A	RY11838	CJ191-70508-513	07/28/2020
FVS-737	4542903	CK041-57440-531	02/28/2021

Total expanded measurement uncertainties expressed are based on a confidence level of 95%; coverage factor of (k=2). The statement of compliance in this certificate was issued without taking the uncertainty of measurement into consideration. The customer shall assess the results and uncertainty when determining if the results meet their needs. (This is considered "shared responsibility.") Uncertainties expressed in nominal units.

All instruments have been calibrated against standards traceable to NIST. Calibration was completed in accordance with ISO/IEC 17025:2017, ANSI/NCSL Z540-1-1994 and ANSI/NCSL Z540.3-2006. Other standards listed upon request.

Calibration Results

* denotes "Out of Tolerance"

Feature	Nominal	Lower Limit	Upper Limit	As Found	As Left	Uncertainty
Root Difference Square guardbanding method used.						
UUT IDENTIFICATION						
Serial Number: MY49002695 Firmware Level: 1.11-1.12-02-01						
INPUT MODULE CHARACTERISTICS						
Model: 34901A Firmware Level: 2.3						
SELF TEST				Pass	Pass	

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Certificate No. ACT-1272

Feature	Nominal	Lower Limit	Upper Limit	As Found	As Left	Uncertainty
INTERNAL DMM VERIFICATION						
ZERO OFFSET VERIFICATION						
DC CURRENT						
10 mA Range						
0.00000 mA	0.00000	-0.00200	0.00200	0.00003	0.00003	0.000007
100 mA Range						
0.0000 mA	0.0000	-0.0050	0.0050	0.0000	0.0000	0.00006
1 A Range						
0.000000 A	0.000000	-0.000100	0.000100	0.000001	0.000001	0.0000006
DC VOLTS						
100 mV Range						
0.0000 mV	0.0000	-0.0040	0.0040	0.0004	0.0004	0.00007
1 V Range						
0.000000 V	0.000000	-0.000007	0.000007	0.000001	0.000001	0.0000007
10 V Range						
0.00000 V	0.00000	-0.00005	0.00005	0.00000	0.00000	0.000007
100 V Range						
0.0000 V	0.0000	-0.0006	0.0006	0.0000	0.0000	0.00006
300 V Range						
0.000 V	0.000	-0.009	0.009	0.000	0.000	0.0006
2 WIRE						
100 Range						
0.0000 Ohm	0.0000	-4.0040	4.0040	0.0626	0.0626	0.00007
1 k Range						
0.000000 kOhm	0.000000	-0.004010	0.004010	0.000065	0.000065	0.0000006
10 k Range						
0.00000 kOhm	0.00000	-0.00410	0.00410	0.00008	0.00008	0.000006
100 k Range						
0.0000 kOhm	0.0000	-0.0050	0.0050	0.0002	0.0002	0.00007
1 M Range						
0.000000 MOhm	0.000000	-0.000014	0.000014	0.000000	0.000000	0.0000007
10 M Range						

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Feature	Nominal	Lower Limit	Upper Limit	As Found	As Left	Uncertainty
0.00000 MOhm	0.00000	-0.00010	0.00010	0.00000	0.00000	0.000007
100 M? Range						
0.0000 MOhm	0.0000	-0.0100	0.0100	0.0000	0.0000	0.00006
4 WIRE						
100 Range						
0.0000 Ohm	0.0000	-0.0040	0.0040	-0.0023	-0.0023	0.00006
1 k Range						
0.000000 kOhm	0.000000	-0.000010	0.000010	0.000000	0.000000	0.0000006
10 k Range						
0.00000 kOhm	0.00000	-0.00010	0.00010	0.00000	0.00000	0.000007
100 k Range						
0.0000 kOhm	0.0000	-0.0010	0.0010	0.0000	0.0000	0.00007
1 M Range						
0.000000 MOhm	0.000000	-0.000010	0.000010	0.000000	0.000000	0.0000006
10 M Range						
0.00000 MOhm	0.00000	-0.00010	0.00010	0.00000	0.00000	0.000006
100 M Range						
0.0000 MOhm	0.0000	-0.0100	0.0100	0.0000	0.0000	0.00007
GAIN VERIFICATION						
DC VOLTS						
100 mV Range						
100.0000 mV	100.0000	99.9910	100.0090	100.0000	100.0000	0.00006
-100.0000 mV	-100.0000	-100.0090	-99.9910	-99.9987	-99.9987	0.00007
1 V Range						
1.000000 V	1.000000	0.999953	1.000047	0.999993	0.999993	0.0000007
-1.000000 V	-1.000000	-1.000047	-0.999953	-0.999989	-0.999989	0.0000007
10 V Range						
10.00000 V	10.00000	9.99960	10.00040	9.99994	9.99994	0.000006
-10.00000 V	-10.00000	-10.00040	-9.99960	-9.99992	-9.99992	0.000006
100 V Range						
100.0000 V	100.0000	99.9949	100.0051	99.9996	99.9996	0.00007
-100.0000 V	-100.0000	-100.0051	-99.9949	-99.9993	-99.9993	0.00007
300 V Range						
300.000 V	300.000	299.978	300.022	299.998	299.998	0.0006

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Certificate No. ACT-1272

Feature	Nominal	Lower Limit	Upper Limit	As Found	As Left	Uncertainty
2 WIRE						
100 Range						
100.0000 Ohm	100.0000	95.9860	104.0140	100.0067	100.0067	0.00007
1 k Range						
1.000000 kOhm	1.000000	0.995890	1.004110	1.000032	1.000032	0.0000006
10 k Range						
10.00000 kOhm	10.00000	9.99490	10.00510	10.00035	10.00035	0.000007
100 k Range						
100.0000 kOhm	100.0000	99.9850	100.0150	100.0029	100.0029	0.00006
1 M Range						
1.000000 MOhm	1.000000	0.999886	1.000114	1.000016	1.000016	0.0000006
10 M Range						
10.00000 MOhm	10.00000	9.99590	10.00410	9.99768	9.99768	0.000006
100 M Range						
100.0000 MOhm	100.0000	99.1900	100.8100	100.3688	100.3688	0.00007
4 WIRE						
100 Range						
100.0000 Ohm	100.0000	99.9860	100.0140	100.0039	100.0039	0.00006
1 k Range						
1.000000 kOhm	1.000000	0.999890	1.000110	1.000030	1.000030	0.0000007
10 k Range						
10.00000 kOhm	10.00000	9.99890	10.00110	10.00032	10.00032	0.000006
100 k Range						
100.0000 kOhm	100.0000	99.9890	100.0110	100.0021	100.0021	0.00007
1 M Range						
1.000000 MOhm	1.000000	0.999890	1.000110	0.999970	0.999970	0.0000007
10 M Range						
10.00000 MOhm	10.00000	9.99590	10.00410	9.99595	9.99595	0.000006
100 M Range						
100.0000 MOhm	100.0000	99.1900	100.8100	99.8275	99.8275	0.00006
DC CURRENT						
10 mA Range						
10.00000 mA	10.00000	9.99300	10.00700	9.99898	9.99898	0.000007
-10.00000 mA	-10.00000	-10.00700	-9.99300	-9.99887	-9.99887	0.000007

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Feature	Nominal	Lower Limit	Upper Limit	As Found	As Left	Uncertainty
100 mA Range						
100.0000 mA	100.0000	99.9450	100.0550	99.9882	99.9882	0.00006
-100.0000 mA	-100.0000	-100.0550	-99.9450	-99.9879	-99.9879	0.00006
1 A Range						
1.000000 A	1.000000	0.998900	1.001100	0.999534	0.999534	0.0000006
-1.000000 A	-1.000000	-1.001100	-0.998900	-0.999537	-0.999537	0.0000006
AC VOLTS						
100 mV Range						
10.0000 mV @ 1 kHz	10.0000	9.9540	10.0460	9.9997	9.9997	0.00006
100.0000 mV @ 1 kHz	100.0000	99.9000	100.1000	99.9912	99.9912	0.00006
100.0000 mV @ 50 kHz	100.0000	99.8300	100.1700	99.9383	99.9383	0.00006
1 V Range						
1.000000 V @ 20 Hz	1.000000	0.999000	1.001000	0.999803	0.999803	0.0000006
1.000000 V @ 1 kHz	1.000000	0.999000	1.001000	0.999950	0.999950	0.0000006
1.000000 V @ 20 kHz	1.000000	0.999000	1.001000	0.999888	0.999888	0.0000006
1.000000 V @ 50 kHz	1.000000	0.998300	1.001700	0.999504	0.999504	0.0000007
1.000000 V @ 100 kHz	1.000000	0.993200	1.006800	0.998811	0.998811	0.0000006
1.000000 V @ 200 kHz	1.000000	0.955000	1.045000	0.999068	0.999068	0.0000006
1.000000 V @ 250 kHz	1.000000	0.955000	1.045000	0.999202	0.999202	0.0000007
1.000000 V @ 300 kHz	1.000000	0.955000	1.045000	0.998797	0.998797	0.0000006
10 V Range						
0.10000 V @ 1 kHz	0.10000	0.08594	0.11406	0.10086	0.10086	0.000006
1.00000 V @ 1 kHz	1.00000	0.99540	1.00460	0.99992	0.99992	0.000006
10.00000 V @ 10 Hz	10.00000	9.99000	10.01000	9.99743	9.99743	0.000007
10.00000 V @ 1 kHz	10.00000	9.99000	10.01000	9.99855	9.99855	0.000006
10.00000 V @ 50 kHz	10.00000	9.98300	10.01700	9.99499	9.99499	0.000006
100 V Range						
100.0000 V @ 1 kHz	100.0000	99.9000	100.1000	99.9653	99.9653	0.00006
100.0000 V @ 50 kHz	100.0000	99.8300	100.1700	99.8943	99.8943	0.00006

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Feature	Nominal	Lower Limit	Upper Limit	As Found	As Left	Uncertainty
300 V Range						
300.000 V @ 1 kHz	300.000	299.580	300.420	299.884	299.884	0.0006
200.000 V @ 50 kHz	200.000	199.400	200.600	199.750	199.750	0.0007
AC CURRENT						
10 mA Range						
10.00000 mA @ 1 kHz	10.00000	9.98600	10.01400	9.99766	9.99766	0.000007
100 mA Range						
100.0000 mA @ 1 kHz	100.0000	99.4000	100.6000	99.9484	99.9484	0.00007
1 A Range						
0.010000 A @ 1 kHz	0.010000	0.008590	0.011410	0.009960	0.009960	0.0000007
1.000000 A @ 1 kHz	1.000000	0.998600	1.001400	0.999502	0.999502	0.0000006
FREQUENCY						
100 Hz Range						
100.0000 Hz	100.0000	99.9000	100.1000	100.0056	100.0056	0.00007
100 kHz Range						
100.0000 kHz	100.0000	99.9900	100.0100	100.0001	100.0001	0.00007

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CERTIFICATE OF CALIBRATION

ACCREDITED ISO IEC 17025 CALIBRATION AND TESTING LABORATORY

Certificate No. ACT-1272

Certification Number CK198-39504-466

For Eaton Corporation - ICD
W126 N7250 Flint Drive
Menomonee Falls, WI 53051

Purchase Order #	4044-671109
Test Instrument	Multimeter Digital Multimeter
Make	Fluke
Model	179
Serial Number	77840008
Identification	EM4437
Customer Location	ICD
Condition Received	In Tolerance
Condition Returned	In Tolerance
Calibrated By	Alex Paulsen
Technical Review By	Tim Bending
Calibration Location	FVM
Calibration Conditions	68.3°F, 20.2°C, 56.2%RH
Calibration Date	07/16/2020
Recalibration Due	07/16/2021

Procedures Followed
FVE-000 rev. 2
FVE-001 rev. 2

Standards Used

Instrument	Serial Number	Trace Number	Next Cal
FVS-275A	RY11838	CJ191-70508-513	07/28/2020
FVS-737	4542903	CK041-57440-531	02/28/2021

Total expanded measurement uncertainties expressed are based on a confidence level of 95%; coverage factor of (k=2). The statement of compliance in this certificate was issued without taking the uncertainty of measurement into consideration. The customer shall assess the results and uncertainty when determining if the results meet their needs. (This is considered "shared responsibility.") Uncertainties expressed in base units.

All instruments have been calibrated against standards traceable to NIST. Calibration was completed in accordance with ISO/IEC 17025:2017, ANSI/NCSL Z540-1-1994 and ANSI/NCSL Z540.3-2006. Other standards listed upon request.

* denotes "Out of Tolerance"

Calibration Results

Feature	Nominal	Lower Limit	Upper Limit	As Found	As Left	Uncertainty
AC VOLTS						
600 mV Range						
300.0 mV @ 45 Hz	300.0	296.7	303.3	299.2	299.2	0.07
6 V Range						
5.000 V @ 500 Hz	5.000	4.947	5.053	4.987	4.987	0.0007
5.000 V @ 1 kHz	5.000	4.897	5.103	4.949	4.949	0.0007
60 V Range						
50.00 V @ 45 Hz	50.00	49.47	50.53	49.98	49.98	0.007
50.00 V @ 1 kHz	50.00	48.97	51.03	50.02	50.02	0.007
600 V Range						
300.0 V @ 45 Hz	300.0	296.7	303.3	299.9	299.9	0.07
500.0 V @ 500 Hz	500.0	494.7	505.3	500.5	500.5	0.06
500.0 V @ 1 kHz	500.0	489.7	510.3	500.5	500.5	0.06
1000 V Range						
1000 V @ 45 Hz	1000	987	1013	1002	1002	0.7

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Feature	Nominal	Lower Limit	Upper Limit	As Found	As Left	Uncertainty
AC VOLTS FREQUENCY						
45.00 Hz @ 1 V	45.00	44.95	45.06	45.01	45.01	0.007
50.00 kHz @ 5 V	50.00	49.94	50.06	50.00	50.00	0.006
DC VOLTAGE						
6 V Range						
5.000 V	5.000	4.994	5.007	4.997	4.997	0.0006
600 V Range						
300.0 V	300.0	299.5	300.5	299.8	299.8	0.06
1000 V Range						
1000 V	1000	997	1004	999	999	0.6
-1000 V	-1000	-1004	-997	-1000	-1000	0.7
DC VOLTS FREQUENCY						
45.00 Hz @ 3 V	45.00	44.95	45.06	45.01	45.01	0.007
50.00 kHz @ 30 V	50.00	49.94	50.06	50.00	50.00	0.007
DC MILLIVOLTS						
30.0 mV	30.0	29.8	30.2	30.0	30.0	0.06
-300.0 mV	-300.0	-300.5	-299.5	-299.9	-299.9	0.06
600.0 mV	600.0	599.3	600.7	599.7	599.7	0.07
TEMPERATURE						
0.0 °C	0.0	-1.0	1.0	1.0	1.0	0.06
-40.0 °C	-40.0	-41.4	-38.6	-39.0	-39.0	0.07
400.0 °C	400.0	395.0	405.0	400.9	400.9	0.06
OHMS						
600 Ohm Range						
19.0 Ohm	19.0	18.6	19.4	19.3	19.3	0.07
50 MOhm Range						
19.00 MOhm	19.00	18.68	19.32	19.00	19.00	0.006
CAPACITANCE						
1000 nF Range						
900 nF	900	887	913	899	899	0.6
CONTINUITY						
0 Ohms: Beeper On				Pass	Pass	
190 Ohms: Beeper Off				Pass	Pass	
DIODE TEST						

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Feature	Nominal	Lower Limit	Upper Limit	As Found	As Left	Uncertainty
2.000 V	2.000	1.978	2.022	2.000	2.000	0.0007
AC MILLIAMPS						
60 mA Range						
3.00 mA @ 45 Hz	3.00	2.92	3.08	3.00	3.00	0.007
50.00 mA @ 1 kHz	50.00	49.22	50.78	50.06	50.06	0.006
400 mA Range						
400.0 mA @ 1 kHz	400.0	393.7	406.3	400.4	400.4	0.07
AC AMPS						
6 A Range						
4.000 A @ 45 Hz	4.000	3.937	4.063	4.005	4.005	0.0007
10A Range						
9.00 A @ 1 kHz	9.00	8.84	9.16	9.04	9.04	0.007
DC MILLIAMPS						
60 mA Range						
3.00 mA	3.00	2.94	3.06	3.00	3.00	0.006
50.00 mA	50.00	49.47	50.53	49.92	49.92	0.007
400 mA Range						
-400.0 mA	-400.0	-404.3	-395.7	-399.8	-399.8	0.07
DC AMPS						
6 A Range						
4.000 A	4.000	3.957	4.043	3.999	3.999	0.0007
10 A Range						
-9.00 A	-9.00	-9.12	-8.88	-9.01	-9.01	0.006

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CERTIFICATE OF CALIBRATION

Certificate No. ACT-1272

Certification Number CK198-38060-466

For Eaton Corporation - ICD
W126 N7250 Flint Drive
Menomonee Falls, WI 53051

Purchase Order #	4044-671109
Test Instrument	Multimeter Digital Multimeter
Make	Fluke
Model	175
Serial Number	13700492
Identification	EM7014
Customer Location	ICD
Condition Received	In Tolerance
Condition Returned	In Tolerance
Calibrated By	Alex Paulsen
Technical Review By	Tim Bending
Calibration Location	FVM
Calibration Conditions	68.2°F, 20.1°C, 56.6%RH
Calibration Date	07/16/2020
Recalibration Due	07/16/2021

Procedures Followed
FVE-000 rev. 2
FVE-001 rev. 2

Form Revision 6: 02/04/2012

Standards Used

Instrument	Serial Number	Trace Number	Next Cal
FVS-275A	RY11838	CJ191-70508-513	07/28/2020
FVS-737	4542903	CK041-57440-531	02/28/2021

Total expanded measurement uncertainties expressed are based on a confidence level of 95%; coverage factor of (k=2). The statement of compliance in this certificate was issued without taking the uncertainty of measurement into consideration. The customer shall assess the results and uncertainty when determining if the results meet their needs. (This is considered "shared responsibility.") Uncertainties expressed in base units.

All instruments have been calibrated against standards traceable to NIST. Calibration was completed in accordance with ISO/IEC 17025:2017, ANSI/NCSL Z540-1-1994 and ANSI/NCSL Z540.3-2006. Other standards listed upon request.

Calibration Results

* denotes "Out of Tolerance"

Feature	Nominal	Lower Limit	Upper Limit	As Found	As Left	Uncertainty
AC VOLTS						
600 mV Range						
300.0 mV @ 45 Hz	300.0	296.7	303.3	299.9	299.9	0.07
6 V Range						
5.000 V @ 500 Hz	5.000	4.947	5.053	4.994	4.994	0.0007
5.000 V @ 1 kHz	5.000	4.897	5.103	4.955	4.955	0.0006
60 V Range						
50.00 V @ 45 Hz	50.00	49.47	50.53	49.94	49.94	0.007
50.00 V @ 1 kHz	50.00	48.97	51.03	50.06	50.06	0.006
600 V Range						
300.0 V @ 45 Hz	300.0	296.7	303.3	299.8	299.8	0.07
500.0 V @ 500 Hz	500.0	494.7	505.3	500.4	500.4	0.07
500.0 V @ 1 kHz	500.0	489.7	510.3	500.4	500.4	0.06
1000 V Range						
1000 V @ 45 Hz	1000	987	1013	996	996	0.6

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Certificate No. ACT-1272

Feature	Nominal	Lower Limit	Upper Limit	As Found	As Left	Uncertainty
AC VOLTS FREQUENCY						
45.00 Hz @ 1 V	45.00	44.95	45.06	45.00	45.00	0.007
50.00 kHz @ 5 V	50.00	49.94	50.06	50.00	50.00	0.007
DC VOLTAGE						
6 V Range						
5.000 V	5.000	4.990	5.010	5.000	5.000	0.0007
600 V Range						
300.0 V	300.0	299.4	300.6	300.0	300.0	0.06
1000 V Range						
1000 V	1000	997	1004	1000	1000	0.7
-1000 V	-1000	-1004	-997	-1000	-1000	0.7
DC VOLTS FREQUENCY						
45.00 Hz @ 3 V	45.00	44.95	45.06	45.00	45.00	0.007
50.00 kHz @ 30 V	50.00	49.94	50.06	50.00	50.00	0.007
DC MILLIVOLTS						
30.0 mV	30.0	29.8	30.2	30.0	30.0	0.07
-300.0 mV	-300.0	-300.6	-299.4	-299.9	-299.9	0.06
600.0 mV	600.0	598.9	601.1	599.9	599.9	0.06
OHMS						
600 Ohm Range						
19.0 Ohm	19.0	18.6	19.4	19.0	19.0	0.07
50 MOhm Range						
19.00 MOhm	19.00	18.68	19.32	18.99	18.99	0.006
CAPACITANCE						
1000 nF Range						
900 nF	900	887	913	900	900	0.7
CONTINUITY						
0 Ohms: Beeper On				Pass	Pass	
190 Ohms: Beeper Off				Pass	Pass	
DIODE TEST						
2.000 V	2.000	1.978	2.022	2.001	2.001	0.0006
AC MILLIAMPS						
60 mA Range						

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Certificate No. ACT-1272

Feature	Nominal	Lower Limit	Upper Limit	As Found	As Left	Uncertainty
3.00 mA @ 45 Hz	3.00	2.92	3.08	3.01	3.01	0.007
50.00 mA @ 1 kHz	50.00	49.22	50.78	49.96	49.96	0.007
400 mA Range						
400.0 mA @ 1 kHz	400.0	393.7	406.3	399.4	399.4	0.06
AC AMPS						
6 A Range						
4.000 A @ 45 Hz	4.000	3.937	4.063	3.997	3.997	0.0007
10A Range						
9.00 A @ 1 kHz	9.00	8.84	9.16	9.00	9.00	0.007
DC MILLIAMPS						
60 mA Range						
3.00 mA	3.00	2.94	3.06	3.02	3.02	0.006
50.00 mA	50.00	49.47	50.53	49.99	49.99	0.006
400 mA Range						
-400.0 mA	-400.0	-404.3	-395.7	-400.0	-400.0	0.07
DC AMPS						
6 A Range						
4.000 A	4.000	3.957	4.043	3.999	3.999	0.0007
10 A Range						
-9.00 A	-9.00	-9.12	-8.88	-9.00	-9.00	0.007

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CERTIFICATE OF CALIBRATION

Certificate No. ACT-1272

Certification Number CK198-38779-466

For Eaton Corporation - ICD
W126 N7250 Flint Drive
Menomonee Falls, WI 53051

Purchase Order #	4044-671109
Test Instrument	Multimeter Digital Multimeter
Make	Fluke
Model	179
Serial Number	14370601
Identification	EM7024
Customer Location	ICD
Condition Received	In Tolerance
Condition Returned	In Tolerance
Calibrated By	Alex Paulsen
Technical Review By	Tim Bending
Calibration Location	FVM
Calibration Conditions	68.2°F, 20.1°C, 56.6%RH
Calibration Date	07/16/2020
Recalibration Due	07/16/2021

Procedures Followed
FVE-000 rev. 2
FVE-001 rev. 2

Standards Used

Instrument	Serial Number	Trace Number	Next Cal
FVS-275A	RY11838	CJ191-70508-513	07/28/2020
FVS-737	4542903	CK041-57440-531	02/28/2021

Total expanded measurement uncertainties expressed are based on a confidence level of 95%; coverage factor of (k=2). The statement of compliance in this certificate was issued without taking the uncertainty of measurement into consideration. The customer shall assess the results and uncertainty when determining if the results meet their needs. (This is considered "shared responsibility.") Uncertainties expressed in nominal units.

All instruments have been calibrated against standards traceable to NIST. Calibration was completed in accordance with ISO/IEC 17025:2017, ANSI/NCSL Z540-1-1994 and ANSI/NCSL Z540.3-2006. Other standards listed upon request.

Calibration Results

* denotes "Out of Tolerance"

Feature	Nominal	Lower Limit	Upper Limit	As Found	As Left	Uncertainty
AC VOLTS						
600 mV Range						
300.0 mV @ 45 Hz	300.0	296.7	303.3	300.0	300.0	0.06
6 V Range						
5.000 V @ 500 Hz	5.000	4.947	5.053	4.997	4.997	0.0006
5.000 V @ 1 kHz	5.000	4.897	5.103	4.961	4.961	0.0006
60 V Range						
50.00 V @ 45 Hz	50.00	49.47	50.53	49.97	49.97	0.006
50.00 V @ 1 kHz	50.00	48.97	51.03	50.10	50.10	0.007
600 V Range						
300.0 V @ 45 Hz	300.0	296.7	303.3	300.0	300.0	0.07
500.0 V @ 500 Hz	500.0	494.7	505.3	500.9	500.9	0.06
500.0 V @ 1 kHz	500.0	489.7	510.3	500.8	500.8	0.06
1000 V Range						
1000 V @ 45 Hz	1000	987	1013	997	997	0.7

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CERTIFICATE OF CALIBRATION

Certificate No. ACT-1272

Feature	Nominal	Lower Limit	Upper Limit	As Found	As Left	Uncertainty
AC VOLTS FREQUENCY						
45.00 Hz @ 1 V	45.00	44.95	45.06	45.00	45.00	0.007
50.00 kHz @ 5 V	50.00	49.94	50.06	50.00	50.00	0.006
DC VOLTAGE						
6 V Range						
5.000 V	5.000	4.994	5.007	5.000	5.000	0.0006
600 V Range						
300.0 V	300.0	299.5	300.5	299.9	299.9	0.06
1000 V Range						
1000 V	1000	997	1004	1000	1000	0.7
-1000 V	-1000	-1004	-997	-1000	-1000	0.7
DC VOLTS FREQUENCY						
45.00 Hz @ 3 V	45.00	44.95	45.06	45.00	45.00	0.007
50.00 kHz @ 30 V	50.00	49.94	50.06	50.00	50.00	0.006
DC MILLIVOLTS						
30.0 mV	30.0	29.8	30.2	30.0	30.0	0.06
-300.0 mV	-300.0	-300.5	-299.5	-299.9	-299.9	0.06
600.0 mV	600.0	599.3	600.7	599.8	599.8	0.06
TEMPERATURE						
0.0 °C	0.0	-1.0	1.0	0.5	0.5	0.06
-40.0 °C	-40.0	-41.4	-38.6	-39.3	-39.3	0.06
400.0 °C	400.0	395.0	405.0	400.4	400.4	0.06
OHMS						
600 Ohm Range						
19.0 Ohm	19.0	18.6	19.4	19.0	19.0	0.06
50 MOhm Range						
19.00 MOhm	19.00	18.68	19.32	18.98	18.98	0.006
CAPACITANCE						
1000 nF Range						
900 nF	900	887	913	900	900	0.6
CONTINUITY						
0 Ohms: Beeper On				Pass	Pass	
190 Ohms: Beeper Off				Pass	Pass	
DIODE TEST						

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CERTIFICATE OF CALIBRATION

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Certificate No. ACT-1272

Feature	Nominal	Lower Limit	Upper Limit	As Found	As Left	Uncertainty
2.000 V	2.000	1.978	2.022	2.001	2.001	0.0007
AC MILLIAMPS						
60 mA Range						
3.00 mA @ 45 Hz	3.00	2.92	3.08	3.02	3.02	0.006
50.00 mA @ 1 kHz	50.00	49.22	50.78	50.03	50.03	0.006
400 mA Range						
400.0 mA @ 1 kHz	400.0	393.7	406.3	399.9	399.9	0.06
AC AMPS						
6 A Range						
4.000 A @ 45 Hz	4.000	3.937	4.063	4.004	4.004	0.0006
10A Range						
9.00 A @ 1 kHz	9.00	8.84	9.16	9.01	9.01	0.007
DC MILLIAMPS						
60 mA Range						
3.00 mA	3.00	2.94	3.06	3.01	3.01	0.007
50.00 mA	50.00	49.47	50.53	49.99	49.99	0.007
400 mA Range						
-400.0 mA	-400.0	-404.3	-395.7	-399.9	-399.9	0.06
DC AMPS						
6 A Range						
4.000 A	4.000	3.957	4.043	3.998	3.998	0.0006
10 A Range						
-9.00 A	-9.00	-9.12	-8.88	-9.00	-9.00	0.007

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CERTIFICATE OF CALIBRATION

Certificate No. ACT-1272

Certification Number CK198-41226-466

For Eaton Corporation - ICD
W126 N7250 Flint Drive
Menomonee Falls, WI 53051

Purchase Order #	4044-671109
Test Instrument	Clamp Meter
Make	AEMC
Model	SR759
Serial Number	224137GKDV
Identification	EM6996
Customer Location	ICD
Condition Received	In Tolerance
Condition Returned	In Tolerance
Calibrated By	Alex Paulsen
Technical Review By	Tim Bending
Calibration Location	FVM
Calibration Conditions	67.8°F, 19.9°C, 56.3%RH
Calibration Date	07/16/2020
Recalibration Due	07/16/2021

Procedures Followed
FVE-007 rev. 2

Standards Used

Instrument	Serial Number	Trace Number	Next Cal
FVS-275A	RY11838	CJ191-70508-513	07/28/2020
FVS-546	24560221	CK093-41519-573	04/30/2021
FVS-737	4542903	CK041-57440-531	02/28/2021

Total expanded measurement uncertainties expressed are based on a confidence level of 95%; coverage factor of (k=2). The statement of compliance in this certificate was issued without taking the uncertainty of measurement into consideration. The customer shall assess the results and uncertainty when determining if the results meet their needs. (This is considered "shared responsibility.") Uncertainties expressed in nominal units.

All instruments have been calibrated against standards traceable to NIST. Calibration was completed in accordance with ISO/IEC 17025:2017, ANSI/NCSL Z540-1-1994 and ANSI/NCSL Z540.3-2006. Other standards listed upon request.

Calibration Results

* denotes "Out of Tolerance"

Feature	Nominal	Lower Limit	Upper Limit	As Found	As Left	Uncertainty
1A Range; 1000mV/A @60 Hz	(mV AC)	(mV AC)	(mV AC)	(mV AC)	(mV AC)	(mV AC)
10 mA	10.0	8.7	11.3	10.1	10.1	0.07
100 mA	100.0	96.0	104.0	101.3	101.3	0.06
500 mA	500.0	495.5	504.5	504.5	504.5	0.06
	(V AC)	(V AC)	(V AC)	(V AC)	(V AC)	(V AC)
1 A	1.000	0.992	1.008	1.008	1.008	0.0006
10A Range; 100mV/A @60 Hz	(mV AC)	(mV AC)	(mV AC)	(mV AC)	(mV AC)	(mV AC)
100 mA	10.0	9.7	10.3	10.0	10.0	0.07
1 A	100.0	99.3	100.7	100.4	100.4	0.07
5 A	500.0	497.5	502.5	501.8	501.8	0.06
	(V AC)	(V AC)	(V AC)	(V AC)	(V AC)	(V AC)
10 A	1.000	0.995	1.005	1.004	1.004	0.0007
100A Range; 10mV/A @60 Hz	(mV AC)	(mV AC)	(mV AC)	(mV AC)	(mV AC)	(mV AC)
1 A	10.0	9.7	10.3	10.0	10.0	0.07
10 A	100.0	99.3	100.7	100.1	100.1	0.06

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Feature	Nominal	Lower Limit	Upper Limit	As Found	As Left	Uncertainty
50 A	500.0	498.5	501.5	500.3	500.3	0.06
	(V AC)	(V AC)	(V AC)	(V AC)	(V AC)	(V AC)
100 A	1.000	0.998	1.002	1.001	1.001	0.0006
1000A Range; 1mV/A @60 Hz	(mV AC)	(mV AC)	(mV AC)	(mV AC)	(mV AC)	(mV AC)
10 A	10.0	9.7	10.3	10.0	10.0	0.06
100 A	100.0	99.3	100.7	100.1	100.1	0.07
500 A	500.0	499.0	501.0	500.5	500.5	0.07
900 A	900.0	898.0	902.0	901.2	901.2	0.07

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CERTIFICATE OF CALIBRATION

ilac-MRA ANAB ACCREDITED ISO IEC 17025 CALIBRATION AND TESTING LABORATORY
Certificate No. ACT-1272

Certification Number CK198-40179-466

For Eaton Corporation - ICD
W126 N7250 Flint Drive
Menomonee Falls, WI 53051

Purchase Order #	4044-671109
Test Instrument	Clamp Meter
Make	AEMC
Model	SR759
Serial Number	224139GKDV
Identification	EM6997
Customer Location	ICD
Condition Received	In Tolerance
Condition Returned	In Tolerance
Calibrated By	Alex Paulsen
Technical Review By	Tim Bending
Calibration Location	FVM
Calibration Conditions	67.8°F, 19.9°C, 56.3%RH
Calibration Date	07/16/2020
Recalibration Due	07/16/2021

Procedures Followed
FVE-007 rev. 2

Standards Used

Instrument	Serial Number	Trace Number	Next Cal
FVS-275A	RY11838	CJ191-70508-513	07/28/2020
FVS-546	24560221	CK093-41519-573	04/30/2021
FVS-737	4542903	CK041-57440-531	02/28/2021

Total expanded measurement uncertainties expressed are based on a confidence level of 95%; coverage factor of (k=2). The statement of compliance in this certificate was issued without taking the uncertainty of measurement into consideration. The customer shall assess the results and uncertainty when determining if the results meet their needs. (This is considered "shared responsibility.") Uncertainties expressed in nominal units.

All instruments have been calibrated against standards traceable to NIST. Calibration was completed in accordance with ISO/IEC 17025:2017, ANSI/NCSL Z540-1-1994 and ANSI/NCSL Z540.3-2006. Other standards listed upon request.

* denotes "Out of Tolerance"

Calibration Results

Feature	Nominal	Lower Limit	Upper Limit	As Found	As Left	Uncertainty
1A Range; 1000mV/A @60 Hz	(mV AC)	(mV AC)	(mV AC)	(mV AC)	(mV AC)	(mV AC)
10 mA	10.0	8.7	11.3	10.1	10.1	0.06
100 mA	100.0	96.0	104.0	101.1	101.1	0.06
500 mA	500.0	495.5	504.5	504.5	504.5	0.06
	(V AC)	(V AC)	(V AC)	(V AC)	(V AC)	(V AC)
1 A	1.000	0.992	1.008	1.008	1.008	0.0006
10A Range; 100mV/A @60 Hz	(mV AC)	(mV AC)	(mV AC)	(mV AC)	(mV AC)	(mV AC)
100 mA	10.0	9.7	10.3	10.0	10.0	0.07
1 A	100.0	99.3	100.7	100.2	100.2	0.06
5 A	500.0	497.5	502.5	500.9	500.9	0.06
	(V AC)	(V AC)	(V AC)	(V AC)	(V AC)	(V AC)
10 A	1.000	0.995	1.005	1.002	1.002	0.0006
100A Range; 10mV/A @60 Hz	(mV AC)	(mV AC)	(mV AC)	(mV AC)	(mV AC)	(mV AC)
1 A	10.0	9.7	10.3	10.0	10.0	0.06
10 A	100.0	99.3	100.7	100.1	100.1	0.07

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Certificate No. ACT-1272

Feature	Nominal	Lower Limit	Upper Limit	As Found	As Left	Uncertainty
50 A	500.0	498.5	501.5	500.1	500.1	0.06
	(V AC)	(V AC)	(V AC)	(V AC)	(V AC)	(V AC)
100 A	1.000	0.998	1.002	1.001	1.001	0.0006
1000A Range; 1mV/A @60 Hz	(mV AC)	(mV AC)	(mV AC)	(mV AC)	(mV AC)	(mV AC)
10 A	10.0	9.7	10.3	10.0	10.0	0.07
100 A	100.0	99.3	100.7	100.1	100.1	0.06
500 A	500.0	499.0	501.0	500.3	500.3	0.06
900 A	900.0	898.0	902.0	901.4	901.4	0.06

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CERTIFICATE OF CALIBRATION

ilac-MRA ANAB ACCREDITED ISO IEC 17025 CALIBRATION AND TESTING LABORATORY

Certificate No. ACT-1272

Certification Number CK198-41583-466

For Eaton Corporation - ICD
W126 N7250 Flint Drive
Menomonee Falls, WI 53051

Purchase Order #	4044-671109
Test Instrument	Clamp Meter
Make	AEMC
Model	SR759
Serial Number	239584HKDV
Identification	EM8032
Customer Location	ICD
Condition Received	In Tolerance
Condition Returned	In Tolerance
Calibrated By	Alex Paulsen
Technical Review By	Tim Bending
Calibration Location	FVM
Calibration Conditions	67.8°F, 19.9°C, 56.3%RH
Calibration Date	07/16/2020
Recalibration Due	07/16/2021

Procedures Followed
FVE-007 rev. 2

Standards Used

Instrument	Serial Number	Trace Number	Next Cal
FVS-275A	RY11838	CJ191-70508-513	07/28/2020
FVS-546	24560221	CK093-41519-573	04/30/2021
FVS-737	4542903	CK041-57440-531	02/28/2021

Total expanded measurement uncertainties expressed are based on a confidence level of 95%; coverage factor of (k=2). The statement of compliance in this certificate was issued without taking the uncertainty of measurement into consideration. The customer shall assess the results and uncertainty when determining if the results meet their needs. (This is considered "shared responsibility.") Uncertainties expressed in nominal units.

All instruments have been calibrated against standards traceable to NIST. Calibration was completed in accordance with ISO/IEC 17025:2017, ANSI/NCSL Z540-1-1994 and ANSI/NCSL Z540.3-2006. Other standards listed upon request.

Calibration Results

* denotes "Out of Tolerance"

Feature	Nominal	Lower Limit	Upper Limit	As Found	As Left	Uncertainty
1A Range; 1000mV/A @60 Hz	(mV AC)	(mV AC)	(mV AC)	(mV AC)	(mV AC)	(mV AC)
10 mA	10.0	8.7	11.3	10.2	10.2	0.07
100 mA	100.0	96.0	104.0	101.1	101.1	0.07
500 mA	500.0	495.5	504.5	504.3	504.3	0.06
	(V AC)	(V AC)	(V AC)	(V AC)	(V AC)	(V AC)
1 A	1.000	0.992	1.008	1.007	1.007	0.0007
10A Range; 100mV/A @60 Hz	(mV AC)	(mV AC)	(mV AC)	(mV AC)	(mV AC)	(mV AC)
100 mA	10.0	9.7	10.3	10.0	10.0	0.07
1 A	100.0	99.3	100.7	100.2	100.2	0.07
5 A	500.0	497.5	502.5	500.7	500.7	0.06
	(V AC)	(V AC)	(V AC)	(V AC)	(V AC)	(V AC)
10 A	1.000	0.995	1.005	1.002	1.002	0.0006
100A Range; 10mV/A @60 Hz	(mV AC)	(mV AC)	(mV AC)	(mV AC)	(mV AC)	(mV AC)
1 A	10.0	9.7	10.3	10.0	10.0	0.07
10 A	100.0	99.3	100.7	100.0	100.0	0.07

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Certificate No. ACT-1272

Feature	Nominal	Lower Limit	Upper Limit	As Found	As Left	Uncertainty
50 A	500.0	498.5	501.5	500.0	500.0	0.07
	(V AC)	(V AC)	(V AC)	(V AC)	(V AC)	(V AC)
100 A	1.000	0.998	1.002	1.000	1.000	0.0007
1000A Range; 1mV/A @60 Hz	(mV AC)	(mV AC)	(mV AC)	(mV AC)	(mV AC)	(mV AC)
10 A	10.0	9.7	10.3	10.0	10.0	0.07
100 A	100.0	99.3	100.7	100.0	100.0	0.06
500 A	500.0	499.0	501.0	500.3	500.3	0.07
900 A	900.0	898.0	902.0	900.6	900.6	0.07

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CERTIFICATE OF CALIBRATION

ANAB ACCREDITED ISO IEC 17025 CALIBRATION AND TESTING LABORATORY

Certificate No. ACT-1272

Certification Number CK196-72143-379

For Eaton Corporation - ICD
W126 N7250 Flint Drive
Menomonee Falls, WI 53051

Purchase Order #	4044-671109
Test Instrument	Torque Wrench
Make	CDI
Model	1502LDIN (3%)
Serial Number	0312910937
Identification	EM8363
Customer Location	ICD
Condition Received	In Tolerance
Condition Returned	In Tolerance
Calibrated By	Jim Peterson
Technical Review By	Kevin Dehne
Calibration Location	FVM
Calibration Conditions	69.0°F, 20.6°C, 54.2%RH
Calibration Date	07/14/2020
Recalibration Due	07/14/2021

Procedures Followed
FVE-014 rev. 2

Standards Used

Instrument	Serial Number	Trace Number	Next Cal
FVS-093	03111	CK191-31886-628	10/31/2020
FVS-275A	RY11838	CJ191-70508-513	07/28/2020

Total expanded measurement uncertainties expressed are based on a confidence level of 95%; coverage factor of (k=2). The statement of compliance in this certificate was issued without taking the uncertainty of measurement into consideration. The customer shall assess the results and uncertainty when determining if the results meet their needs. (This is considered "shared responsibility.") Uncertainties expressed in nominal units.

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* denotes "Out of Tolerance"

Calibration Results

Feature	Nominal	Lower Limit	Upper Limit	As Found	As Left	Uncertainty
Clockwise	(in lb)	(in lb)	(in lb)	(in lb)	(in lb)	(in lb)
	30.00	29.10	30.90	29.89	29.89	0.091
	90.00	87.30	92.70	90.23	90.23	0.271
	150.00	145.50	154.50	152.00	152.00	0.450
Counter Clockwise	(in lb)	(in lb)	(in lb)	(in lb)	(in lb)	(in lb)
	30.00	29.10	30.90	30.31	30.31	0.091
	90.00	87.30	92.70	89.53	89.53	0.271
	150.00	145.50	154.50	148.58	148.58	0.450

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CERTIFICATE OF CALIBRATION

Certificate No. ACT-1272

Certification Number CK198-49542-348

For Eaton Corporation - ICD
W126 N7250 Flint Drive
Menomonee Falls, WI 53051

Purchase Order #	4044-671109
Test Instrument	Tape Measure
Make	Stanley
Model	30-824
Serial Number	
Identification	EM6927
Customer Location	ICD Tony
Condition Received	In Tolerance
Condition Returned	In Tolerance
Calibrated By	Matthew Roughen
Technical Review By	Laura Fuhrmann
Calibration Location	FVM
Calibration Conditions	69.5°F, 20.8°C, 34.8%RH
Calibration Date	07/16/2020
Recalibration Due	07/16/2021

Procedures Followed
FVM-042 rev. 1

Standards Used

Instrument	Serial Number	Trace Number	Next Cal
FVM-044	C404R	CH121-20770-384	05/28/2022
FVM-079A	RY11924	CJ191-72229-513	07/28/2020

Total expanded measurement uncertainties expressed are based on a confidence level of 95%; coverage factor of (k=2). The statement of compliance in this certificate was issued without taking the uncertainty of measurement into consideration. The customer shall assess the results and uncertainty when determining if the results meet their needs. (This is considered "shared responsibility.") Uncertainties expressed in nominal units.

All instruments have been calibrated against standards traceable to NIST. Calibration was completed in accordance with ISO/IEC 17025:2017, ANSI/NCSL Z540-1-1994 and ANSI/NCSL Z540.3-2006. Other standards listed upon request.

Calibration Results

* denotes "Out of Tolerance"

Feature	Nominal	Lower Limit	Upper Limit	As Found	As Left	Uncertainty
Length	(in)	(in)	(in)	(in)	(in)	
	12.000	11.969	12.031	11.995	11.995	0.0006
	24.000	23.938	24.062	23.995	23.995	0.0007
	48.000	47.938	48.062	47.995	47.995	0.0007
	72.000	71.938	72.062	71.995	71.995	0.0007
	144.000	143.938	144.062	143.995	143.995	0.0006
	216.000	215.938	216.062	215.995	215.995	0.0006
	312.000	311.938	312.062	311.995	311.995	0.0007
Length	(cm)	(cm)	(cm)	(cm)	(cm)	(cm)
	500.00	499.00	501.00	499.87	499.87	0.007
	1000.00	999.00	1001.00	999.87	999.87	0.006
	5000.00	4999.00	5001.00	4999.87	4999.87	0.008
	8000.00	7999.00	8001.00	7999.87	7999.87	0.012

406.3

406.3 Receptacle Rating and Type.

(A) Receptacles. Receptacles shall be listed and marked with the manufacturer's name or identification and voltage and ampere ratings. Receptacles shall not be permitted to be reconditioned.

(B) Rating. Receptacles and cord connectors shall be rated not less than 15 amperes, 125 volts, or 15 amperes, 250 volts, and shall be of a type not suitable for use as lampholders.

Informational Note: See 210.21(B) for receptacle ratings where installed on branch circuits.

(C) Receptacles for Aluminum Conductors. Receptacles rated 20 amperes or less and designed for the direct connection of aluminum conductors shall be marked CO/ALR.

(D) Receptacles with Push-in Terminals. Push-in terminals of receptacles rated 15 amperes shall be directly connected solely to 14 AWG solid copper conductors. For receptacles rated 15 amperes and having push-in terminals that are identified additionally, and so marked, as suitable for 14 AWG solid copper-clad aluminum conductors, the push-in terminals shall be permitted to be directly connected to 14 AWG solid copper-clad aluminum in accordance with 240.4(D)(3).

(~~D~~E) Isolated Ground Receptacles. Receptacles incorporating an isolated equipment grounding conductor connection intended for the reduction of electromagnetic interference as permitted in 250.146(D) shall be identified by an orange triangle located on the face of the receptacle.

(1) Isolated Equipment Grounding Conductor Required. Receptacles so identified shall be used only with equipment grounding conductors that are isolated in accordance with 250.146(D).

(2) Installation in Nonmetallic Boxes. Isolated ground receptacles installed in nonmetallic boxes shall be covered with a nonmetallic faceplate.

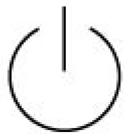
Exception: Where an isolated ground receptacle is installed in a nonmetallic box, a metal faceplate shall be permitted if the box contains a feature or accessory that permits the connection of the faceplate to the equipment grounding conductor.

(~~E~~F) Controlled Receptacle Marking. All nonlocking-type, 125-volt, 15- and 20-ampere receptacles that are controlled by an automatic control device, or that incorporate control features that remove power from the receptacle for the purpose of energy management or building automation, shall be permanently marked with the symbol shown in Figure 406.3(E) and the word "controlled."

For receptacles controlled by an automatic control device, the marking shall be located on the receptacle face and visible after installation.

In both cases where a multiple receptacle device is used, the required marking of the word "controlled" and symbol shall denote which contact device(s) are controlled.

Figure 406.3(E) Controlled Receptacle Marking Symbol.



Controlled

Exception: The marking shall not be required for receptacles controlled by a wall switch that provide the required room lighting outlets as permitted by 210.70.

406.3(~~F~~G) Receptacle with USB Charger. A 125-volt 15- or 20-ampere receptacle that additionally provides Class 2 power shall be listed and constructed such that the Class 2 circuitry is integral with the receptacle.

Substantiation:

Task Group Statement

This public input is submitted on behalf of the task group formed in accordance with the direction of the NFPA Standards Council in their Decisions D#19-2 and D#19-23. This task group was appointed to identify potential proposed changes to the 2020 edition of the NEC in the form of proposed Tentative Interim Amendments (TIAs) or to the 2023 edition of the NEC in the form of Public Inputs (PIs) that within the Task Group's scope of activity as specified by the Standards Council.

These proposed PIs relate to new requirements covering the use of copper-clad aluminum conductors throughout the NEC as a coordinated set of new or revised requirements. These Public Inputs should not be misconstrued by the CMPs as precluding consideration of other Public Inputs, with supporting test data, submitted now or in the future, for other potentially eligible conductor materials or sizes.

The task group members are; David Hittinger-Chair, Todd Crisman, Roland Deike, Thomas Domitrovich, Peter Graser, Christel Hunter, Chuck Mello, Ken Riedl, Susan Newman Scearce, Susan Stene, George Straniero, Frank Tse and Brian Rock. This task group of balanced interests provided the expertise to develop these public inputs covering the use of copper-clad aluminum conductors.

Public Inputs are being submitted in the following sections: Article 100, definition of "copper-clad aluminum", 210.12, 210.18, 210.21(B)(1), 210.23, 210.24, 210.52(B), 240.4(D), 240.6, 310.3(A), 310.3(B), Table 310.16, Table 310.17, 330.104, 334.104, 336.104, 340.104,404.14(D), and 406.3(D).

Technical Substantiation

The UL standard and associated guide information under category code RTRT for receptacles with push in terminals permits only 14 AWG solid copper conductors to be used at this time.

"Screwless terminal connectors of the conductor push-in type (also known as "push-in-terminals") are restricted to 15 A branch circuits and are for connection with 14 AWG solid copper wire only. They are not intended for use with aluminum or copper-clad aluminum wire, 14 AWG stranded copper wire, or 12 AWG solid or stranded copper wire."

The change to this section is to highlight this limitation for receptacles that may have push-in terminals provided. The introduction of 14 AWG copper-clad aluminum into the NEC for branch circuit wiring needs this limitation to ensure push-in terminals on wiring devices are being installed in accordance with their listing.

Public Input No. 1229-NFPA 70-2020 [Section No. 406.3(C)]

(C) ~~Receptacles for Aluminum Conductors.~~ **CO/ALR Receptacles**

Receptacles rated 20 amperes or less and designed for the direct connection of aluminum conductors shall be marked CO/ALR.

Statement of Problem and Substantiation for Public Input

Replace article name from “Receptacles for Aluminum Conductors” to “CO/ALR Receptacles” to match language style/formatting for snap switches; ref 404.13 (C).

The NEC has improved significantly in large part due to improved formatting, use of language and consistency of requirements and application. This change will continue the trend of making the NEC consistent and predictable.

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Submittal Date: Sat May 23 11:57:56 EDT 2020

Committee: NEC-P18

Public Input No. 2907-NFPA 70-2020 [New Section after 406.3(F)]

TITLE OF NEW CONTENT

406.3(G) **Receptacle Faceplate Connections.** All 125-volt 15- or 20-ampere receptacle connections tightened by use of tools shall not be used as alternate points of connection for faceplate power unless approved by the receptacle manufacturer.

Statement of Problem and Substantiation for Public Input

CMP-2 added 406.3(F) in the 2017 edition of the NEC to address “clip-on” USB charger faceplates. Other products on the market use LED lighting that derives power from a “clip-on” faceplate that is not integral with the receptacle. This PI recommends expanding the prohibition to also cover other “clip-on” faceplates that draw power from the receptacle terminals. Receptacle terminals may not present a uniform surface for “clip-on” faceplate connections because of terminal deformation caused by installation tools (e.g., screwdrivers). Connections may also corrode, resulting in a high resistance contact.

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Committee:	NEC-P18

Public Input No. 4091-NFPA 70-2020 [New Section after 406.3(F)]

TITLE OF NEW CONTENT

406.3(G) Receptacles with NEMA 5-15R Blade Configuration.

Type your content here ...

All current carrying components of 15 amp, 125 volt receptacles that are installed on a 20 amp circuit shall have an ampacity of 20 amps including the contacts.

Additional Proposed Changes

File Name	Description	Approved
Image_1-Six_outlet_four_USB_adaptor.jpg	Image #1- Six outlet adaptor with four USB charging ports	
Image_2-_Side_view.jpg	Image #2- Side view of six outlet adaptor with four USB charging ports	
Image_4-_Adaptor.jpg	Image #4- An adaptor	
Image_5-_Power_strip.jpg	Image #5- A power strip rated 20 amps	
Image_6-_Power_strip_plug_NEMA_5-20P.jpg	Image #6- NEMA 5-20P plug for 20 amp power strip	
Image_7-_Power_strip_and_adaptor.jpg	Image #7- A 20 amp power strip and an adaptor	
Image_3-_NEMA_5-20R_to_NEMA_5-15P_adaptor.jpg	Image #3- NEMA 5-20R to NEMA 5-15P adaptor	

Statement of Problem and Substantiation for Public Input

This public input, along with the others I am providing, is a direct consequence of my investigation of a fire in a GFCI receptacle mounted on the outside of my house which could have been catastrophic, but thankfully wasn't. I am a licensed engineer. A detailed report was prepared.

The distribution of receptacles in a facility, particularly dwellings, often favors 20 amp circuits with 15 amp receptacles. The 20 amp circuit rating minimizes homeruns while the 15 amp receptacles are sufficiently sized for most non-fixed cord-and-plug connected equipment. There is a gap between the 20 amp circuit rating and the 15 amp receptacle rating amounting to five amps. Circuit design typically involves determination of the load, then selecting conductors size based on the sum of the non-continuous load and 125% of the continuous load, and lastly selecting a breaker size that corresponds to the conductor size or is the next higher breaker rating where the conductor size is not a standard OCPD size. This description is a simplification and in addition load calculations for dwellings have a different approach that allows near capacity loading of conductors for multi-outlet branch circuits. Table 210.24 shows maximum loadings that are maximum for the conductor as well as the circuit breaker. The installation of multiple 15 amp receptacles on a circuit relies on diversity of relatively low-amperage loading to prevent nuisance tripping. Section 210.21(B)(3) and Table 210.21(B)(2) stipulate the maximum receptacle load for 15, 20, and 30 amp circuits to be values that represent 80% of the receptacle rating, the inverse of the 125% factor applied to conductors. Thus, for a 15 amp circuit with a 15 amp receptacle the maximum load on the receptacle is 12 amps, 80% of 15 amps. The same receptacle on a 20 amp circuit represents a loading of just 60% of circuit capacity for that one receptacle.

These maximum loads are simply administrative controls likely based on customary power requirements of manufactured cord-and-plug connected equipment as well as loading patterns that have evolved for diversely located 15 amp receptacles. The maximum receptacle loadings go back at least as far as the 1968 NEC without change. Such administrative controls do not even rise to the level of being used “under conditions of maintenance and supervision,” since there is no method to prevent a load larger than 15 amps from being applied to a NEMA 5-15R receptacle.

Without a circuit breaker that is matched to the receptacle rating, there is a distinct possibility that an overcurrent condition can develop in an outlet of a 15 amp receptacle because its amperage rating is less than the 20 amp trip rating of the circuit breaker. The overcurrent could be a low level fault condition or an overloading of an outlet of the receptacle. The first two images below, images #1 and #2, show the front and side views of an adaptor that has six 120 volt outlets and four USB charging outlets. The side view shows that there is a prong on the back of the adaptor that fits into the ground contact of the lower outlet of a duplex that is mounted on the wall in a vertical orientation. The purpose of this prong is to mechanically stabilize the adaptor against the effects of gravity since the adaptor is offset from the receptacle mounted in the wall. Any attachment plugs, or device charging adaptors, plugged into the adaptor are further offset, creating a tendency for the plug of the adaptor to pull out of the top outlet of the duplex receptacle. Other adaptors actually screw into the duplex receptacle itself in the manner of a receptacle faceplate to prevent the adaptor from detaching from the wall receptacle. Such an arrangement can concentrate any heating that might occur in the wall receptacle.

Another type of adaptor is shown in image #3. It is very clearly obvious that this adaptor is intended to draw 20 amps of power from a receptacle rated at only 15 amps. Another way of putting it is that a piece of equipment that has a NEMA 5-20P configuration, capable of drawing 20 amps, is being plugged into a NEMA 5-15R outlet capable of only providing 15 amps safely.

Next there is the last adaptor shown below in image #4, the implications of which I won’t even begin to discuss.

Lastly, we come to power strips. Two images below, images #5 and #6, show aspects of a power strip, rated 20 amps at 120 volts with a NEMA 5-20P connecting plug.

The last image, image #7, shows a power strip, which is rated 20 amps, along with a recommended adaptor that will allow the 20 amp power strip to be plugged into a NEMA 5-15R wall receptacle.

A gamer may need a 20 amp power strip to power all of his computer equipment except that he needs an adaptor shown in images #3 and #7, to plug into the NEMA 5-15R wall receptacle. Some power strips are meant for installation into a computer rack but nothing is to prevent them from being attached to a desk or just left on the floor.

Adaptors and power strips represent a market for devices that are capable of extracting more ampacity from a receptacle than it is rated for, namely the NEMA 5-15R receptacle. In the case of power strips, a UL listing may administratively restrict such application. It is unknown whether any of the adaptors have a UL listing. I can imagine that the six-outlet adaptor may be utilized to plug in individual device adaptors that convert AC to DC. I can also imagine power strips plugged into each outlet on the adaptor. I can further imagine daisy chained power strips. All of these possibilities, and many I haven’t even thought of, rail against a 15 amp wall receptacle on a 20 amp circuit unless the contact capacity of the 15 amp receptacle is also 20 amps. It is not possible to control the use of devices that are capable of being plugged into a NEMA 5-15R receptacle that can draw more power than 15 amps.

Receptacles rated at 15 amps are typically allowed on 20 amp circuits because of their feed-through capability which allows any outlet on a multi-outlet branch circuit to feed downstream parallel-connected receptacles up to the maximum circuit loading of 20 amps. However, each outlet of a duplex receptacle is also a parallel-connected load. The load on each receptacle is administratively controlled as shown in Table 210.21(B)(2). The crux of this discussion concerns those situations where the controls are bypassed, ignored or not understood, or not even known. This feed-through capability of a 15 amp receptacle, as tested in accordance with UL 498, Standard for Attachment Plugs and Receptacles, is verified by feed-through temperature tests on the current carrying components that can conduct current to downstream receptacles. A 20 amp load is utilized. If needed, depending on the type of conductor termination, a terminal temperature test is performed as well. It is necessary that the temperature test be performed on the contacts of the 15 amp receptacle under a 20 amp load to ensure the entire receptacle can carry 20 amps. Redesign of the contacts may be necessary to pass such a test.

As a result, each outlet of a duplex, or a quad, will be safe to support up to a 20 amp applied load but of course the administrative controls of Table 210.21(B)(2) still apply in the interests of preventing nuisance tripping. The NEMA 5-15R blade configuration will be the same to allow the number of receptacles on a 20 amp circuit to remain the same. However, it must be recognized that there is a trend to a higher concentration of power use particularly in dwellings because of remote work, remote education, and conversion of hydrocarbon sources of energy to battery powered sources that require charging.

On a very generic basis there are four options for resolving this problem by code mandated requirements.

1. Receptacles with a NEMA 5-15R configuration rated 15 amps with 15 amp contacts are allowed only for 15 amp circuits and receptacles with a NEMA 5-15R configuration rated 15 amps (based on blade configuration) with 20 amp contacts are allowed on 15 or 20 amp circuits. Product differentiation would be a problem along with misapplication, which leads back to the safety problem.

2. All NEMA 5-15R receptacles are designed to carry 20 amps at the contacts. This approach is recommended.

3. All 15 amp circuits require NEMA 5-15R receptacles and all 20 amp circuits require NEMA 5-20R receptacles. Product confusion is a problem and misapplication could still occur with the consequent safety issue, particularly since the practice of using 15 amp receptacles on 20 amp circuits has become embedded in the electrical industry.

4. Require all multi-outlet circuits to be 20 amp with NEMA 5-20R receptacles. This option is the most expensive requiring more expensive circuit components and in general, more circuits. It is a safe solution and also eliminates any lingering public confusion as to why NEMA 5-15R receptacles are used on 20 amp circuits.

The second possibility is the only one that ensures a 15 amp receptacle can never be overloaded as long as a circuit breaker functions properly. It is the recommended approach and the basis of this public input. It also assures that the consumer doesn’t become an unsuspecting victim for using the wrong receptacle on the wrong circuit. There would be a public misperception, for those who are aware of it, as to why 15 amp outlets are used on 20 amp circuits, but that is nothing new, and then if the15 amp receptacles are all rated 20 amps internally anyway, why not just use NEMA 5-20R receptacles everywhere? It is a valid question, the answer being that the 15 amp receptacles on the 20 amp circuit allows for more receptacles on that circuit. As a result there are fewer circuits since the blade configuration is a limiting mechanism for loading on the receptacle, and thus circuit.

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Committee:	NEC-P18

Public Input No. 4438-NFPA 70-2020 [Section No. 406.4]

406.4 General Installation Requirements.

Receptacle outlets shall be located in branch circuits in accordance with Part III of Article 210. General installation requirements shall be in accordance with 406.4(A) through (~~F~~ G).

(A) Grounding Type.

Except as provided in 406.4(D), receptacles installed on 15- and 20-ampere branch circuits shall be of the grounding type. Grounding-type receptacles shall be installed only on circuits of the voltage class and current for which they are rated, except as provided in 210.21(B)(1) for single receptacles or Table 210.21(B)(2) and Table 210.21(B)(3) for two or more receptacles.

(B) To Be Grounded.

Receptacles and cord connectors that have equipment grounding conductor contacts shall have those contacts connected to an equipment grounding conductor.

Exception No. 1: Receptacles mounted on portable and vehicle-mounted generator sets and generators in accordance with 250.34.

Exception No. 2: Replacement receptacles as permitted by 406.4(D).

(C) Methods of Grounding.

The equipment grounding conductor contacts of receptacles and cord connectors shall be connected to the equipment grounding conductor of the circuit supplying the receptacle or cord connector.

Informational Note: For installation requirements for the reduction of electromagnetic interference, see 250.146(D).

The branch-circuit wiring method shall include or provide an equipment grounding conductor to which the equipment grounding conductor contacts of the receptacle or cord connector are connected.

Informational Note No. 1: See 250.118 for acceptable grounding means.

Informational Note No. 2: For extensions of existing branch circuits, see 250.130.

(D) Replacements.

Replacement of receptacles shall comply with 406.4(D)(1) through (D)(7), as applicable. Arc-fault circuit-interrupter type and ground-fault circuit-interrupter type receptacles shall be installed in a readily accessible location.

(1) Grounding-Type Receptacles.

Where a grounding means exists in the receptacle enclosure or an equipment grounding conductor is installed in accordance with 250.130(C), grounding-type receptacles shall be used and shall be connected to the equipment grounding conductor in accordance with 406.4(C) or 250.130(C).

(2) Non–Grounding-Type Receptacles.

Where attachment to an equipment grounding conductor does not exist in the receptacle enclosure, the installation shall comply with 406.4(D)(2)(a), (D)(2)(b), or (D)(2)(c).

(a) A non–grounding-type receptacle(s) shall be permitted to be replaced with another non–grounding-type receptacle(s).

(b) A non–grounding-type receptacle(s) shall be permitted to be replaced with a ground-fault circuit interrupter-type of receptacle(s). These receptacles or their cover plates shall be marked “No Equipment Ground.” An equipment grounding conductor shall not be connected from the ground-fault circuit-interrupter-type receptacle to any outlet supplied from the ground-fault circuit-interrupter receptacle.

(c) A non–grounding-type receptacle(s) shall be permitted to be replaced with a grounding-type receptacle(s) where supplied through a ground-fault circuit interrupter. Where grounding-type receptacles are supplied through the ground-fault circuit interrupter, grounding-type receptacles or their cover plates shall be marked “GFCI Protected” and “No Equipment Ground,” visible after installation. An equipment grounding conductor shall not be connected between the grounding-type receptacles.

Informational Note No. 1: Some equipment or appliance manufacturers require that the branch circuit to the equipment or appliance includes an equipment grounding conductor.

Informational Note No. 2: See 250.114 for a list of a cord-and-plug-connected equipment or appliances that require an equipment grounding conductor.

(3) Ground-Fault Circuit-Interrupter Protection.

Ground-fault circuit-interrupter protected receptacles shall be provided where replacements are made at receptacle outlets that are required to be so protected elsewhere in this *Code*.

Exception: Where the outlet box size will not permit the installation of the GFCI receptacle, the receptacle shall be permitted to be replaced with a new receptacle of the existing type, where GFCI protection is provided and the receptacle is marked “GFCI Protected” and “No Equipment Ground,” in accordance with 406.4(D)(2)(a), (D)(2)(b), or (D)(2)(c), as applicable.

(4) Arc-Fault Circuit-Interrupter Protection.

If a receptacle outlet located in any areas specified in 210.12(A), (B), or (C) is replaced, a replacement receptacle at this outlet shall be one of the following:

(1) A listed outlet branch-circuit type arc-fault circuit-interrupter receptacle

(2) A receptacle protected by a listed outlet branch-circuit type arc-fault circuit-interrupter type receptacle

(3) A receptacle protected by a listed combination type arc-fault circuit-interrupter type circuit breaker

Exception: Section 210.12(D), Exception, shall not apply to replacement of receptacles.

(5) Tamper-Resistant Receptacles.

Listed tamper-resistant receptacles shall be provided where replacements are made at receptacle outlets that are required to be tamper-resistant elsewhere in this *Code*, except where a non-grounding receptacle is replaced with another non-grounding receptacle.

(6) Weather-Resistant Receptacles.

Weather-resistant receptacles shall be provided where replacements are made at receptacle outlets that are required to be so protected elsewhere in this *Code*.

(7) Controlled Receptacles.

Automatically controlled receptacles shall be replaced with equivalently controlled receptacles. If automatic control is no longer required, the receptacle and any associated receptacles marked in accordance with 406.3(E) shall be replaced with a receptacle and faceplate not marked in accordance with 406.3(E).

(E) Cord- and Plug-Connected Equipment.

The installation of grounding-type receptacles shall not be used as a requirement that all cord- and plug-connected equipment be of the grounded type.

Informational Note: See 250.114 for types of cord-and plug-connected equipment to be grounded.

(F) Noninterchangeable Types.

Receptacles connected to circuits that have different voltages, frequencies, or types of current (ac or dc) on the same premises shall be of such design that the attachment plugs used on these circuits are not interchangeable.

<u>(G) Back wired stab in receptacles shall not be used as feed through devices. Each pole of the device shall only be permitted to have a single stab in connection.</u>

Statement of Problem and Substantiation for Public Input

Receptacles with stab in connections that are used to feed through a device are failing due to the fact that the device is carrying the entire load of the circuit. When the connections are made in listed termination device then the receptacle is only carrying the connected load to the individual device. The other advantage is that when the receptacle is not being used as a feed through if the receptacle fails then the other receptacles connected to the circuit are not necessarily de-energized and will continue to operate as designed. The use of the plug type receptacle pigtails manufactured by Pass-Seymour and Leviton have helped to eliminated these types of installation issues. I would be in favor of all receptacle only being allowed to have a single connection to each pole. This would require that all spliced with a single pigtail for connection to each pole of the receptacle.

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Committee: NEC-P18

Public Input No. 1353-NFPA 70-2020 [Section No. 406.4(B)]

(B) ~~To Be Grounded~~ Connection to Equipment Grounding Conductor .

Receptacles and cord connectors that have equipment grounding conductor contacts shall have those contacts connected to an equipment grounding conductor.

Exception No. 1: Receptacles mounted on portable and vehicle-mounted generator sets and generators in accordance with 250.34.

Exception No. 2: Replacement receptacles as permitted by 406.4(D).

Statement of Problem and Substantiation for Public Input

According to the NFPA Style Manual, the Section Title needs to reflect the content of the rule. The rule is about the equipment grounding conductor, not about 'Grounding.'

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Committee: NEC-P18

Public Input No. 1354-NFPA 70-2020 [Section No. 406.4(C)]

(C) Methods of Connection to Equipment Grounding Conductor .

The equipment grounding conductor contacts of receptacles ~~and cord connectors~~ shall be connected to ~~the~~ an equipment grounding conductor ~~of the circuit supplying the receptacle or cord connector.~~

~~Informational Note: For installation requirements for the reduction of electromagnetic interference, see~~

in accordance with 250.146

~~(D).~~

~~The branch-circuit wiring method shall include or provide an equipment grounding conductor to which~~ . Cord connectors shall be connected to the equipment grounding conductor ~~contacts~~ of the ~~receptacle or~~ circuit supplying the cord connector ~~are connected~~ .

~~Informational Note No. 1: See 250.118 for acceptable grounding means.~~

~~Informational Note No. 2: For extensions of existing branch circuits, see 250.130 .~~

Statement of Problem and Substantiation for Public Input

According to the NFPA Style Manual, the Section Title needs to reflect the content of the rule. The rule is about the equipment grounding conductor, not about 'Grounding.'
Requirements for the receptacle connection to the EGC should simply be referenced to 250.148.
Information nots and other delted text is already contained in 250.148, so not need to have them.
Let's just have the rule simply state it's requirements.

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Committee: NEC-P18

Public Input No. 15-NFPA 70-2019 [Section No. 406.4(D)]

(D) Replacements.

Replacement of receptacles shall comply with 406.4(D)(1) through (D)(7), as applicable. Arc-fault circuit-interrupter type and ground-fault circuit-interrupter type receptacles shall be installed in a readily accessible location.

(1) Grounding-Type Receptacles.

Where a grounding means exists in the receptacle enclosure or an equipment grounding conductor is installed in accordance with 250.130(C), grounding-type receptacles shall be used and shall be connected to the equipment grounding conductor in accordance with 406.4(C) or 250.130(C).

(2) Non–Grounding-Type Receptacles.

Where attachment to an equipment grounding conductor does not exist in the receptacle enclosure, the installation shall comply with 406.4(D)(2)(a), (D)(2)(b), or (D)(2)(c).

(a) A non–grounding-type receptacle(s) shall be permitted to be replaced with another non–grounding-type receptacle(s).

(b) A non–grounding-type receptacle(s) shall be permitted to be replaced with a ground-fault circuit interrupter-type of receptacle(s). These receptacles or their cover plates shall be marked “No Equipment Ground.” An equipment grounding conductor shall not be connected from the ground-fault circuit-interrupter-type receptacle to any outlet supplied from the ground-fault circuit-interrupter receptacle.

(c) A non–grounding-type receptacle(s) shall be permitted to be replaced with a grounding-type receptacle(s) where supplied through a ground-fault circuit interrupter. Where grounding-type receptacles are supplied through the ground-fault circuit interrupter, grounding-type receptacles or their cover plates shall be marked “GFCI Protected” and “No Equipment Ground,” visible after installation. An equipment grounding conductor shall not be connected between the grounding-type receptacles.

Informational Note No. 1: Some equipment or appliance manufacturers require that the branch circuit to the equipment or appliance includes an equipment grounding conductor.

Informational Note No. 2: See 250.114 for a list of a cord-and-plug-connected equipment or appliances that require an equipment grounding conductor.

(3) Ground-Fault Circuit-Interrupter Protection.

Ground-fault circuit-interrupter protected receptacles shall be provided where replacements are made at receptacle outlets that are required to be so protected elsewhere in this *Code*.

Exception: Where the outlet box size will not permit the installation of the GFCI receptacle, the receptacle shall be permitted to be replaced with a new receptacle of the existing type, where GFCI protection is provided and the receptacle is marked “GFCI Protected” and “No Equipment Ground,” in accordance with 406.4(D)(2)(a), (D)(2)(b), or (D)(2)(c), as applicable.

(4) Arc-Fault Circuit-Interrupter Protection.

If a receptacle outlet located in any areas specified in 210.12(A), (B), or (C) is replaced, a replacement receptacle at this outlet shall be one of the following:

(1) A listed outlet branch-circuit type arc-fault circuit-interrupter receptacle

(2) A receptacle protected by a listed outlet branch-circuit type arc-fault circuit-interrupter type receptacle

(3) A receptacle protected by a listed combination type arc-fault circuit-interrupter type circuit breaker

Exception: Section 210.12(D), Exception, shall not apply to replacement of receptacles.

(5) Tamper-Resistant Receptacles.

Listed tamper-resistant receptacles shall be provided where replacements are made at receptacle outlets that are required to be tamper-resistant elsewhere in this *Code*, except where a non-grounding receptacle is replaced with another non-grounding receptacle.

(6) Weather-Resistant Receptacles.

Weather-resistant receptacles shall be provided where replacements are made at receptacle outlets that are required to be so protected elsewhere in this *Code*.

(7) Controlled Receptacles.

Automatically controlled receptacles shall be replaced with equivalently controlled receptacles. If automatic control is no longer required, the receptacle and any associated receptacles marked in accordance with 406.3(E) shall be replaced with a receptacle and faceplate not marked in accordance with 406.3(E).

(8) Ground-Fault Protection of Equipment.

Receptacles shall be provided with ground-fault protection of equipment where replacements are made at receptacle outlets that are required to be so protected elsewhere in this *Code*.

Statement of Problem and Substantiation for Public Input

This requirement is very similar to (3) of this section initiating providing the GFPE protection when modifications are made. areas such as Marinas where GFPE protection has been recently expanded must be afforded protection as the system ages and modifications are made.

Submitter Information Verification

Submitter Full Name: Thomas Domitrovich
Organization: Eaton Corporation
Street Address:
City:
State:
Zip:
Submittal Date: Fri Nov 01 18:04:48 EDT 2019
Committee: NEC-P18

Public Input No. 1739-NFPA 70-2020 [Section No. 406.4(D)]

(D) Replacements.

Replacement of receptacles shall comply with 406.4(D)(1) through (D)(7), as applicable. Arc-fault circuit-interrupter type and ground-fault circuit-interrupter type receptacles shall be installed in a readily accessible location.

(1) Grounding-Type Receptacles.

Where a grounding means exists in the receptacle enclosure or an equipment grounding conductor is installed in accordance with 250.130(C), grounding-type receptacles shall be used and shall be connected to the equipment grounding conductor in accordance with 406.4(C) or 250.130(C).

(2) Non–Grounding-Type Receptacles.

Where attachment to an equipment grounding conductor does not exist in the receptacle enclosure, the installation shall comply with 406.4(D)(2)(a), (D)(2)(b), or (D)(2)(c).

(a) A non–grounding-type receptacle(s) shall be permitted to be replaced with another non–grounding-type receptacle(s).

(b) A non–grounding-type receptacle(s) shall be permitted to be replaced with a ground-fault circuit interrupter-type of receptacle(s). These receptacles or their cover plates shall be marked “No Equipment Ground.” An equipment grounding conductor shall not be connected from the ground-fault circuit-interrupter-type receptacle to any outlet supplied from the ground-fault circuit-interrupter receptacle.

(c) A non–grounding-type receptacle(s) shall be permitted to be replaced with a grounding-type receptacle(s) where supplied through a ground-fault circuit interrupter. Where grounding-type receptacles are supplied through the ground-fault circuit interrupter, grounding-type receptacles or their cover plates shall be marked “GFCI Protected” and “No Equipment Ground,” visible after installation. An equipment grounding conductor shall not be connected between the grounding-type receptacles.

Informational Note No. 1: Some equipment or appliance manufacturers require that the branch circuit to the equipment or appliance includes an equipment grounding conductor.

Informational Note No. 2: See 250.114 for a list of a cord-and-plug-connected equipment or appliances that require an equipment grounding conductor.

(3) Ground-Fault Circuit-Interrupter Protection.

Ground-fault circuit-interrupter protected receptacles shall be provided where replacements are made at receptacle outlets that are required to be so protected elsewhere in this *Code*.

Exception: Where the outlet box size will not permit the installation of the GFCI receptacle, the receptacle shall be permitted to be replaced with a new receptacle of the existing type, where GFCI protection is provided and the receptacle is marked “GFCI Protected” and “No Equipment Ground,” in accordance with 406.4(D)(2)(a), (D)(2)(b), or (D)(2)(c), as applicable.

(4) Arc-Fault Circuit-Interrupter Protection.

If a receptacle ~~outlet~~ located in any areas specified in 210.12(A), (B), or (C) is replaced, a replacement receptacle at this outlet shall be one of the following:

(1) A listed outlet branch-circuit type arc-fault circuit-interrupter receptacle

(2) A receptacle protected by a listed outlet branch-circuit type arc-fault circuit-interrupter type receptacle

(3) A receptacle protected by a listed combination type arc-fault circuit-interrupter type circuit breaker

Exception: Section 210.12(D), Exception, shall not apply to replacement of receptacles.

(5) Tamper-Resistant Receptacles.

Listed tamper-resistant receptacles shall be provided where replacements are made at receptacle outlets that are required to be tamper-resistant elsewhere in this *Code*, except where a non-grounding receptacle is replaced with another non-grounding receptacle.

(6) Weather-Resistant Receptacles.

Weather-resistant receptacles shall be provided where replacements are made at receptacle outlets that are required to be so protected elsewhere in this *Code*.

(7) Controlled Receptacles.

Automatically controlled receptacles shall be replaced with equivalently controlled receptacles. If automatic control is no longer required, the receptacle and any associated receptacles marked in accordance with 406.3(E) shall be replaced with a receptacle and faceplate not marked in accordance with 406.3(E).

Statement of Problem and Substantiation for Public Input

Delete “outlet” since the rule is related to receptacles that have been replaced.

Submitter Information Verification

Submitter Full Name: Mike Holt

Organization: Mike Holt Enterprises Inc

Street Address:

City:

State:

Zip:

Submittal Date: Thu Jun 25 17:41:06 EDT 2020

Committee: NEC-P18

Public Input No. 3269-NFPA 70-2020 [Section No. 406.4(D)(2)]

(2) Non–Grounding-Type Receptacles.

Where attachment to an equipment grounding conductor does not exist in the receptacle enclosure, the installation shall comply with 406.4(D)(2)(a), (D)(2)(b), or (D)(2)(c).

(a) A non–grounding-type receptacle(s) shall be permitted to be replaced with another non–grounding-type receptacle(s).

(b) A non–grounding-type receptacle(s) shall be permitted to be replaced with a ground-fault circuit interrupter-type of receptacle(s). These receptacles or their cover plates shall be marked “No Equipment Ground.” An equipment grounding conductor shall not be connected from the ground-fault circuit-interrupter-type receptacle to any outlet supplied from the ground-fault circuit-interrupter receptacle.

(c) A non–grounding-type receptacle(s) shall be permitted to be replaced with a grounding-type receptacle(s) where supplied through a ground-fault circuit interrupter. Where grounding-type receptacles are supplied through the ground-fault circuit interrupter, grounding-type receptacles or their cover plates shall be marked “GFCI Protected” and “No Equipment Ground,” visible after installation. An equipment grounding conductor shall not be connected between the grounding-type receptacles.

Informational Note No. 1: Some equipment or appliance manufacturers require that the branch circuit to the equipment or appliance includes an equipment grounding conductor.

~~Informational Note No. 2: See 250.114 for a list of a cord-and-plug-connected equipment or appliances that require an equipment grounding conductor.~~

Statement of Problem and Substantiation for Public Input

If my proposal to add an exception to 250.114(3) is accepted by CMP 5 to permit receptacles installed under the provisions of this section to be supplied by circuits that do not have an EGC is accepted, this note is no longer needed.

Related Public Inputs for This Document

Related Input	Relationship
Public Input No. 3268-NFPA 70-2020 [Section No. 250.114]	acceptance of linked PI makes removes need for IN
Public Input No. 3268-NFPA 70-2020 [Section No. 250.114]	

Submitter Information Verification

Submitter Full Name: Don Ganiere
Organization: [Not Specified]
Street Address:
City:
State:
Zip:

Submittal Date:	Mon Sep 07 13:29:25 EDT 2020
Committee:	NEC-P18

Public Input No. 2213-NFPA 70-2020 [Section No. 406.4(D)(3)]

(3) Ground-Fault Circuit-Interrupter Protection.

Ground-fault circuit-interrupter protected receptacles shall be provided where replacements are made at receptacle outlets that are required to be so protected elsewhere in this *Code*. Ground-fault circuit-interrupters shall be listed.

Exception: Where the outlet box size will not permit the installation of the GFCI receptacle, the receptacle shall be permitted to be replaced with a new receptacle of the existing type, where GFCI protection is provided and the receptacle is marked "GFCI Protected" and "No Equipment Ground," in accordance with 406.4(D)(2)(a), (D)(2)(b), or (D)(2)(c), as applicable.

Statement of Problem and Substantiation for Public Input

I find it a bit ironic that such an important safety device is not required to tested and certified by an independent lab. GFCI devices are every bit as important, perhaps even more so than the AFCI devices specified in 210.12 and 406.4(D)(4) which ARE required to be listed.
Using unlisted GFCI devices should not be permitted because these safety devices are simply too important to allow anything less.

Related Public Inputs for This Document

Related Input	Relationship
Public Input No. 2208-NFPA 70-2020 [Section No. 210.8 [Excluding any Sub-Sections]]	Listed GFCI devices
Public Input No. 2209-NFPA 70-2020 [Section No. 215.9]	Listed GFCI devices
Public Input No. 2210-NFPA 70-2020 [Section No. 555.9]	Listed GFCI devices
Public Input No. 2211-NFPA 70-2020 [Section No. 422.5(A)]	Listed GFCI devices
Public Input No. 2212-NFPA 70-2020 [Section No. 590.6]	Listed GFCI devices

Submitter Information Verification

Submitter Full Name: Russ Leblanc
Organization: Leblanc Consulting Services
Street Address:
City:
State:
Zip:

Submittal Date: Tue Aug 11 07:32:44 EDT 2020
Committee: NEC-P18

Public Input No. 4443-NFPA 70-2020 [Section No. 406.4(D)(3)]

(3) Ground-Fault Circuit-Interrupter Protection.

Ground-fault circuit-interrupter protected receptacles shall be provided where replacements are made at receptacle outlets that are required to be so protected elsewhere in this *Code*.

~~*Exception: Where the outlet box size will not permit the installation of the GFCI receptacle, the receptacle shall be permitted to be replaced with a new receptacle of the existing type, where GFCI protection is provided and the receptacle is marked "GFCI Protected" and "No Equipment Ground," in accordance with 406.4(D)(2)(a) , (D)(2)(b), or (D)(2)(c), as applicable.*~~

Statement of Problem and Substantiation for Public Input

This exception permits conventional receptacles to be used for replacements if the existing outlet box will not accommodate a GFCI receptacle and further provides that GFCI protection is arranged ahead of the new receptacle. This will create the erroneous impression that 406.4(D)(3) requires the use of a GFCI receptacle. It does not. It requires the use of a "ground-fault circuit-interrupter protected receptacle." A conventional receptacle on the load side of a GFCI circuit breaker already complies with this rule. The NEC exception is completely unnecessary.

It is also technically incorrect because it requires the use of labeling indicating "GFCI protected" and "no equipment ground." The latter label should not be used if an equipment ground is present, and yet would be required. There are many applications of small outlet boxes containing old wiring that nevertheless do provide an equipment grounding return path.

This exception, which is permissive and therefore does not vary the rule it follows, can technically be safely ignored. However, it continues to cause confusion and should be deleted.

Submitter Information Verification

Submitter Full Name:	Frederic Hartwell
Organization:	Hartwell Electrical Services, Inc.
Affiliation:	self
Street Address:	
City:	
State:	
Zip:	
Submittal Date:	Thu Sep 10 13:08:49 EDT 2020
Committee:	NEC-P18

Public Input No. 2585-NFPA 70-2020 [Section No. 406.4(D)(4)]

(4) Arc-Fault Circuit-Interrupter Protection.

If a receptacle ~~outlet~~ located in any areas specified in 210.12(A), (B), or (C) is replaced, a replacement receptacle at this outlet shall be one of the following:

(1) A listed outlet branch-circuit type arc-fault circuit-interrupter receptacle

(2) A receptacle protected by a listed outlet branch-circuit type arc-fault circuit-interrupter type receptacle

(3) A receptacle protected by a listed combination type arc-fault circuit-interrupter type circuit breaker

Exception: Section 210.12(D), Exception, shall not apply to replacement of receptacles.

Statement of Problem and Substantiation for Public Input

The current language only requires an AFCI device to be installed where the receptacle outlet is replaced. The receptacle outlet is the box where the receptacle is installed. As written this rule only applies where the box is replaced.

Receptacle Outlet.

An outlet where one or more receptacles are installed. (CMP-18)

By removing the word "outlet" the requirement applies where the receptacle is replaced.

Submitter Information Verification

Submitter Full Name: Don Ganiere
Organization: [Not Specified]
Street Address:
City:
State:
Zip:
Submittal Date: Mon Aug 24 20:42:12 EDT 2020
Committee: NEC-P18

Public Input No. 3779-NFPA 70-2020 [Section No. 406.4(D)(4)]

(4) Arc-Fault Circuit-Interrupter (AFCI) Protection.

If a receptacle outlet located in any areas specified in 210.12(A), (B), or (C) is replaced, a replacement receptacle at this outlet shall be one of the following:

(1) A listed outlet branch-circuit type ~~arc-fault circuit-interrupter receptacle~~ AFCI

(2) A receptacle protected by a listed outlet branch-circuit type ~~arc-fault circuit-interrupter type receptacle~~ AFCI

(3) A receptacle protected by a listed combination type ~~arc-fault circuit-interrupter type circuit breaker~~ AFCI

Exception: Section 210.12(D), Exception, shall not apply to replacement of receptacles.

Statement of Problem and Substantiation for Public Input

The proposed revisions to this section are an attempt to create a consistent naming scheme for the various methods of providing AFCI protection recognized by the code. The code should use the exact same terms, hyphenations, and abbreviations when describing these products in all sections of the code. This public input works in concert with a similar public input submitted for 210.12 where the same naming scheme is proposed.

Submitter Information Verification

Submitter Full Name: Megan Hayes
Organization: Nema
Street Address:
City:
State:
Zip:
Submittal Date: Wed Sep 09 12:31:49 EDT 2020
Committee: NEC-P18

Public Input No. 739-NFPA 70-2020 [Section No. 406.4(D)(4)]

(4) Arc-Fault Circuit-Interrupter Protection.

If a ~~receptacle outlet located~~ receptacle located in any areas specified in 210.12(A), (B), or (C) is replaced, a replacement receptacle at this outlet shall be one of the following:

(1) A listed outlet branch-circuit type arc-fault circuit-interrupter receptacle

(2) A receptacle protected by a listed outlet branch-circuit type arc-fault circuit-interrupter type receptacle

(3) A receptacle protected by a listed combination type arc-fault circuit-interrupter type circuit breaker

Exception: Section 210.12(D), Exception, shall not apply to replacement of receptacles.

Statement of Problem and Substantiation for Public Input

As written, this section is only in force when the wiring in the box is replaced. If it is the intention for this section to be in force when only the receptacle is replaced, "receptacle outlet" should be changed to "receptacle."

Submitter Information Verification

Submitter Full Name:	Eric Stromberg
Organization:	Los Alamos National Laboratory
Affiliation:	Self
Street Address:	
City:	
State:	
Zip:	
Submittal Date:	Sat Mar 21 22:43:14 EDT 2020
Committee:	NEC-P18

Public Input No. 829-NFPA 70-2020 [Section No. 406.4(D)(4)]

(4) Arc-Fault Circuit-Interrupter Protection.

If a receptacle ~~outlet~~ located in any areas specified in 210.12(A), (B), or (C) is replaced, ~~a~~ the replacement receptacle at this outlet shall be one of the following:

(1) A listed outlet branch-circuit type arc-fault circuit-interrupter receptacle

(2) A receptacle protected by a listed outlet branch-circuit type arc-fault circuit-interrupter type receptacle

(3) A receptacle protected by a listed combination type arc-fault circuit-interrupter type circuit breaker

Exception: Section 210.12(D), Exception, shall not apply to replacement of receptacles.

Statement of Problem and Substantiation for Public Input

Replacement of a receptacle outlet in an existing home is very unlikely and not, in my opinion, the intent of the original requirement. This change makes it clear that it is the replacement of the receptacle and not the receptacle outlet in one of the areas identified as part of 210.12 (A), (B), or (C) that should trigger the requirements of AFCI protection.

Submitter Information Verification

Submitter Full Name: Thomas Domitrovich

Organization: Eaton Corporation

Street Address:

City:

State:

Zip:

Submittal Date: Thu Apr 02 22:19:28 EDT 2020

Committee: NEC-P18

Public Input No. 4150-NFPA 70-2020 [Section No. 406.4(D)(5)]

(5) Tamper-Resistant Receptacles.

Listed tamper-resistant receptacles shall be provided where replacements are made at receptacle outlets that are required to be tamper-resistant elsewhere in this *Code*, except where a non-grounding receptacle is replaced with another non-grounding receptacle, or where a CO/ALR receptacle is installed to replace a conventional receptacle directly connected to aluminum branch-circuit conductors .

Statement of Problem and Substantiation for Public Input

As a practical matter, CO/ALR receptacles are not and never will be available in a tamper-resistant configuration. Without this change, they never will be able to be installed in the future except in non-residential occupancies, and statistically speaking, that is not where this sort of wiring is found.The time period when old aluminum wiring was being routinely installed long predated the more recent changes made by CMP 9 to increase the size of boxes. There is insufficient room to install copper pigtails to modern receptacles. CMP 18 long ago recognized market practicalities in exempting nongrounding receptacle replacements without tamper-resistant constructions, and it should do the same for CO/ALR receptacles. Rewiring with CO/ALR receptacles eliminates a fire waiting to happen, and is plainly the lesser evil in this case.

Submitter Information Verification

Submitter Full Name: Frederic Hartwell

Organization: Hartwell Electrical Services, Inc.

Affiliation: self

Street Address:

City:

State:

Zip:

Submittal Date: Wed Sep 09 22:11:20 EDT 2020

Committee: NEC-P18

Public Input No. 1111-NFPA 70-2020 [New Section after 406.5(D)]

TITLE OF NEW CONTENT

Type your content here ...

Regarding existing 406.5(D) Position of Receptacle Faces -

No change whatsoever with this existing NEC code. The change I'd like to see is for manufacturers of floorboxes to adhere to 406.5(D). Frequently, floorboxes are installed according to the instructions but the blades of a cord plug make poor contact because the floor box receptacle cover prevents plugging in entirely. The receptacle(s) do not project from the metal cover but actually recede.

Statement of Problem and Substantiation for Public Input

No change whatsoever with this existing NEC code. The change I'd like to see is for manufacturers of floorboxes to adhere to 406.5(D). Frequently, floorbox receptacles are installed according to the instructions but the blades of a cord plug make poor contact because the floorbox receptacle cover prevents plugging in entirely. The receptacle(s) do not project from the metal cover but actually recess.

Submitter Information Verification

Submitter Full Name: Norman Feck
Organization: State of Colorado
Street Address:
City:
State:
Zip:
Submittal Date: Sat May 16 16:34:17 EDT 2020
Committee: NEC-P18

Public Input No. 1019-NFPA 70-2020 [Section No. 406.5(G)(1)]

(1) Countertop and Work Surfaces.

~~Receptacles shall not be~~ No receptacles shall be installed in a face-up position in or on countertop surfaces or work surfaces unless GFCI protected and listed for countertop or work surface applications.

Statement of Problem and Substantiation for Public Input

there will be greater safety and the artical section will be more clear for people to read

Submitter Information Verification

Submitter Full Name: Jose Ruiz

Organization: E light

Street Address:

City:

State:

Zip:

Submittal Date: Sun May 10 16:50:26 EDT 2020

Committee: NEC-P18

Public Input No. 1417-NFPA 70-2020 [Section No. 406.5(J)]

(J) Voltage Between Adjacent Devices.

A receptacle shall not be grouped or ganged in enclosures with other receptacles, snap switches, or similar devices, unless they are arranged so that the voltage between adjacent devices does not exceed 300 volts, or unless they are installed in enclosures equipped with identified, securely installed barriers between adjacent devices.

Exception: Barriers shall not be required between devices having no exposed conductor terminals other than terminals for connections of equipment grounding conductors

Additional Proposed Changes

File Name	Description	Approved
6A82049F-4BB6-4E85-8DF1-C7DAECC7C668.jpeg	dimmer 1	
03F25B8F-B4AD-4255-A90D-F813BBE35816.jpeg	receptacle 1	
AFD20B9C-835A-4D9B-AE40-8EEE3746059B.jpeg	receptacle 2	
6BCE78A6-2EC0-4FBE-9D68-B186F1CEE45C.jpeg	switch 1	
E8A64B36-BF23-45A8-90CB-166ED511766A.jpeg	switch 2	

Statement of Problem and Substantiation for Public Input

Devices with no exposed terminals effectively have “barriers” built-in as part of the design of the device. These types of devices pose much less of a shock hazard than devices having exposed energized terminals. The risk of an arc between devices is also greatly reduced since there are no exposed terminals. Barriers should not be required where these types of devices are installed.

Related Public Inputs for This Document

Related Input	Relationship
Public Input No. 1414-NFPA 70-2020 [Section No. 404.8(B)]	Barriers between adjacent devices
Public Input No. 1414-NFPA 70-2020 [Section No. 404.8(B)]	

Submitter Information Verification

Submitter Full Name: Russ Leblanc

Organization: Leblanc Consulting Services

Street Address:

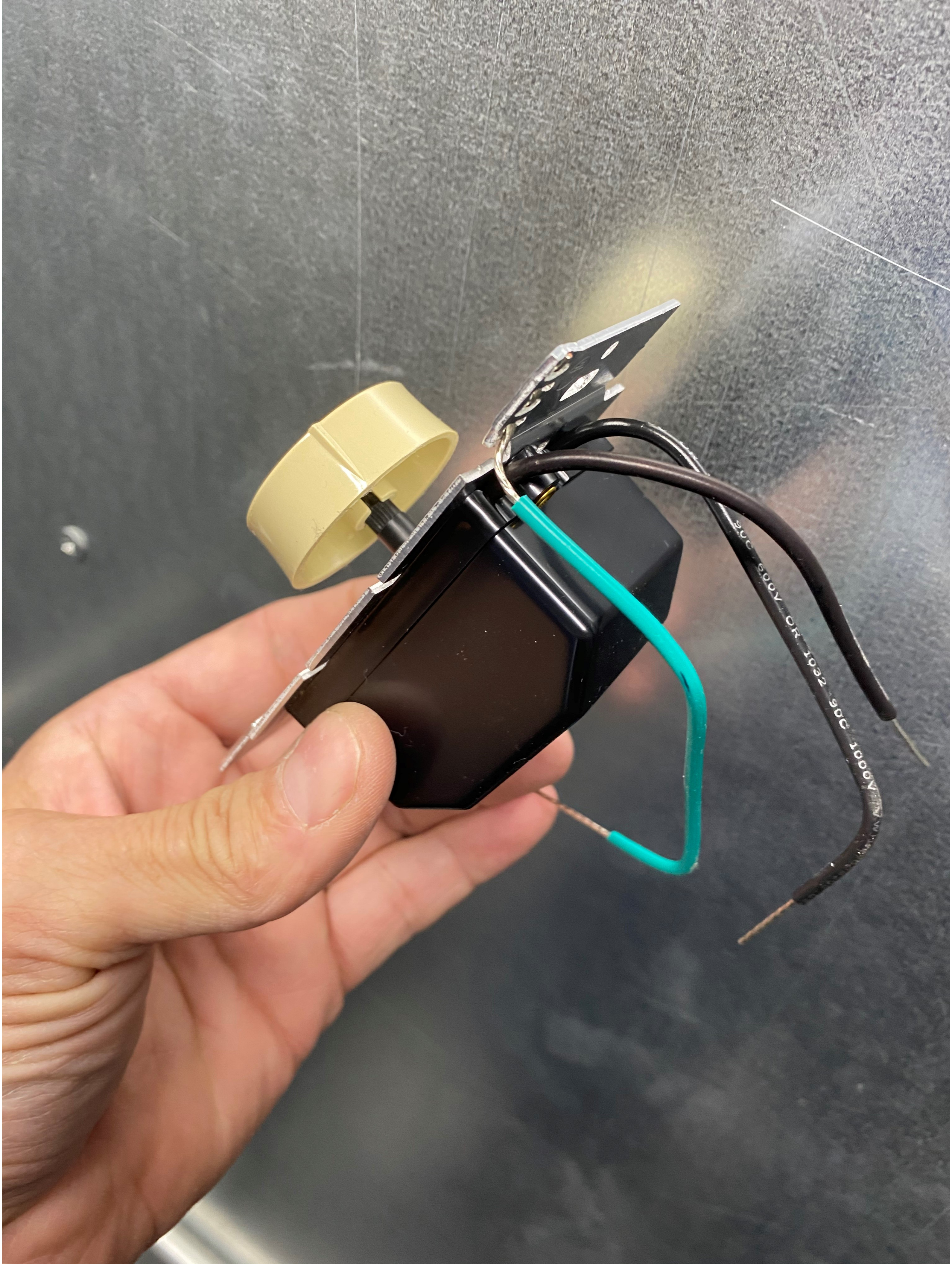
City:

State:

Zip:

Submittal Date: Tue Jun 02 12:58:47 EDT 2020

Committee: NEC-P18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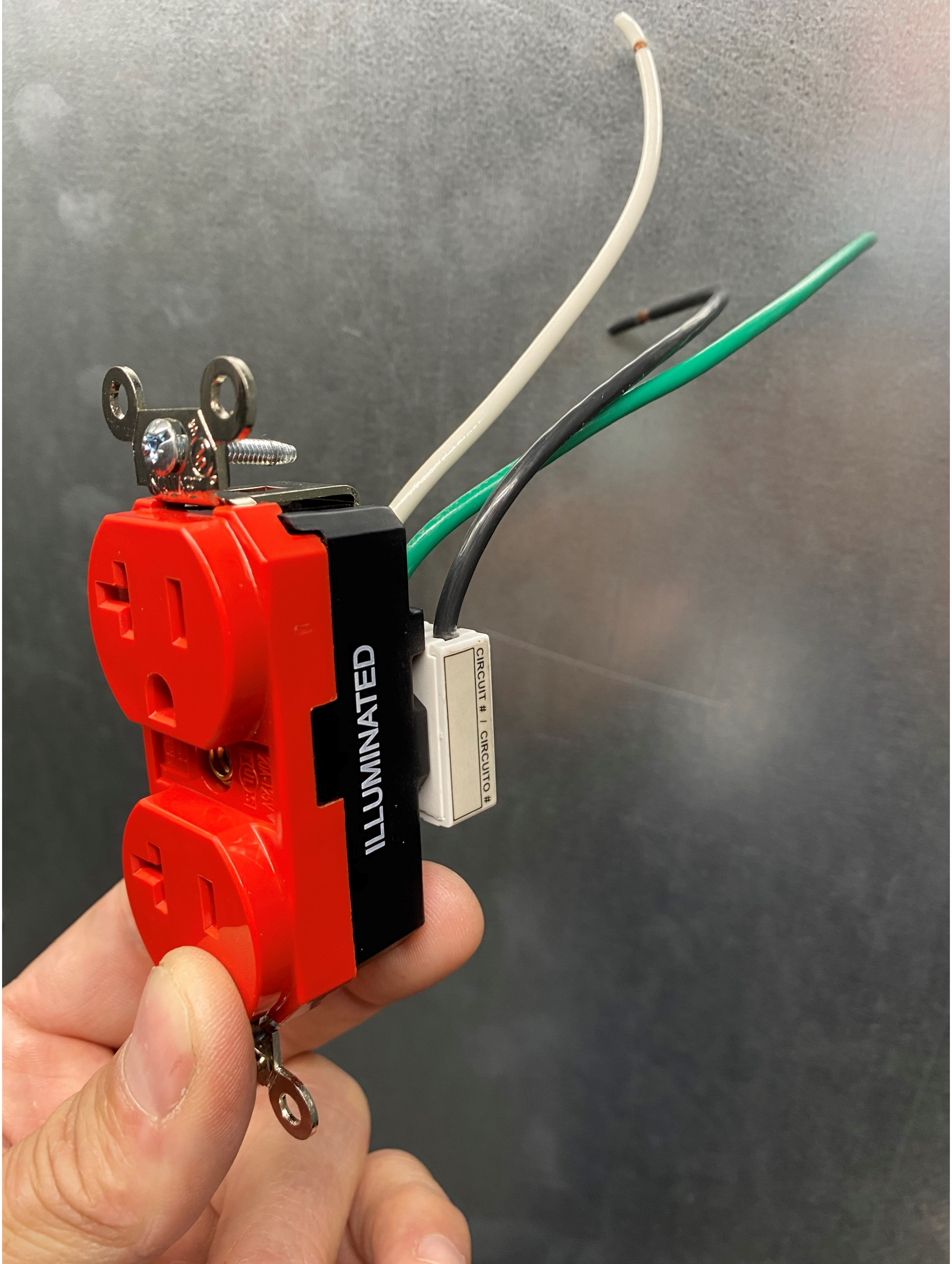
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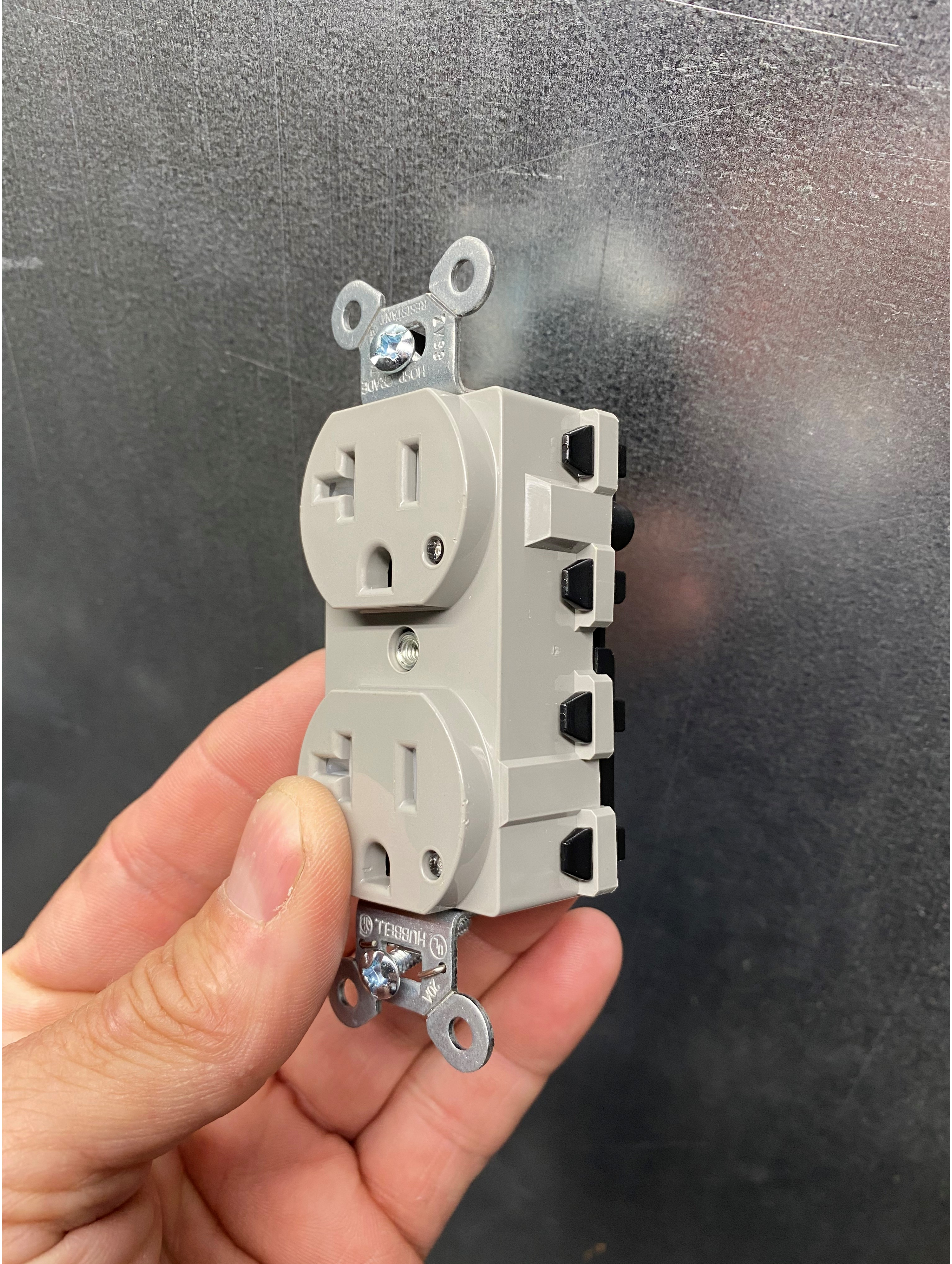

RESISTANT
HOSP GRADE
HUBBELL
20A


STRIP GAGE
WS-301
T 3.0
PIR Wall Switch
Occupancy Sensor
LISTED
Appliance
Control
88T9
E101196
120 or 277VAC, 60Hz
@120VAC 1000VA max:
Tungsten & Ballast &
E-ballast & LED , 1/4 HP
@277VAC 1200VA max :
Ballast & E-ballast &
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Indoor Use Only
legrand
www.legrand.us/wattstopper
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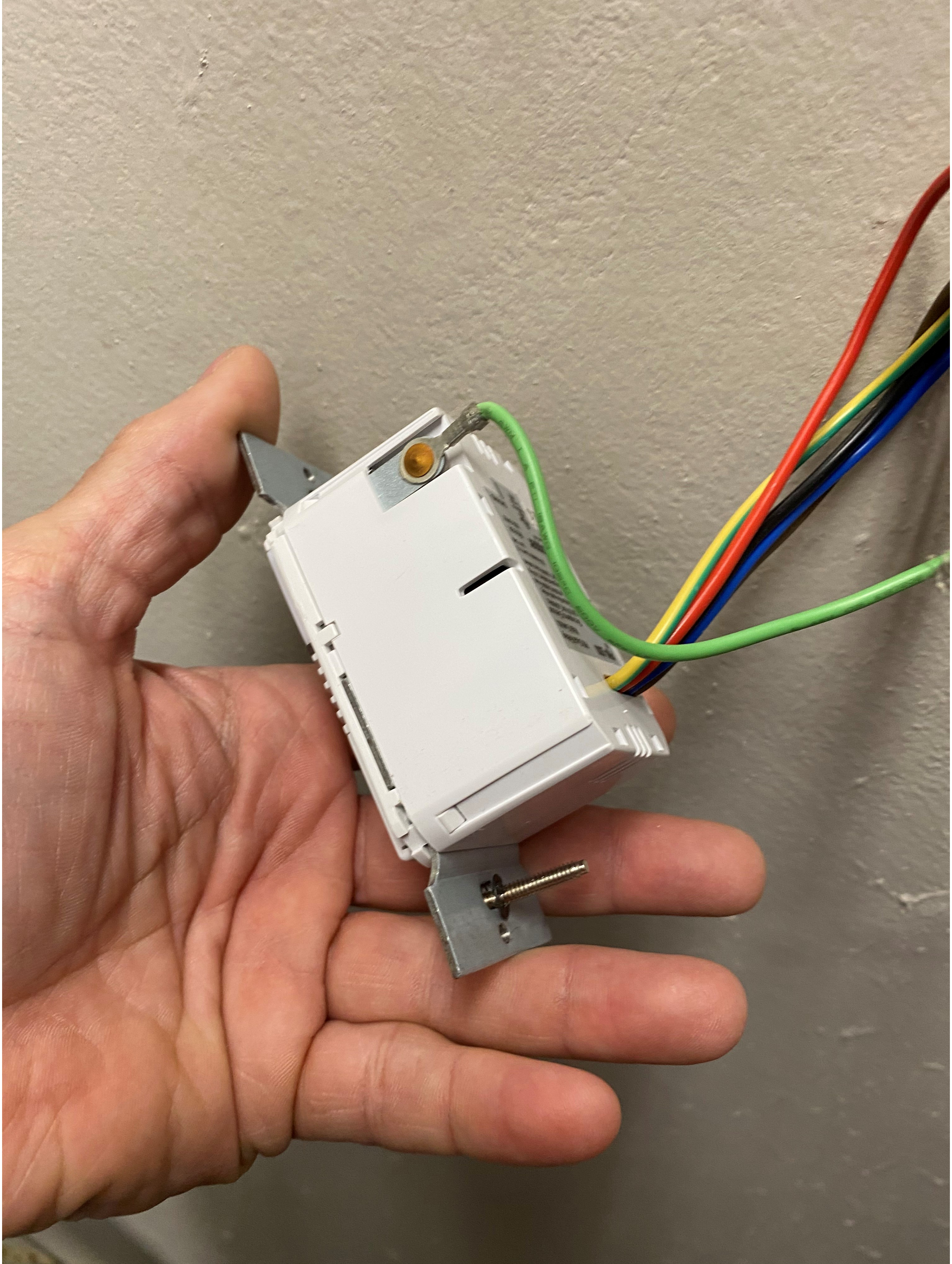


Public Input No. 1355-NFPA 70-2020 [Section No. 406.6(B)]

(B) ~~Grounding~~ Bonding .

Metal faceplates shall be ~~grounded~~ bonded to the receptacle yoke by securing the metal faceplate to the yoke with two metal screws .

Statement of Problem and Substantiation for Public Input

This rule needs to tell us how we are to 'bond' the receptacle to the circuit equipment grounding conductor. My PI is intended to help the installer understand what is required. Clearly saying it needs to be grounded is what we would have said 20 years ago...

Submitter Information Verification

Submitter Full Name:	Mike Holt
Organization:	Mike Holt Enterprises Inc
Street Address:	
City:	
State:	
Zip:	
Submittal Date:	Mon Jun 01 17:28:53 EDT 2020
Committee:	NEC-P18

Public Input No. 1513-NFPA 70-2020 [New Section after 406.6(D)]

TITLE OF NEW CONTENT 406.6(E)

Type your content here ...In other than dwelling units, receptacle face plates shall be marked with panel and circuit number

Statement of Problem and Substantiation for Public Input

I have been an inspector for over 17 years, inspecting mostly commercial. As far as plug testing for panel schedule accuracy there is no better method than to label the receptacle itself. panel schedules are difficult to put down all the different locations a circuit can cover. These factory panel schedules allow little room for detailed description even with the new allowance of a booklet. this method is speced out on certain projects and certain companies do it as a good practice. I will tell you that labeling does assure accuracy versus a descriptive panel schedule

Submitter Information Verification

Submitter Full Name: James Dorsey
Organization: Douglas County Electrical Insp
Street Address:
City:
State:
Zip:

Submittal Date: Sun Jun 14 17:45:48 EDT 2020
Committee: NEC-P18

Public Input No. 2408-NFPA 70-2020 [Section No. 406.6(D)]

(D) Receptacle Faceplate (Cover Plates) with Integral Night Light and/or USB Charger.

A flush device cover plate that additionally provides a night light and/or Class 2 output connector(s) shall be listed and constructed such that the night light and/or Class 2 circuitry is integral with the flush device cover plate.

<u>Such a faceplate shall connect to the branch circuit using approved wiring methods. It shall not connect through the use of friction or spring contact members with the screw heads or other components of the receptacle unless specifically evaluated and identified by the receptacle manufacturer.</u>

Statement of Problem and Substantiation for Public Input

A faceplate that requires power to operate must be connected to the branch circuit in a code compliant manner. Article 110.3(B) that requires Listed or labeled equipment shall be installed and used in accordance with any instructions included in the listing or labeling. Receptacles have not been listed, evaluated or tested to provide a friction or spring contact method of electrical connection to its terminals. There is no industry or ANSI standard for dimensions, location, material or coatings for receptacle terminals

This type of connection can result in overheating, arcing and significantly compromise electrical spacing resulting in fire or electric shock. There are also many receptacles of similar construction but with varying voltages presenting additional hazards.

NEC Article 110.14 Electrical Connections is very specific regarding secure connections and use of terminals and appropriate wires. If a faceplate or other accessory requires power it must be connected to the branch circuit using approved methods such as pigtails, splices or approved terminals or wired in connectors. The only approved way to connect directly to a receptacle is to plug directly into the receptacle outlet with a properly configured blade interface.

Submitter Information Verification

Submitter Full Name:	David Lutz
Organization:	Hubbell
Street Address:	
City:	
State:	
Zip:	
Submittal Date:	Wed Aug 19 13:48:31 EDT 2020
Committee:	NEC-P18

Public Input No. 4442-NFPA 70-2020 [Section No. 406.9]

406.9 Receptacles in Damp or Wet Locations.

(A) Damp Locations.

A receptacle installed outdoors in a location protected from the weather or in other damp locations shall have an enclosure for the receptacle that is weatherproof when the receptacle is covered (attachment plug cap not inserted and receptacle covers closed).

An installation suitable for wet locations shall also be considered suitable for damp locations.

A receptacle shall be considered to be in a location protected from the weather where located under roofed open porches, canopies, marquees, and the like, and will not be subjected to a beating rain or water runoff. ~~All 15~~ All 125 - and ~~20-ampere, 125- and~~ 250-volt nonlocking receptacles shall be a listed weather-resistant type.

> Informational Note: The types of receptacles covered by this requirement are ~~identified as 5-15, 5-20, 6-15, and 6-20 in~~ identified in ANSI/NEMA WD 6–2016, *Wiring Devices — Dimensional Specifications*.

(B) Wet Locations.

(1) Receptacles of 15 and 20 Amperes in a Wet Location.

Receptacles of 15 and 20 amperes, 125 and 250 volts installed in a wet location shall have an enclosure that is weatherproof whether or not the attachment plug cap is inserted. An outlet box hood installed for this purpose shall be listed and shall be identified as “extra-duty.” Other listed products, enclosures, or assemblies providing weatherproof protection that do not utilize an outlet box hood need not be marked “extra duty.”

> Informational Note No. 1: Requirements for extra-duty outlet box hoods are found in ANSI/UL 514D–2016, *Cover Plates for Flush-Mounted Wiring Devices*. “Extra duty” identification and requirements are not applicable to listed receptacles, faceplates, outlet boxes, enclosures, or assemblies that are identified as either being suitable for wet locations or rated as one of the outdoor enclosure–type numbers of Table 110.28 that does not utilize an outlet box hood.

Exception: 15- and 20-ampere, 125- through 250-volt receptacles installed in a wet location and subject to routine high-pressure spray washing shall be permitted to have an enclosure that is weatherproof when the attachment plug is removed.

All 15- and 20-ampere, 125- and 250-volt nonlocking-type receptacles shall be listed and so identified as the weather-resistant type.

> Informational Note No. 2: The configuration of weather-resistant receptacles covered by this requirement are identified as 5-15, 5-20, 6-15, and 6-20 in ANSI/NEMA WD 6–2016, *Wiring Devices — Dimensional Specifications*.

(2) Other Receptacles.

All other receptacles installed in a wet location shall be listed and so identified as the weather-resistant type, and installation shall comply with 406.9(B)(2)(a) or (B)(2)(b).

(a) A receptacle installed in a wet location, where the product intended to be plugged into it is not attended while in use, shall have an enclosure that is weatherproof with the attachment plug cap inserted or removed.

(b) A receptacle installed in a wet location where the product intended to be plugged into it will be attended while in use (e.g., portable tools) shall have an enclosure that is weatherproof when the attachment plug is removed.

(C) Bathtub and Shower Space.

Receptacles shall not be installed within a zone measured 900 mm (3 ft) horizontally and 2.5 m (8 ft) vertically from the top of the bathtub rim or shower stall threshold. The identified zone is all-encompassing and shall include the space directly over the tub or shower stall.

Exception: In bathrooms with less than the required zone the receptacle(s) shall be permitted to be installed opposite the bathtub rim or shower stall threshold on the farthest wall within the room.

(D) Protection for Floor Receptacles.

Standpipes of floor receptacles shall allow floor-cleaning equipment to be operated without damage to receptacles.

(E) Flush Mounting with Faceplate.

The enclosure for a receptacle installed in an outlet box flush-mounted in a finished surface shall be made weatherproof by means of a weatherproof faceplate assembly that provides a watertight connection between the plate and the finished surface.

Statement of Problem and Substantiation for Public Input

This public input intends to expand upon the current weather-resistant requirements which only applied to 15- and 20-ampere, 125- and 250-volt receptacles installed in wet and damp locations. Receptacles other than 15- and 20-ampere, 125- and 250-volt rated are commonly installed in close-proximity and exposed to the same, and in many cases even more severe, environmental influences. Over-heating caused by corroded/compromised current path will be more severe due to the higher current drawn from these receptacles. Requiring these receptacles to be weather-resistant will result in improved safety for the users of these devices.

Submitter Information Verification

Submitter Full Name: James Lowe
Organization: Leviton Manufacturing Company
Street Address:
City:
State:
Zip:
Submittal Date: Thu Sep 10 13:04:48 EDT 2020
Committee: NEC-P18

Public Input No. 1112-NFPA 70-2020 [Section No. 406.9(B)(1)]

(1) Receptacles of 15 and 20 Amperes in a Wet Location.

Receptacles of 15 and 20 amperes, 125 and 250 volts installed in a wet location shall have an enclosure that is weatherproof whether or not the attachment plug cap is inserted. An outlet box hood installed for this purpose shall be listed and shall be identified as “extra-duty.” Other listed products, enclosures, or assemblies providing weatherproof protection that do not utilize an outlet box hood need not be marked “extra duty.” Hinged covers of outlet box hoods shall be able to open at least 90 degrees after installation.

Informational Note No. 1: Requirements for extra-duty outlet box hoods are found in ANSI/UL 514D–2016, *Cover Plates for Flush-Mounted Wiring Devices*. “Extra duty” identification and requirements are not applicable to listed receptacles, faceplates, outlet boxes, enclosures, or assemblies that are identified as either being suitable for wet locations or rated as one of the outdoor enclosure–type numbers of Table 110.28 that does not utilize an outlet box hood.

Exception: 15- and 20-ampere, 125- through 250-volt receptacles installed in a wet location and subject to routine high-pressure spray washing shall be permitted to have an enclosure that is weatherproof when the attachment plug is removed.

All 15- and 20-ampere, 125- and 250-volt nonlocking-type receptacles shall be listed and so identified as the weather-resistant type.

Informational Note No. 2: The configuration of weather-resistant receptacles covered by this requirement are identified as 5-15, 5-20, 6-15, and 6-20 in ANSI/NEMA WD 6–2016, *Wiring Devices — Dimensional Specifications*.

Statement of Problem and Substantiation for Public Input

Too often, these covers are installed under a panelboard with a factory 1/2" offset nipple or short nipple which doesn't have the length to allow the cover to fully open. These covers can often be discovered broken and in pieces beside the receptacle. First, opening it is a user-unfriendly design. Second, it is light duty construction, except the metal outlet box hoods, despite the extra-duty identification.

Similar to 110.26(A)(2).

This public input would surely alleviate the problem. Manufacturers have to step up and make the extra-duty identification believable.

Submitter Information Verification

Submitter Full Name: Norman Feck

Organization: State of Colorado

Street Address:

City:

State:

Zip:

Submittal Date: Sat May 16 16:47:25 EDT 2020

Committee: NEC-P18

Public Input No. 560-NFPA 70-2020 [Section No. 406.9(B)(1)]

(1) Receptacles of 15 and 20 Amperes in a Wet Location.

Receptacles of 15 and 20 amperes, 125 and 250 volts installed in a wet location shall have an enclosure that is weatherproof whether or not the attachment plug cap is inserted. An outlet box hood installed for this purpose shall be listed and shall be identified as “extra-duty.” Other listed products, enclosures, or assemblies providing weatherproof protection that do not utilize an outlet box hood need not be ~~marked~~ identified “extra duty.”

Informational Note No. 1: Requirements for extra-duty outlet box hoods are found in ANSI/UL 514D–2016, *Cover Plates for Flush-Mounted Wiring Devices*. “Extra duty” identification and requirements are not applicable to listed receptacles, faceplates, outlet boxes, enclosures, or assemblies that are identified as either being suitable for wet locations or rated as one of the outdoor enclosure–type numbers of Table 110.28 that does not utilize an outlet box hood.

Exception: 15- and 20-ampere, 125- through 250-volt receptacles installed in a wet location and subject to routine high-pressure spray washing shall be permitted to have an enclosure that is weatherproof when the attachment plug is removed.

All 15- and 20-ampere, 125- and 250-volt nonlocking-type receptacles shall be listed and so identified as the weather-resistant type.

Informational Note No. 2: The configuration of weather-resistant receptacles covered by this requirement are identified as 5-15, 5-20, 6-15, and 6-20 in ANSI/NEMA WD 6–2016, *Wiring Devices — Dimensional Specifications*.

Statement of Problem and Substantiation for Public Input

Identified does not mean "marked." See Article 100.

Submitter Information Verification

Submitter Full Name: Ryan Jackson
Organization: Ryan Jackson
Street Address:
City:
State:
Zip:
Submittal Date: Fri Feb 28 11:42:10 EST 2020
Committee: NEC-P18

Public Input No. 1066-NFPA 70-2020 [Section No. 406.9(B)(2)]

(2) Other Receptacles.

All ~~other~~ receptacles installed in a wet location shall comply with 406.9(B)(2)(a) or (B)(2)(b).

(a) A receptacle installed in a wet location, where the product intended to be plugged into it is not attended while in use, shall have an enclosure that is weatherproof with the attachment plug cap inserted or removed.

(b) A receptacle installed in a wet location where the product intended to be plugged into it will be attended while in use (e.g., portable tools) shall have an enclosure that is weatherproof when the attachment plug is removed.

Statement of Problem and Substantiation for Public Input

it would explain that all receptacles installed in a wet location will comply with article 406.9(B)(2)(a) or (B)(2)(b)

Submitter Information Verification

Submitter Full Name: Gilbert Romero
Organization: E Light Electric Services, Inc.
Street Address:
City:
State:
Zip:
Submittal Date: Thu May 14 19:53:21 EDT 2020
Committee: NEC-P18

Public Input No. 1257-NFPA 70-2020 [Section No. 406.9(C)]

(C) Bathtub and Shower Space.

Receptacles shall not be installed within a zone measured 900 mm (3 ft) horizontally (including the tub and shower stall and the space outside the tub or shower space below the zone) and 2.5 m (8 ft) vertically from the top of the bathtub rim or shower stall threshold. The identified zone is all-encompassing and shall include the space directly over the tub or shower stall.

Exception: In bathrooms with less than the required zone the receptacle(s) shall be permitted to be installed opposite the bathtub rim or shower stall threshold on the farthest wall within the room.

Additional Proposed Changes

File Name	Description	Approved
_406.9_C_2023_NEC_.jpg	406.9(C) (2023 NEC) (K Lofland)	

Statement of Problem and Substantiation for Public Input

Presently, a "zone" has been established around a tub or shower restricting receptacle outlet placement around tubs and shower stalls. This "zone" for receptacle outlets in Article 406 was patterned after the existing “zone” for luminaires at 410.10(D). It would be logical to assume that a luminaire or ceiling fan would not be located below this restrictive zone which extends 3 ft. out and 8 ft. tall from the bathtub rim. The logic would not hold true for the placement of a receptacle outlet below this restrictive zone. Nothing in the 2020 NEC would prevent a 125-volt. 20 ampere receptacle outlet from being installed on the front of the bathroom cabinet located 3 in. from the tub and 1 in. below the bathtub rim (below and outside of the restrictive zone). Would this receptacle outlet located about 18 in. off the floor be convenient...maybe not, but it would be Code complaint. I question if this was the intent of CMP-18 for the restriction of receptacle outlets around tubs for the 2020 NEC.

Submitter Information Verification

Submitter Full Name: L. Keith Lofland

Organization: IAEI

Affiliation: None

Street Address:

City:

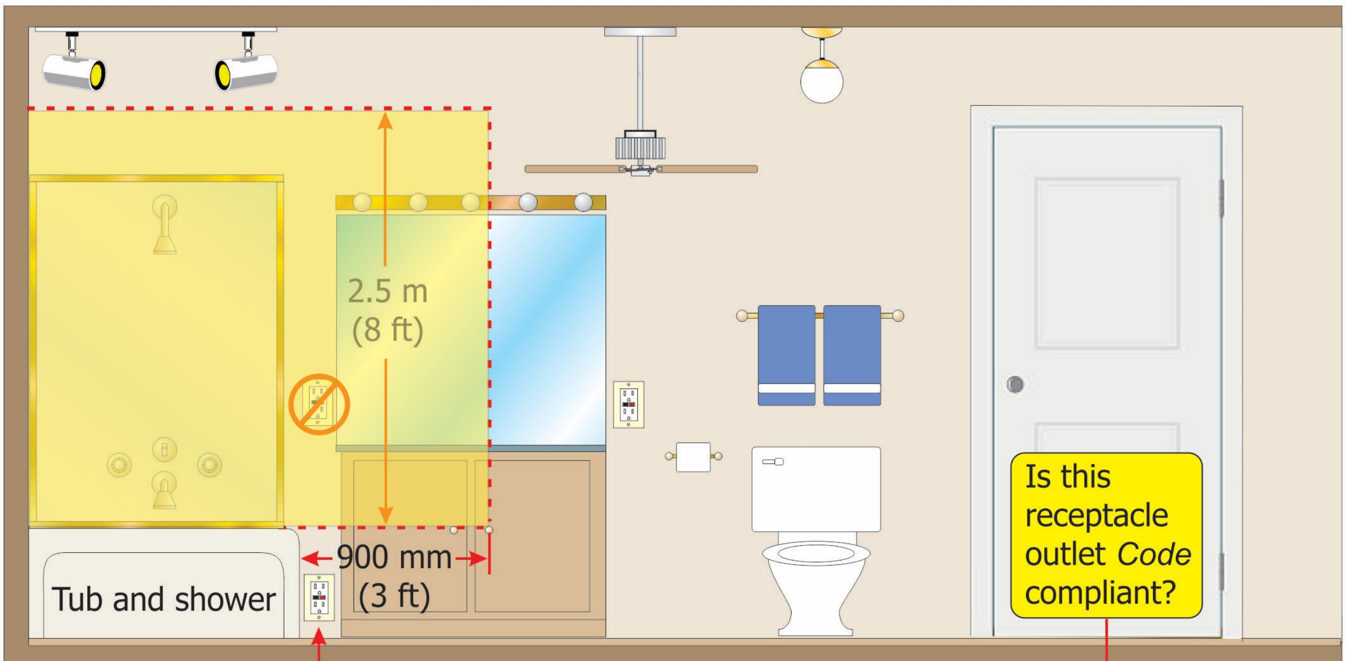
State:

Zip:

Submittal Date: Tue May 26 15:45:55 EDT 2020

Committee: NEC-P18

406.9(C) Bathtub and Shower Space



Receptacles shall not be installed within a zone measured 900 mm (3 ft) horizontally and 2.5 m (8 ft) vertically from the top of the bathtub rim or shower stall threshold.

Exception: In bathrooms with less than the required zone the receptacle(s) permitted to be installed opposite the bathtub rim or shower stall threshold on the farthest wall within the room.

Public Input No. 1258-NFPA 70-2020 [Section No. 406.9(C)]

(C) Bathtub and Shower Space.

Receptacles shall not be installed within a zone measured 900 mm (3 ft) horizontally and 2.5 m (8 ft) vertically from the top of the bathtub rim or shower stall threshold. The identified zone is all-encompassing and shall include the space directly over the tub or shower stall <u>and the space below this zone</u> .

Exception: In bathrooms with less than the required zone the receptacle(s) shall be permitted to be installed opposite the bathtub rim or shower stall threshold on the farthest wall within the room.

Additional Proposed Changes

File Name	Description	Approved
_406.9_C_2023_NEC_.jpg	406.9(C) (2023 NEC) (K Lofland)	

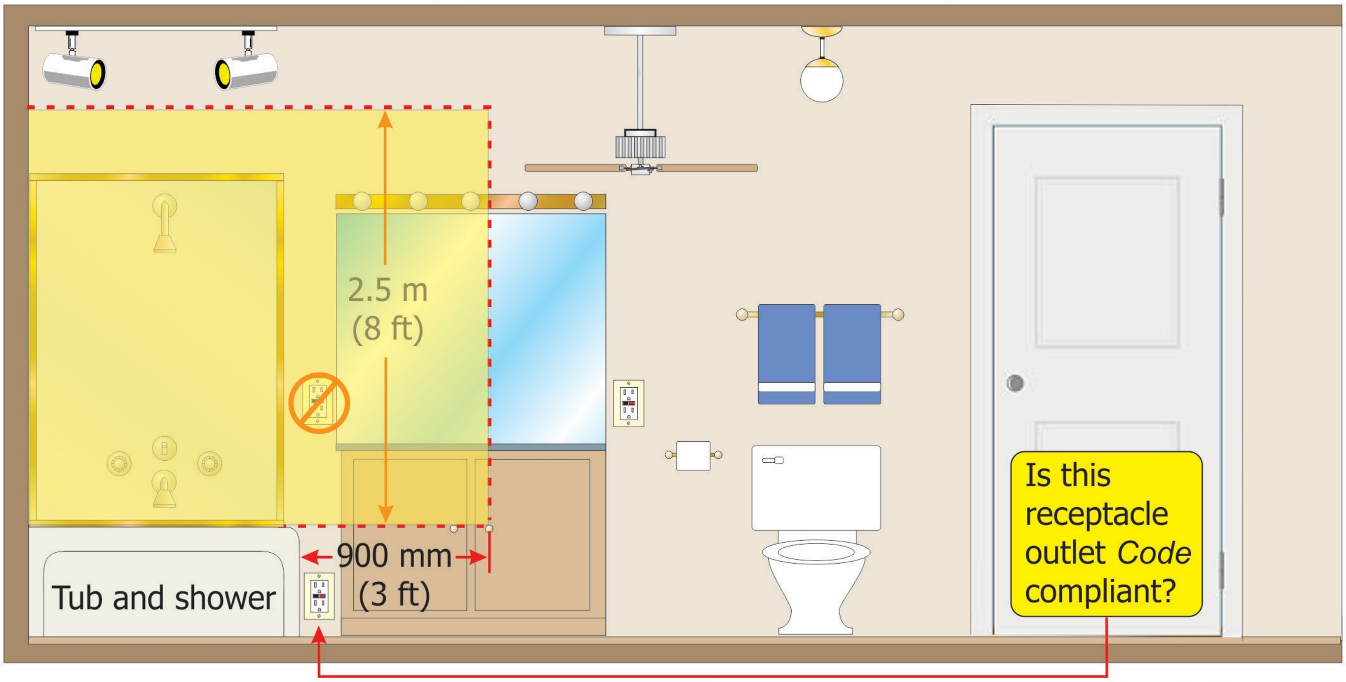
Statement of Problem and Substantiation for Public Input

Presently, a "zone" has been established around a tub or shower restricting receptacle outlet placement around tubs and shower stalls. This "zone" for receptacle outlets in Article 406 was patterned after the existing “zone” for luminaires at 410.10(D). It would be logical to assume that a luminaire or ceiling fan would not be located below this restrictive zone which extends 3 ft. out and 8 ft. tall from the bathtub rim. The logic would not hold true for the placement of a receptacle outlet below this restrictive zone. Nothing in the 2020 NEC would prevent a 125-volt. 20 ampere receptacle outlet from being installed on the front of the bathroom cabinet located 3 in. from the tub and 1 in. below the bathtub rim (below and outside of the restrictive zone). Would this receptacle outlet located about 18 in. off the floor be convenient...maybe not, but it would be Code complaint. I question if this was the intent of CMP-18 for the restriction of receptacle outlets around tubs for the 2020 NEC.

Submitter Information Verification

Submitter Full Name: L. Keith Lofland
Organization: IAEI
Affiliation: None
Street Address:
City:
State:
Zip:
Submittal Date: Tue May 26 16:20:25 EDT 2020
Committee: NEC-P18

406.9(C) Bathtub and Shower Space



Receptacles shall not be installed within a zone measured 900 mm (3 ft) horizontally and 2.5 m (8 ft) vertically from the top of the bathtub rim or shower stall threshold.

Exception: In bathrooms with less than the required zone the receptacle(s) permitted to be installed opposite the bathtub rim or shower stall threshold on the farthest wall within the room.

Public Input No. 1443-NFPA 70-2020 [Section No. 406.9(C)]

(C) Bathtub and Shower Space.

Receptacles shall not be installed within a zone measured 900 mm (3 ft) horizontally and 2.5 m (8 ft) vertically from the top of the bathtub rim or shower stall threshold. The identified zone is all-encompassing and shall include the space directly over the tub or shower stall, but not the space separated by a floor, wall, ceiling, door, window, or fixed barrier .

Exception: In bathrooms with less than the required zone the receptacle required by 210.52 (~~s~~ D) ~~shall~~ shall be permitted to be installed opposite the bathtub rim or shower stall threshold on the farthest wall within the room.

Statement of Problem and Substantiation for Public Input

The additional text adds clarity that receptacles are permitted on the other side of a wall, floor, ceiling, door, or fixed barrier even if they are in the measured zone.
I also revised the exception to make it clear that only the 'required NEC receptacle' is permitted for the exception to apply

Submitter Information Verification

Submitter Full Name:	Mike Holt
Organization:	Mike Holt Enterprises Inc
Street Address:	
City:	
State:	
Zip:	
Submittal Date:	Thu Jun 04 18:18:44 EDT 2020
Committee:	NEC-P18

Public Input No. 2586-NFPA 70-2020 [Section No. 406.9(C)]

(C) Bathtub and Shower Space.

Receptacles shall not be installed within a zone measured 900 mm (3 ft) horizontally and vertically from the floor to 2.5 m (8 ft) ~~vertically from~~ above the top of the bathtub rim or shower stall threshold. The identified zone is all-encompassing and shall include the space directly over the tub or shower stall.

Exception: In bathrooms with less than the required zone the receptacle(s) shall be permitted to be installed opposite the bathtub rim or shower stall threshold on the farthest wall within the room.

Statement of Problem and Substantiation for Public Input

The existing language permits a receptacle to be in the area 3' horizontally from the tub rim, but below the rim. The hazard of installing a receptacle in the space below the tub rim is just a great as where the receptacle is installed above the tub rim.

Submitter Information Verification

Submitter Full Name: Don Ganiere
Organization: [Not Specified]
Street Address:
City:
State:
Zip:
Submittal Date: Mon Aug 24 20:52:07 EDT 2020
Committee: NEC-P18

Public Input No. 2694-NFPA 70-2020 [Section No. 406.9(C)]

(C) Bathtub and Shower Space.

Receptacles shall not be installed within a zone measured 900 mm (3 ft) horizontally and 2.5 m (8 ft) vertically from the top of the bathtub rim or shower stall threshold. The identified zone is all-encompassing and shall include the space directly over the tub or shower stall.

Exception No. 1 : In bathrooms with less than the required zone the receptacle(s) shall be permitted to be installed opposite the bathtub rim or shower stall threshold on the farthest wall within the room.

Exception No. 2: Weight supporting ceiling receptacles (WSCR) shall be permitted to be installed for luminaires complying with 410.10(D).

Statement of Problem and Substantiation for Public Input

Luminaires installed in accordance with 410.10(D) by fixed wiring methods are permitted in the defined tub or shower area. The weight supporting ceiling receptacle (WSCR) that is being installed to facilitate the installation of luminaires to comply with 410.10(D) should be permitted in this area. The requirement is clear that standard convenience receptacles for cord and plug equipment shall not be installed in the tub or shower area and the exception clarifies that the specific configuration WSCR for luminaire installation is to be permitted in this area. There is no increased hazard created when installing or replacing a fixed luminaire in this area than installing or replacing the luminaire with the WSCR.

Please see the following related public inputs 2690, 2691, 2693 and 3423 as cross references to this public input.

Related Public Inputs for This Document

Related Input	Relationship
Public Input No. 2691-NFPA 70-2020 [Definition: Attachment Fitting.]	Definition of terms used in exception
Public Input No. 2690-NFPA 70-2020 [New Definition after Definition: Receptacle.]	Definition of terms used in exception
Public Input No. 2693-NFPA 70-2020 [Section No. 210.8(A)]	Related section for bath or tub area with similar exception.

Submitter Information Verification

Submitter Full Name: Charles Mello
Organization: cdcmello Consulting LLC
Affiliation: Submitted on behalf of Sky Technologies
Street Address:
City:
State:
Zip:
Submittal Date: Fri Aug 28 15:25:16 EDT 2020
Committee: NEC-P18

Public Input No. 2723-NFPA 70-2020 [Section No. 406.9(C)]

(C) Bathtub and Shower Space.

Receptacles shall not be ~~installed~~ installed within a zone measured 900 mm (3 ft) horizontally in front of and 2.5 m (8 ft) vertically from the top of the bathtub rim or shower stall threshold. The identified zone ~~is all-encompassing and~~ shall include the space directly over the tub or shower stall ~~.~~

~~Exception: In bathrooms with less than the required zone the receptacle(s) shall be permitted to be installed opposite the bathtub rim or shower stall threshold on the farthest wall within the room~~

and directly in front of the tub or shower stall. It shall not include any area to the left or right outside of the bath tub or shower stall .

Statement of Problem and Substantiation for Public Input

The language as written has been very difficult to enforce as an AHJ in a bath room with two sinks in the same vanity cabinet that is next to the tub or shower. And the requirements for a receptacle outlet for each bowl as required by 210.52(D) and to the best of my knowledge there have been no electrical accidents, and the outlets that are being installed in the bathrooms are required to be GFI protected. When you look at section 410.10(D) which covers luminaries at Bathtub & Shower areas and at 410.10(D)(1) it says and I quote “ this zone is all-encompassing and includes the space directly over the tub or shower. I believe that that language is crystal clear. And I believe that no change at all was needed at 406.9(C)

Submitter Information Verification

Submitter Full Name:	Paul J Kennedy Jr
Organization:	Kennedy Seminars
Street Address:	
City:	
State:	
Zip:	
Submittal Date:	Sat Aug 29 16:32:50 EDT 2020
Committee:	NEC-P18

Public Input No. 561-NFPA 70-2020 [Section No. 406.9(C)]

(C) Bathtub and Shower Space.

Receptacles shall not be ~~installed within a zone measured 900 mm (3 ft) horizontally and 2.5 m (8 ft) vertically from the top of the bathtub rim or shower stall threshold. The identified zone is all-encompassing and shall include the space directly over the tub or shower stall.~~

~~Exception: In bathrooms with less than the required zone the receptacle(s) shall be permitted to be installed opposite the bathtub rim or shower stall threshold on the farthest wall within the room~~

installed within, or directly above, a bathtub or shower .

Statement of Problem and Substantiation for Public Input

This change seeks to undo the change made in 2020. There was no substantiation for the change, and it can be easily argued that the change reduces safety. Bathtub electrocutions today are typically the result of someone using a 120V cord to provide power for charging a cell phone that the bather is using. By moving the receptacle farther from the tub we increase the likelihood of this happening. With the receptacle closer to the tub the bather is more likely to use the Class 2 charger without a cord, greatly reducing the likelihood of a fatality.

Submitter Information Verification

Submitter Full Name:	Ryan Jackson
Organization:	Ryan Jackson
Street Address:	
City:	
State:	
Zip:	
Submittal Date:	Fri Feb 28 11:43:01 EST 2020
Committee:	NEC-P18

Public Input No. 1081-NFPA 70-2020 [Section No. 406.9(D)]

(D) Protection for Floor Receptacles.

Protection for Floor Receptacles shall be in accordance with (1) and (2):

(1) Standpipes of floor receptacles shall allow floor-cleaning equipment to be operated without damage to receptacles

(2) All 125-volt, single-phase, 15- and 20-ampere floor receptacles installed in the locations specified in 406 . 9(D)(2)(a) and (b) shall have GFCI protection for personnel.

(a) food courts

(b) places of awaiting transportation where food or drinks are available for purchase

Statement of Problem and Substantiation for Public Input

The reason this proposed language came about, is the person (formerly) in charge of maintenance for McCarran Airport who now works with me in the building department has enlightened me about the number of problems and issues common to floor receptacles. Drink and food spills on or around floor receptacles are common. Then when spills are cleaned (mopping) it can pose a hazard for maintenance personnel. Also, with thousands of people coming through the airport each week, the receptacle covers tend not to remain closed. For large facilities like this it isn't possible to monitor each and every floor receptacle at every moment in time, every day. GFCI protection would at least provide a higher level of safety in areas prone to wet spills and splatters.

Reason for code change is protection for personnel as well as increased public safety.

Submitter Information Verification

Submitter Full Name: Nick Sasso

Organization: Clark County Building and Fire

Street Address:

City:

State:

Zip:

Submittal Date: Fri May 15 18:11:14 EDT 2020

Committee: NEC-P18

Public Input No. 1333-NFPA 70-2020 [Section No. 406.12]

406.12 Tamper-Resistant Receptacles.

All 15- and 20-ampere, 125- and 250-volt nonlocking-type receptacles in the areas specified in 406.12(1) through (~~8~~ 9) shall be listed tamper-resistant receptacles.

(1) Dwelling units, including attached and detached garages and accessory buildings to dwelling units, and common areas of multifamily dwellings specified in 210.52 and 550.13

(2) Guest rooms and guest suites of hotels, motels, and their common areas

(3) Child care facilities

(4) Preschools and education facilities

(5) Business offices, corridors, waiting rooms, patient care spaces and the like in clinics, medical and dental offices, and outpatient ~~facilities~~ facilities

(6) Subset of assembly occupancies described in 518.2 to include places of awaiting transportation, gymnasiums, skating rinks, and auditoriums

(7) Dormitory units

(8) Assisted living facilities (Use Group I-1 including Use Groups R-3 and R-4 as per IBC 2018)

(9) Institutional Use Group I-2 (including Use Group R-3 as per IBC 2018)

Informational Note No. 1: This requirement would include receptacles identified as 5-15, 5-20, 6-15, and 6-20 in ANSI/NEMA WD 6-2016, *Wiring Devices — Dimensional Specifications*.

Informational Note No. 2: Assisted living facilities are Institutional Use Group I-1 per IBC ~~2015~~ 2018 .

Exception to (1), (2), (3), (4), (5), (6), (7) and (8): Receptacles in the following locations shall not be required to be tamper resistant:

(1) Receptacles located more than 1.7 m (5 ½ ft) above the floor

(2) Receptacles that are part of a luminaire or appliance

(3) A single receptacle, or a duplex receptacle for two appliances, located within the dedicated space for each appliance that, in normal use, is not easily moved from one place to another and that is cord-and-plug-connected in accordance with 400.10(A)(6), (A)(7), or (A)(8)

(4) Nongrounding receptacles used for replacements as permitted in 406.4(D)(2)(a)

Statement of Problem and Substantiation for Public Input

Requirement for Tamper Resistant Receptacles was added in NEC 2020 for Use Group I-1 recognizing the fact that same hazards exist in assisted living facilities as in residential occupancies. Current language in NEC 2020 does not include occupancies classified as R-3 and R-4 under Use Group I-1 under the IBC 2018 although the same hazards exist there. These are basically residential units only. Same logic applies to Use Group I-2 as per IBC 2018 and should include the provision for providing Tamper Resistant Receptacles for safety of the occupants and the visiting families.

Tamper Resistant Receptacles should also be provided for the safety of patients which include children and adults in patient care spaces in clinics, medical and dental offices.

Submitter Information Verification

Submitter Full Name:	Mohinder Sood
Organization:	Core Engineers
Affiliation:	International Association of Electrical Inspectors (IAEI)
Street Address:	
City:	
State:	
Zip:	
Submittal Date:	Mon Jun 01 16:09:02 EDT 2020
Committee:	NEC-P18

Public Input No. 1987-NFPA 70-2020 [Section No. 406.12]

406.12 Tamper-Resistant Receptacles.

All 15- and 20-ampere, 125- and 250-volt nonlocking-type receptacles in the areas specified in 406.12(1) through (8) shall be listed tamper-resistant receptacles.

(1) ~~Dwelling units, including~~ Dwellings, boathouses, mobile homes, and manufactured homes including their attached and detached garages ~~and accessory buildings to dwelling units, and common areas of multifamily dwellings specified in 210.52 and 550.13~~ , accessory buildings and their common areas.

(2) Guest rooms and guest suites of hotels, motels, and their common areas

(3) Child care facilities

(4) Preschools and education facilities

(5) Business offices, corridors, waiting rooms and the like in clinics, medical and dental offices, and outpatient facilities

(6) Subset of assembly occupancies described in 518.2 to include places of awaiting transportation, gymnasiums, skating rinks, and auditoriums

(7) Dormitory units

(8) Assisted living facilities

Informational Note No. 1: This requirement would include receptacles identified as 5-15, 5-20, 6-15, and 6-20 in ANSI/NEMA WD 6-2016, *Wiring Devices — Dimensional Specifications*.

Informational Note No. 2: Assisted living facilities are Institutional Use Group I-1 per IBC 2015.

Exception to (1), (2), (3), (4), (5), (6), (7) and (8): Receptacles in the following locations shall not be required to be tamper resistant:

(1) Receptacles located more than 1.7 m (5 ½ ft) above the floor

(2) Receptacles that are part of a luminaire or appliance

(3) A single receptacle, or a duplex receptacle for two appliances, located within the dedicated space for each appliance that, in normal use, is not easily moved from one place to another and that is cord-and-plug-connected in accordance with 400.10(A)(6), (A)(7), or (A)(8)

(4) Nongrounding receptacles used for replacements as permitted in 406.4(D)(2)(a)

Statement of Problem and Substantiation for Public Input

As currently written in the 2020 NEC, tamper-resistant receptacles are only required in dwelling units where specified in 210.52 and 550.13. However, the original intent was for the requirement to apply to any and all 15- and 20- ampere, 125- and 250-volt receptacles installed in a dwelling, boathouse, mobile home and manufactured home unless exempted by 406.12. The current pointer to 210.52 and 550.13 is unnecessary and unintendedly exempts receptacles installed in addition to those specified in 210.52 and 550.13 such as floor receptacles located more than 18 in. from a wall, receptacles installed in bathrooms not located at the sink basin, and receptacles required by 210.63. Additionally, the current use of the term “dwelling units” does not clearly indicate that 406.12(1) applies to all dwelling types, boathouse, mobile homes, and manufactured homes. The revised language ensures receptacles installed in all of these dwelling-type occupancies are tamper-resistant and covers all receptacles installed whether specified by other parts of the code or not.

Submitter Information Verification

Submitter Full Name:	Megan Hayes
Organization:	Nema
Street Address:	
City:	
State:	
Zip:	
Submittal Date:	Thu Jul 23 09:24:09 EDT 2020
Committee:	NEC-P18

Public Input No. 2148-NFPA 70-2020 [Section No. 406.12]

406.12 Tamper-Resistant Receptacles.

All 15- and 20-ampere, 125- and 250-volt nonlocking-type receptacles, required and other than required, that are installed in the ~~areas~~ locations specified in 406.12(1) through (8) shall be listed tamper-resistant receptacles.

(1) Dwelling units, including attached and detached garages and accessory buildings to dwelling units, and common areas of multifamily dwellings specified in 210.52 and 550.13

(2) Guest rooms and guest suites of hotels, motels, and their common areas

(3) Child care facilities

(4) Preschools and education facilities

(5) ~~Business offices, corridors, waiting rooms and the like in~~ Within clinics, medical and dental offices, and ~~outpatient facilities out-patient facilities, the following spaces and the like:~~

- (6) ~~Business offices~~
- (7) ~~Lobbies, corridors, waiting spaces~~
- (8) ~~Spaces used exclusively for patient sleeping~~

(9) Subset of assembly occupancies described in 518.2 to include places of awaiting transportation, gymnasiums, skating rinks, and auditoriums

(10) Dormitory units

(11) Assisted living facilities

Informational Note No. 1: This requirement would include receptacles identified as 5-15, 5-20, 6-15, and 6-20 in ANSI/NEMA WD 6-2016, *Wiring Devices — Dimensional Specifications*.

Informational Note No. 2: Assisted living facilities are Institutional Use Group I-1 per IBC 2015.

Exception to (1), (2), (3), (4), (5), (6), (7) and (8): Receptacles in the following locations shall not be required to be tamper resistant:

(1) Receptacles located more than 1.7 m (5 ½ ft) above the floor

(2) Receptacles that are part of a luminaire or appliance

(3) A single receptacle that is not readily accessible and that supplies one appliance , or a duplex receptacle ~~for~~ that is not readily accessible and that supplies two appliances, ~~located~~ where the receptacle outlet is installed within the ~~dedicated~~ space occupied by or designated for each appliance that, in normal use, is not easily moved from one place to another and that is cord-and-plug-connected in accordance with 400.10(A)(6), (A)(7), or (A)(8)

(4) Nongrounding receptacles used for replacements as permitted in 406.4(D)(2)(a)

Additional Proposed Changes

File Name	Description	Approved

Public_Input_No._2148-NFPA_70-2020_Section_406.12_.docx	Clean MSWord DOCX copy of this Public Input No. 2148 WITHOUT TerraView alteration of the Submitter's intent

Statement of Problem and Substantiation for Public Input

See the uploaded attachment of a manual entry of this Public Input with text content that hasn't been Terrarized and is consequently readable.

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Usability of the Code: reading skills and English as a First Language.

.

• List item (5) is ambiguous. Reported have been several instances wherein inspectors misconstrued list item (5) to mean that “business offices, corridors, waiting rooms” in ANY commercial occupancy, regardless of whether unsupervised toddlers are unlikely ever to visit such an occupancy, and then, oh yeah, ALSO the same type of spaces in clinics, in medical and dental offices, and in out-patient facilities. The submitters’ intent of the original Public Input and subsequent Public Comments was for such spaces SOLELY in in clinics, medical and dental offices, and out-patient facilities, not in any and all commercial occupancies.

.

• “Lobbies” has been added to list item (5) because “corridors” inherently imply solely long, narrow passageways and hallways, and because, in open office designs, elevators may discharge DIRECTLY into lobbies that serve as waiting spaces, which may not always be walled-in “waiting rooms”. NFPA 99, Health Care Facilities Code, since at least the 2015 edition, has abandoned the use of “rooms” and “areas” (2-dimensional) in favor of “spaces”. These spaces have been arranged as subordinate list items.

.

• “Spaces used exclusively for patient sleeping” has been added to list item (5) similar to the 2020 addition to 210.12(C), from 517.10(B) “Not Covered” within health care facilities, those spaces used exclusively for patient sleeping (i.e., NOT for medical procedures).

.

• Although the charging sentence does say “ALL 15- and 20-ampere, 125- and 250-volt nonlocking-type receptacles”, list item (1) refers explicitly to “SPECIFIED in 210.52”. Section 210.52 is located within Part III REQUIRED Outlets of Article 210. Consequently, this has been misinterpreted to mean solely ALL receptacles that are REQUIRED at receptacle outlets BUT NO OTHERS Effectively, those receptacles installed IN ADDITION TO THOSE MINIMUM REQUIRED are being omitted from being tamper-resistant. Consequently, that literal interpretation is addressed by adding the explicit phrase “required and other than required”. (“Required and permitted” was considered but “permitted” may imply that those must be EXPLICITLY permitted.)

.

• List item (3) of the Exception fails to take into account whether or not the receptacle ITSELF is readily accessible. The presumption is that the appliance(s) is (are) in the way of accessing the receptacle but presently that is neither stated nor mandated. For instance, the space intended for a cord-and-plug-connected stationary dishwasher installed in accordance with 422.16(B)(2)(5) and 422.16(B)(2)(6), a cord-and-plug-connected stationary trash compactor installed in accordance with 422.16(B)(2)(4) and 422.16(B)(2)(6), a cord-and-plug-connected stationary microwave-oven/range-hood installed in accordance with 422.16(B)(4)(4), or a cord-and-plug-connected in-sink waste disposer installed in accordance with 422.16(B)(1)(3) would all have a receptacle fully accessible ADJACENT TO THE DESIGNATED APPLIANCE SPACE(S) to tampering by an unsupervised toddler.

.

• “Dedicated”, in list item (3) of the Exception, is commonly misused. “Dedicated” is used in the context of being “devoted”. No empty or occupied space is sentient. The appliance space is “designated”, “assigned”, “intended”, ‘bespoke”, or “designed”, but never “dedicated” or “devoted”. Obi Wan Kenobi: “I think he’s searching for his former master, but I’ve never seen such DEVOTION in a droid before.”

Submitter Information Verification

Submitter Full Name: Brian Rock

Organization:	Hubbell Incorporated
Street Address:	
City:	
State:	
Zip:	
Submittal Date:	Mon Aug 03 17:54:09 EDT 2020
Committee:	NEC-P18

NFPA Public Input Form

NOTE: All Public Input must be received by 5:00 pm EST/EDST on the published Public Input Closing Date.

For further information on the standards-making process, please contact the Codes and Standards Administration at 617-984-7249 or visit www.nfpa.org/codes.

For technical assistance, please call NFPA at 1-800-344-3555

FOR OFFICE USE ONLY

Log #:

Date Rec'd:

Date 2020-July-31 **Name** Brian E. Rock **Tel. No.** [redacted]

Company Hubbell Incorporated **Email** [redacted]

Street Address 40 Waterview Drive **City** Shelton **State** CT **Zip** 06484

Please indicate organization represented (if any) Hubbell Incorporated

1. (a) Title of NFPA Standard National Electrical Code® **NFPA No. & Year** 70 - 2023

(b) Section/Paragraph 406.12

2. Public Input Recommends (check one): ☐ new text ☒ revised text ☐ deleted text

3. Proposed Text of Public Input (include proposed new or revised wording, or identification of wording to be deleted): [Note: Proposed text should be in legislative format; i.e., use underscore to denote wording to be inserted (<u>inserted wording</u>) and strike-through to denote wording to be deleted (~~deleted wording~~).]

406.12 Tamper-Resistant Receptacles.

All 15- and 20-ampere, 125- and 250-volt nonlocking-type receptacles<u>, required and other than required, that are installed</u> in the ~~areas~~ <u>locations</u> specified in 406.12(1) through (8) shall be listed tamper-resistant receptacles.

(1) Dwelling units, including attached and detached garages and accessory buildings to dwelling units, and common areas of multifamily dwellings specified in 210.52 and 550.13

(2) Guest rooms and guest suites of hotels, motels, and their common areas

(3) Child care facilities

(4) Preschools and education facilities

(5) <u>Within clinics, medical and dental offices, and out-patient facilities, the following spaces and the like:</u>

<u>a.</u> Business offices

<u>b.</u> Lobbies<u>,</u> corridors, and waiting <u>spaces</u> ~~rooms and the like in clinics, medical and dental offices, and outpatient facilities~~

<u>c. Spaces used exclusively for patient sleeping</u>

(6) Subset of assembly occupancies described in 518.2 to include places of awaiting transportation, gymnasiums, skating rinks, and auditoriums

(7) Dormitory units

(8) Assisted living facilities

Informational Note No. 1: This requirement would include receptacles identified as 5-15, 5-20, 6-15, and 6-20 in ANSI/NEMA WD 6-2016, *Wiring Devices — Dimensional Specifications*.

Informational Note No. 2: Assisted living facilities are Institutional Use Group I-1 per IBC 2015.

Exception to (1), (2), (3), (4), (5), (6), (7) and (8): Receptacles in the following locations shall not be required to be tamper resistant:

(1) Receptacles located more than 1.7 m (5½ ft) above the floor

(2) Receptacles that are part of a luminaire or appliance

(3) A single receptacle <u>that is not readily accessible and that supplies one appliance</u>, or a duplex receptacle <u>that is not readily accessible and that supplies</u> ~~for~~ two appliances, ~~located~~ <u>where the receptacle outlet is installed</u> within the ~~dedicated~~ space <u>occupied by or designated</u> for each appliance that, in normal use, is not easily moved from one place to another and that is cord-and-plug-connected in accordance with 400.10(A)(6), (A)(7), or (A)(8)

(4) Nongrounding receptacles used for replacements as permitted in 406.4(D)(2)(a)

4. Statement of Problem and Substantiation for Public Input: (Note: State the problem that would be resolved by your recommendation; give the specific reason for your Public Input, including copies of tests, research papers, fire experience, etc. If more than 200 words, it may be abstracted for publication.)

Usability of the Code: reading skills and English as a First Language.

• List item (5) is ambiguous. Reported have been several instances wherein inspectors misconstrued list item (5) to mean that "business offices, corridors, waiting rooms" in ANY commercial occupancy, regardless of whether unsupervised toddlers are unlikely ever to visit such an occupancy, and then, oh yeah, ALSO the same type of spaces in clinics, in medical and dental offices, and in out-patient facilities. The submitters' intent of the original Public Input and subsequent Public Comments was for such spaces SOLELY in in clinics, medical and dental offices, and out-patient facilities, not in any and all commercial occupancies.

• "Lobbies" has been added to list item (5) because "corridors" inherently imply solely long, narrow passageways and hallways, and because, in open office designs, elevators may discharge DIRECTLY into lobbies that serve as waiting spaces, which may not always be walled-in "waiting rooms". NFPA 99, Health Care Facilities Code, since at least the 2015 edition, has abandoned the use of "rooms" and "areas" (2-dimensional) in favor of "spaces". These spaces have been arranged as subordinate list items.

• "Spaces used exclusively for patient sleeping" has been added to list item (5) similar to the 2020 addition to 210.12(C), from 517.10(B) "Not Covered" within health care facilities, those spaces used exclusively for patient sleeping (i.e., NOT for medical procedures).

• Although the charging sentence does say "ALL 15- and 20-ampere, 125- and 250-volt nonlocking-type receptacles", list item (1) refers explicitly to "SPECIFIED in 210.52". Section 210.52 is located within Part III REQUIRED Outlets of Article 210. Consequently, this has been misinterpreted to mean solely ALL receptacles that are REQUIRED at receptacle outlets BUT NO OTHERS Effectively, those receptacles installed IN ADDITION TO THOSE MINIMUM REQUIRED are being omitted from being tamper-resistant. Consequently, that literal interpretation is addressed by adding the explicit phrase "required and other than required". ("Required and permitted" was considered but "permitted" may imply that those must be EXPLICITLY permitted.)

• List item (3) of the Exception fails to take into account whether or not the receptacle ITSELF is readily accessible. The presumption is that the appliance(s) is (are) in the way of accessing the receptacle but presently that is neither stated nor mandated. For instance, the space intended for a cord-and-plug-connected stationary dishwasher installed in accordance with 422.16(B)(2)(5) and 422.16(B)(2)(6), a cord-and-plug-connected stationary trash compactor installed in accordance with 422.16(B)(2)(4) and 422.16(B)(2)(6), a cord-and-plug-connected stationary microwave-oven/range-hood installed in accordance with 422.16(B)(4)(4), or a cord-and-plug-connected in-sink waste disposer installed in accordance with 422.16(B)(1)(3) would all have a receptacle fully accessible ADJACENT TO THE DESIGNATED APPLIANCE SPACE(S) to tampering by an unsupervised toddler.

• "Dedicated", in list item (3) of the Exception, is commonly misused. "Dedicated" is used in the context of being "devoted". No empty or occupied space is sentient. The appliance space is "designated", "assigned", "intended", 'bespoke", or "designed", but never "dedicated" or "devoted". Obi Wan Kenobi: "I think he's searching for his former master, but I've never seen such DEVOTION in a droid before."

5. Copyright Assignment

(a) ☒ **I am the author of the text or other material (such as illustrations, graphs) proposed in the Public Input.**

(b) ☐ **Some or all of the text or other material proposed in this Public Input was not authored by me. Its source is as follows:** (please identify which material and provide complete information on its source)

I hereby grant and assign to the NFPA all and full rights in copyright in this Public Input (including both the Proposed Text and the Statement of Problem and Substantiation). I understand that I acquire no rights in any publication of NFPA in which this Public Input in this or another similar or analogous form is used. Except to the extent that I do not have authority to make an assignment in materials that I have identified in (b) above, I hereby warrant that I am the author of this Public Input and that I have full power and authority to enter into this assignment.

Signature (Required) [redacted]

PLEASE USE SEPARATE FORM FOR EACH PUBLIC INPUT

To: Secretary, Standards Council National Fire Protection Association
1 Batterymarch Park · Quincy, MA 02169-7471 OR
Fax to: (617) 770-3500 OR Email to: proposals_comments@nfpa.org

Public Input No. 2678-NFPA 70-2020 [Section No. 406.12]

406.12 Tamper-Resistant Receptacles.

All 15- and 20-ampere, 125- and 250-volt nonlocking-type receptacles in the areas specified in 406.12(1) through (8) shall be listed tamper-resistant receptacles.

(1) Dwelling units, including attached and detached garages and accessory buildings to dwelling units, and common areas of multifamily dwellings specified in 210.52 and 550.13

(2) Guest rooms and guest suites of hotels, motels, and their common areas

(3) Child care facilities

(4) Preschools and education facilities

(5) Business offices, corridors, waiting rooms and the like in clinics, medical and dental offices, and outpatient facilities

(6) Subset of assembly occupancies described in 518.2 to include places of awaiting transportation, gymnasiums, skating rinks, and auditoriums

(7) Dormitory units

(8) Assisted living facilities

Informational Note No. 1: This requirement would include receptacles identified as 5-15, 5-20, 6-15, and 6-20 in ANSI/NEMA WD 6-2016, *Wiring Devices — Dimensional Specifications*.

Informational Note No. 2: Assisted living facilities are Institutional Use Group I-1 per IBC 2015.

<u>Informational Note No. 3: Gymnasiums can include but are not limited to school and college gymnasiums as well as commercial businesses to include fitness centers, gyms, and athletic clubs containing fitness and exercise equipment.</u>

Exception to (1), (2), (3), (4), (5), (6), (7) and (8): Receptacles in the following locations shall not be required to be tamper resistant:

(1) Receptacles located more than 1.7 m (5 ½ ft) above the floor

(2) Receptacles that are part of a luminaire or appliance

(3) A single receptacle, or a duplex receptacle for two appliances, located within the dedicated space for each appliance that, in normal use, is not easily moved from one place to another and that is cord-and-plug-connected in accordance with 400.10(A)(6), (A)(7), or (A)(8)

(4) Nongrounding receptacles used for replacements as permitted in 406.4(D)(2)(a)

Statement of Problem and Substantiation for Public Input

Pushback is common as most registered design professionals seem to think that "gymnasium" refers to only facilities or parts thereof within a school environment. Adding the informational note would make it clear that gymnasium refers to any school or business where exercise equipment is available to the public. I would also be remiss if I didn't mention that the cost factor involved is almost negligible. There would be only a minute increase as compared to standard, "non-tamper proof" receptacles.

If the language isn't added, perhaps the panel can consider adding a definition?
The reason for the change is to assist electrical inspectors and electrical plans examiners with

enforcement of this section.

Submitter Information Verification

Submitter Full Name:	Nick Sasso
Organization:	Clark County Building and Fire
Street Address:	
City:	
State:	
Zip:	
Submittal Date:	Thu Aug 27 19:23:44 EDT 2020
Committee:	NEC-P18

Public Input No. 2785-NFPA 70-2020 [Section No. 406.12]

406.12 Tamper-Resistant Receptacles.

All 15- and 20-ampere, 125- and 250-volt nonlocking-type receptacles in the areas specified in 406.12(1) through (8) shall be listed tamper-resistant receptacles.

(1) Dwelling units, including attached and detached garages and accessory buildings to dwelling units, and common areas of multifamily dwellings specified in 210.52 and 550.13

(2) Guest rooms and guest suites of hotels, motels, and their common areas

(3) Child care facilities

(4) Preschools and education facilities

(5) Business offices, corridors, waiting rooms and the like in clinics, medical and dental offices, and outpatient facilities

(6) Subset of assembly occupancies described in 518.2 to include places of awaiting transportation, gymnasiums, skating rinks, and auditoriums

(7) Dormitory units

(8) Assisted living facilities

Informational Note No. 1: This requirement would include receptacles identified as 5-15, 5-20, 6-15, and 6-20 in ANSI/NEMA WD 6-2016, *Wiring Devices — Dimensional Specifications*.

Informational Note No. 2: Assisted living facilities are Institutional Use Group I-1 per IBC 2015.

(9) Agricultural Buildings and common areas accessible to the general public .

Exception to (1), (2), (3), (4), (5), (6), (7) and (8): Receptacles in the following locations shall not be required to be tamper resistant:

(1) Receptacles located more than 1.7 m (5 ½ ft) above the floor

(2) Receptacles that are part of a luminaire or appliance

(3) A single receptacle, or a duplex receptacle for two appliances, located within the dedicated space for each appliance that, in normal use, is not easily moved from one place to another and that is cord-and-plug-connected in accordance with 400.10(A)(6), (A)(7), or (A)(8)

(4) Nongrounding receptacles used for replacements as permitted in 406.4(D)(2)(a)

Statement of Problem and Substantiation for Public Input

Children of all ages have access to these areas. EX: Barns, Petting Zoos, Stables and Buildings at Pumpkin Patches where receptacles may be installed with access.

Submitter Information Verification

Submitter Full Name: Richard Hollander
Organization: Shums Coda Associates
Street Address:
City:

State:	
Zip:	
Submittal Date:	Mon Aug 31 21:04:27 EDT 2020
Committee:	NEC-P18

Public Input No. 310-NFPA 70-2020 [Section No. 406.12]

406.12 Tamper-Resistant Receptacles.

All 15- and 20-ampere, 125- and 250-volt nonlocking-type receptacles in the areas specified in 406.12(1) through (8) shall be listed tamper-resistant receptacles.

(1) Dwelling units, including attached and detached garages and accessory buildings to dwelling units, and common areas of multifamily dwellings specified in 210.52 and 550.13

(2) Guest rooms and guest suites of hotels, motels, and their common areas

(3) Child care facilities

(4) Preschools and education facilities

(5) Business offices, corridors, waiting rooms and the like in clinics, medical and dental offices, and outpatient facilities

(6) Subset of assembly occupancies described in 518.2~~ to include places of awaiting transportation, gymnasiums, skating rinks, and auditoriums~~

(7) Dormitory units

(8) Assisted living facilities

Informational Note No. 1: This requirement would include receptacles identified as 5-15, 5-20, 6-15, and 6-20 in ANSI/NEMA WD 6-2016, *Wiring Devices — Dimensional Specifications*.

Informational Note No. 2: Assisted living facilities are Institutional Use Group I-1 per IBC 2015.

Exception to (1), (2), (3), (4), (5), (6), (7) and (8): Receptacles in the following locations shall not be required to be tamper resistant:

(1) Receptacles located more than 1.7 m (5 ½ ft) above the floor

(2) Receptacles that are part of a luminaire or appliance

(3) A single receptacle, or a duplex receptacle for two appliances, located within the dedicated space for each appliance that, in normal use, is not easily moved from one place to another and that is cord-and-plug-connected in accordance with 400.10(A)(6), (A)(7), or (A)(8)

(4) Nongrounding receptacles used for replacements as permitted in 406.4(D)(2)(a)

Statement of Problem and Substantiation for Public Input

It is redundant to say,

"Subset of assembly occupancies described in 518.2 to include"

and then to list four (4) random items that are already described in 518.2 (places of awaiting transportation, gymnasiums, skating rinks, and auditoriums).

We don't know if "subset" means then entire subset that is listed in 518.2, or if "subset" applies just to the four items listed in 406.12(6), or if "subset" means just the four items listed in 406.12(6) only if 100 people or more, or if "subset" means just to the four items listed in 406.12(6) -- but for any amount of people (please see 518.1, scope). Good arguments can be made for any of these interpretations. In fact, I'm submitting code changes for each possible interpretation.

If it is the intent of the code panel that "subset" means all of the items listed in 518.2, then please consider striking the language as outlined in this PI. Reason is for clarity.

In addition, I would pose the following questions to the panel in order to help evaluate this potential code change:
If I have an auditorium that seats 90 people maximum (identified on the electrical plans as "auditorium"), are the tamper-proof receptacles required?
Is the driver for this code the fact that it is assembly, or the fact that children could be present? I think this code needs to be made clearer.

Related Public Inputs for This Document

Related Input	Relationship
Public Input No. 312-NFPA 70-2020 [Section No. 406.12]	
Public Input No. 312-NFPA 70-2020 [Section No. 406.12]	

Submitter Information Verification

Submitter Full Name:	Nick Sasso
Organization:	Clark County Building and Fire
Street Address:	
City:	
State:	
Zip:	
Submittal Date:	Thu Jan 16 12:58:48 EST 2020
Committee:	NEC-P18

Public Input No. 312-NFPA 70-2020 [Section No. 406.12]

406.12 Tamper-Resistant Receptacles.

All 15- and 20-ampere, 125- and 250-volt nonlocking-type receptacles in the areas specified in 406.12(1) through (8) shall be listed tamper-resistant receptacles.

(1) Dwelling units, including attached and detached garages and accessory buildings to dwelling units, and common areas of multifamily dwellings specified in 210.52 and 550.13

(2) Guest rooms and guest suites of hotels, motels, and their common areas

(3) Child care facilities

(4) Preschools and education facilities

(5) Business offices, corridors, waiting rooms and the like in clinics, medical and dental offices, and outpatient facilities

(6) ~~Subset of assembly occupancies described in 518.2 to include places of~~ Places of awaiting transportation, gymnasiums, skating rinks, and auditoriums for any amount of people, as taken from the subset of assembly occupancies listed in 518.2.

(7) Dormitory units

(8) Assisted living facilities

Informational Note No. 1: This requirement would include receptacles identified as 5-15, 5-20, 6-15, and 6-20 in ANSI/NEMA WD 6-2016, *Wiring Devices — Dimensional Specifications*.

Informational Note No. 2: Assisted living facilities are Institutional Use Group I-1 per IBC 2015.

Exception to (1), (2), (3), (4), (5), (6), (7) and (8): Receptacles in the following locations shall not be required to be tamper resistant:

(1) Receptacles located more than 1.7 m (5 ½ ft) above the floor

(2) Receptacles that are part of a luminaire or appliance

(3) A single receptacle, or a duplex receptacle for two appliances, located within the dedicated space for each appliance that, in normal use, is not easily moved from one place to another and that is cord-and-plug-connected in accordance with 400.10(A)(6), (A)(7), or (A)(8)

(4) Nongrounding receptacles used for replacements as permitted in 406.4(D)(2)(a)

Statement of Problem and Substantiation for Public Input

We don't know if "subset" means then entire subset that is listed in 518.2, or if "subset" applies just to the four items listed in 406.12(6), or if "subset" means just the four items listed in 406.12(6) only if 100 people or more, or if "subset" means just to the four items listed in 406.12(6) -- but for any amount of people (please see 518.1, scope). Good arguments can be made for any of these interpretations. In fact, I'm submitting code changes for each possible interpretation.

If it is the intent of the code panel that "subset" means solely the four items listed in 406.12(6), then please consider approving the language as outlined in this PI. Reason is for clarity.

In addition, I would pose the following questions to the panel in order to help evaluate this potential

code change:
If I have an auditorium that seats 90 people maximum (identified on the electrical plans as "auditorium"), are the tamper-proof receptacles required?
Is the driver for this code the fact that it is assembly, or the fact that children could be present?
I think this code needs to be made clearer.

Related Public Inputs for This Document

Related Input	Relationship
Public Input No. 310-NFPA 70-2020 [Section No. 406.12]	
Public Input No. 310-NFPA 70-2020 [Section No. 406.12]	

Submitter Information Verification

Submitter Full Name: Nick Sasso
Organization: Clark County Building and Fire
Street Address:
City:
State:
Zip:

Submittal Date: Thu Jan 16 13:46:56 EST 2020
Committee: NEC-P18

Public Input No. 3554-NFPA 70-2020 [Section No. 406.12]

406.12 Tamper-Resistant Receptacles.

All 15- and 20-ampere, 125- and 250-volt nonlocking-type receptacles in the areas specified in 406.12(1) through (8) shall be listed tamper-resistant receptacles.

(1) Dwelling units, including attached and detached garages and accessory buildings to dwelling units, and common areas of multifamily dwellings specified in 210.52 and 550.13

(2) Guest rooms and guest suites of hotels, motels, and their common areas

(3) Child care facilities

(4) Preschools and education facilities

(5) Business offices, corridors, waiting rooms and the like in clinics, medical and dental offices, and outpatient facilities

(6) Subset of assembly occupancies described in 518.2 to include places of awaiting transportation, gymnasiums, skating rinks, and auditoriums

(7) Dormitory units

(8) ~~Assisted~~ Residential care/assisted living facilities

Informational Note No. 1: This requirement would include receptacles identified as 5-15, 5-20, 6-15, and 6-20 in ANSI/NEMA WD 6-2016, *Wiring Devices — Dimensional Specifications*.

Informational Note No. 2: Assisted living facilities are Institutional Use Group I-1 per IBC 2015.

Exception to (1), (2), (3), (4), (5), (6), (7) and (8): Receptacles in the following locations shall not be required to be tamper resistant:

(1) Receptacles located more than 1.7 m (5 ½ ft) above the floor

(2) Receptacles that are part of a luminaire or appliance

(3) A single receptacle, or a duplex receptacle for two appliances, located within the dedicated space for each appliance that, in normal use, is not easily moved from one place to another and that is cord-and-plug-connected in accordance with 400.10(A)(6), (A)(7), or (A)(8)

(4) Nongrounding receptacles used for replacements as permitted in 406.4(D)(2)(a)

Statement of Problem and Substantiation for Public Input

Requirement for tamper-resistant receptacles was added in NEC 2020 for assisted living facilities (Use Group I-1) recognizing the fact that the same hazards of foreign object insertion at receptacle outlets exist in assisted living facilities as in residential occupancies which offer the same types of services. The proposed added text will cover other occupancies similar to the assisted living facilities, such as community based residential facilities and similar facilities with the same types of occupants and young visitors such as grandchildren. The additional language will make it clear these other residential care facilities are required to have the same types of tamper-resistant receptacles for the safety of the occupants and young visitors.

Submitter Information Verification

Submitter Full Name: Rudolph Garza

Organization:	IAEI
Affiliation:	IAEI
Street Address:	
City:	
State:	
Zip:	
Submittal Date:	Tue Sep 08 22:10:44 EDT 2020
Committee:	NEC-P18

Public Input No. 4363-NFPA 70-2020 [Section No. 406.12]

406.12 Tamper-Resistant Receptacles.

All 15- and 20-ampere, 125- and 250-volt nonlocking-type receptacles in the areas specified in 406.12(1) through (8) shall be listed tamper-resistant receptacles.

(1) Dwelling units, including attached and detached garages and accessory buildings to dwelling units, and common areas of multifamily dwellings specified in 210.52 and 550.13

(2) Guest rooms and guest suites of hotels, motels, and their common areas

(3) Child care facilities

(4) Preschools and education facilities

(5) ~~Business offices~~ Corridors , ~~corridors,~~ waiting rooms and the like in clinics, medical and dental offices, and outpatient facilities

(6) Subset of assembly occupancies described in 518.2 to include places of awaiting transportation, gymnasiums, skating rinks, and auditoriums

(7) Dormitory units

(8) Assisted living facilities

Informational Note No. 1: This requirement would include receptacles identified as 5-15, 5-20, 6-15, and 6-20 in ANSI/NEMA WD 6-2016, *Wiring Devices — Dimensional Specifications*.

Informational Note No. 2: Assisted living facilities are Institutional Use Group I-1 per IBC 2015.

Exception to (1), (2), (3), (4), (5), (6), (7) and (8): Receptacles in the following locations shall not be required to be tamper resistant:

(1) Receptacles located more than 1.7 m (5 ½ ft) above the floor

(2) Receptacles that are part of a luminaire or appliance

(3) A single receptacle, or a duplex receptacle for two appliances, located within the dedicated space for each appliance that, in normal use, is not easily moved from one place to another and that is cord-and-plug-connected in accordance with 400.10(A)(6), (A)(7), or (A)(8)

(4) Nongrounding receptacles used for replacements as permitted in 406.4(D)(2)(a)

Statement of Problem and Substantiation for Public Input

Why should business offices in medical clinics require tamper proof receptacles? The section does not require tamper-proof receptacles in exam rooms in a clinic, where the likelihood of a child being left unsupervised is higher, but does require them in offices. Why is an office in a clinic different than an office in any other business. The wording in 406.12(5) appears to have been copied directly from 517.10 (B) which describes areas not covered by Section 517.

This code limitation results in unnecessary cost and, more significantly, means that standard systems furniture cannot be used in offices in clinics because these systems are not available with tamper proof receptacles.

Submitter Information Verification

Submitter Full Name:	Greg Livengood
Organization:	Stantec
Street Address:	
City:	
State:	
Zip:	
Submittal Date:	Thu Sep 10 11:20:55 EDT 2020
Committee:	NEC-P18

Public Input No. 2674-NFPA 70-2020 [Section No. 410.1]

410.1 Scope.

This article covers luminaires, portable luminaires, lampholders, pendants, incandescent filament lamps, arc lamps, electric-discharge lamps, decorative lighting products, lighting accessories for temporary seasonal and holiday use, portable flexible lighting products, and the wiring and equipment forming part of such products and lighting installations.

<u>*Exception:* Lighting systems and their associated components operating at no more than 30 volts ac or 60 volts dc shall be permitted to be installed in accordance with Article 411, Low Voltage Lighting Systems.</u>

Statement of Problem and Substantiation for Public Input

This public input is intended to eliminate a scope overlap. It is written in a permissive format to allow installation in accordance with Article 411 or Article 410.

Submitter Information Verification

Submitter Full Name: Mark Earley
Organization: Alumni Code Consulting Group
Affiliation: Self
Street Address:
City:
State:
Zip:

Submittal Date: Thu Aug 27 18:56:14 EDT 2020
Committee: NEC-P18

Public Input No. 4458-NFPA 70-2020 [Section No. 410.1]

410.1 Scope.

This article covers luminaires, portable luminaires, lampholders, pendants, incandescent filament lamps, arc lamps, electric-discharge lamps, decorative lighting products, lighting accessories for temporary seasonal and holiday use, portable flexible lighting products, and the wiring and equipment forming part of such products and lighting installations.

<u>Exception: Lighting systems and their associated components operating at no more than 30VAC or no more than 60VDC shall be permitted to be installed in accordance with article 411 Low Voltage Lighting</u>

Statement of Problem and Substantiation for Public Input

There is confusion between article 410 and article 411 regarding the use of low voltage lighting systems. The proposed change eliminates that confusion.

Submitter Information Verification

Submitter Full Name: Joel Goergen

Organization: Cisco Systems, Inc.

Affiliation: Cisco Systems, Inc.

Street Address:

City:

State:

Zip:

Submittal Date: Thu Sep 10 13:26:47 EDT 2020

Committee: NEC-P18

Public Input No. 3625-NFPA 70-2020 [Section No. 410.2]

(Relocate all definitions in the 410. 2 to Article 100, arrange them in alphabetical order and without any subdivisions.)

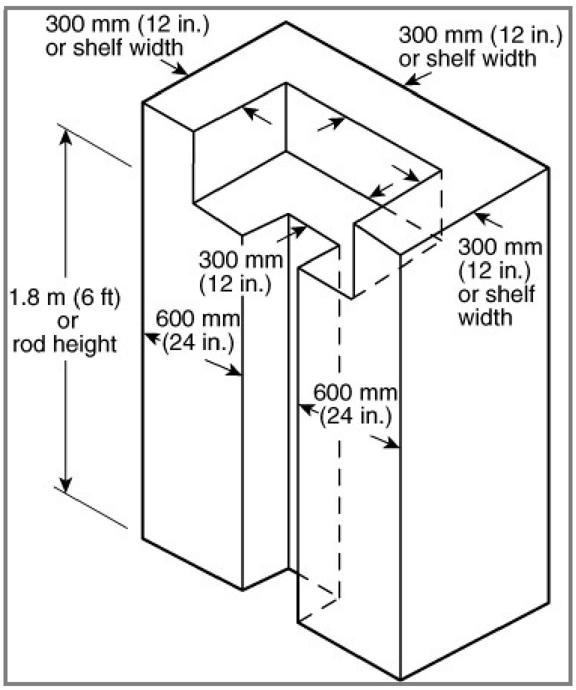
410. 2 Definition.

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

Clothes Closet Storage Space.

The volume bounded by the sides and back closet walls and planes extending from the closet floor vertically to a height of 1.8 m (6 ft) or to the highest clothes-hanging rod and parallel to the walls at a horizontal distance of 600 mm (24 in.) from the sides and back of the closet walls, respectively, and continuing vertically to the closet ceiling parallel to the walls at a horizontal distance of 300 mm (12 in.) or the width of the shelf, whichever is greater; for a closet that permits access to both sides of a hanging rod, this space includes the volume below the highest rod extending 300 mm (12 in.) on either side of the rod on a plane horizontal to the floor extending the entire length of the rod. See Figure 410.2.

Figure 410.2 Clothes Closet Storage Space.



Statement of Problem and Substantiation for Public Input

"The National Electrical Code has definitions in multiple parts in Article 100 and many definitions scattered through out the code many of them in the .2 section of the articles.
Most of the other standards under NFPA have their definitions in one location and this will allow the NEC the same requirement. The revisions to the NEC Style Manual require all the definitions to be relocated to Article 100. "

Submitter Information Verification

Submitter Full Name: David Williams

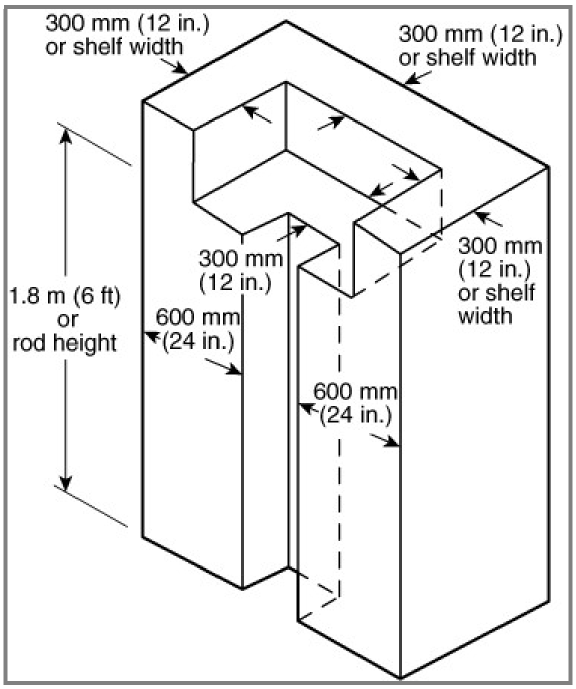
Organization:	Delta Charter Township
Street Address:	
City:	
State:	
Zip:	
Submittal Date:	Wed Sep 09 09:43:50 EDT 2020
Committee:	NEC-P18

Public Input No. 1540-NFPA 70-2020 [Definition: Clothes Closet Storage Space.]

Clothes Closet Storage Space.

Unless there are doors enclosing each storage or hanging space, The volume bounded by the sides and back closet walls and planes extending from the closet floor vertically to a height of 1.8 m (6 ft) or to the highest clothes-hanging rod and parallel to the walls at a horizontal distance of 600 mm (24 in.) from the sides and back of the closet walls, respectively, and continuing vertically to the closet ceiling parallel to the walls at a horizontal distance of 300 mm (12 in.) or the width of the shelf, whichever is greater; for a closet that permits access to both sides of a hanging rod, this space includes the volume below the highest rod extending 300 mm (12 in.) on either side of the rod on a plane horizontal to the floor extending the entire length of the rod. See Figure 410.2.

Figure 410.2 Clothes Closet Storage Space.



Statement of Problem and Substantiation for Public Input

There are some clothes closets that have completely enclosed glass doors over the shelf and rod areas as well as full drawers that are self-closing. The current text does not reference this high end style where no clothing is exposed to hazards' of lamping.

Submitter Information Verification

Submitter Full Name: Steven Froemming

Organization: City of Franklin

Street Address:

City:

State:

Zip:	
Submittal Date:	Mon Jun 15 23:27:04 EDT 2020
Committee:	NEC-P18

Public Input No. 3784-NFPA 70-2020 [Section No. 410.7]

410.7 Reconditioned Equipment.

Luminaires, lampholders, <u>ballasts, LED drivers, lamps,</u> and retrofit kits shall not be permitted to be reconditioned. If a retrofit kit is installed in a luminaire in accordance with the installation instructions, the retrofitted luminaire shall not be considered reconditioned.

Statement of Problem and Substantiation for Public Input

Lighting ballasts, LED drivers, and lamps are constructed using specialized materials, parts and techniques that are specified by the original equipment manufacturer. If these factors are not properly considered during reconditioning, important safety features may not function properly. Additionally, if proper materials, parts, or equipment are not used, the integrity of reconditioned devices may not be assured, and reliability or function may be compromised. Accordingly, the NEMA Technical Position on Reconditioned Equipment, CS 100-2020, specifies that lighting ballasts, drivers, and lamps are components or assemblies that are not suitable for reconditioning. The proposed change will clearly address reconditioning of these devices by adding them to the existing reconditioning requirement for luminaires, lampholders, and retrofit kits.

Submitter Information Verification

Submitter Full Name: Megan Hayes
Organization: Nema
Street Address:
City:
State:
Zip:
Submittal Date: Wed Sep 09 12:40:19 EDT 2020
Committee: NEC-P18

Public Input No. 197-NFPA 70-2019 [Section No. 410.10(D)(1)]

(1)

No parts of cord-connected luminaires, chain-, cable-, or cord-suspended luminaires, lighting track, ~~pendants, or ceiling-suspended (paddle) fans~~ or pendants shall be located within a zone measured 900 mm (3 ft) horizontally and 2.5 m (8 ft) vertically from the top of the bathtub rim or shower stall threshold. This zone is all-encompassing and includes the space directly over the tub or shower stall.

Statement of Problem and Substantiation for Public Input

The reference to ceiling suspended paddle fans does not belong in an Article covering luminaires, lampholders and lamps. I will be submitting an accompanying proposal to address this concern for paddle fans in Article 422 for appliances. The scope of Article 410 does not include appliances such as ceiling suspended paddle fans. The scope of Article 422, however does include appliances, and as such, the clearances for paddle fans located near bathtubs and shower stalls should be address in Article 422 instead of Article 410.

Related Public Inputs for This Document

Related Input	Relationship
Public Input No. 198-NFPA 70-2019 [New Section after 422.18]	

Submitter Information Verification

Submitter Full Name: Russ Leblanc
Organization: Leblanc Consulting Services
Street Address:
City:
State:
Zip:

Submittal Date: Sat Dec 21 12:51:48 EST 2019
Committee: NEC-P18

Public Input No. 2714-NFPA 70-2020 [Section No. 410.10(D)(1)]

(1)

No parts of cord-connected luminaires, wall mounted luminaires, chain-, cable-, or cord-suspended luminaires, lighting track, pendants, or ceiling-suspended (paddle) fans shall be located within a zone measured 900 mm (3 ft) horizontally and 2.5 m (8 ft) vertically from the top of the bathtub rim or shower stall threshold. This zone is all-encompassing and includes the space directly over the tub or shower stall.

Statement of Problem and Substantiation for Public Input

This section previously excluded wall mounted luminaires, yet it can cause an equal life safety hazard

Submitter Information Verification

Submitter Full Name: Greg Chontow
Organization: Town of Dover
Street Address:
City:
State:
Zip:
Submittal Date: Sat Aug 29 09:14:43 EDT 2020
Committee: NEC-P18

Public Input No. 2349-NFPA 70-2020 [Section No. 410.10(D)(2)]

(2)

Luminaires located within the actual outside dimension of the bathtub or shower to a height of 2.5 m (8 ft) vertically from the top of the bathtub rim or shower threshold shall be marked " suitable for damp locations" or marked " suitable for wet locations" . Luminaires located where subject to shower spray shall be marked " suitable for wet locations."

Statement of Problem and Substantiation for Public Input

Quotations missing around the text to be used for equipment marking.

Submitter Information Verification

Submitter Full Name:	John Blissett
Organization:	Bernhard TME
Street Address:	
City:	
State:	
Zip:	
Submittal Date:	Mon Aug 17 14:42:45 EDT 2020
Committee:	NEC-P18

Public Input No. 1119-NFPA 70-2020 [Section No. 410.10(F)]

(F) Luminaires Installed in or Under Roof Decking.

Luminaires installed in exposed or concealed locations under ~~metal-corrugated sheet roof~~ <u>any roof</u> decking shall be installed and supported so there is not less than 38 mm (1½ in.) measured from the lowest surface of the roof decking to the top of the luminaire.

Statement of Problem and Substantiation for Public Input

Corrugated metal sheet roofing isn't the only threat. Any roof can have the metal or shingles replaced. Roofers miss trusses or rafters when nailing/screwing plywood or OSB sheeting and could puncture luminaires.

Recessed can lights are frequently the same depth as 2" x 6" framing causing the lid of the can to just about touch the underside of the roofing. This could be for deck canopies or vaulted ceilings. 110.3(A)(2) is a code article that can be cited for this condition, at present but it would be better to use 410.10F reworded this way.

Article 690 used to call for a full 10" gap for firemen saws for any roof.

Submitter Information Verification

Submitter Full Name:	Norman Feck
Organization:	State of Colorado
Street Address:	
City:	
State:	
Zip:	
Submittal Date:	Sun May 17 15:20:44 EDT 2020
Committee:	NEC-P18

Public Input No. 370-NFPA 70-2020 [Section No. 410.10(F)]

(F) Luminaires Installed in or Under Roof Decking.

Luminaires installed in exposed or concealed locations under metal-corrugated sheet roof decking shall be installed and supported so there is not less than 38 mm (1½ in.) measured from the lowest surface of the roof decking to the top of the luminaire.

Exception: The 38 mm (1 1/2 inch) spacing is not required where metal-corrugated sheet roof decking is covered with a minimum thickness 50mm (2 in.) concrete slab.

Additional Proposed Changes

File Name	Description	Approved
300.4_E_Exception_photo_1.jpg	concrete slab on top of metal roof decking	
300.4_E_Exception_photo_2_.jpg	wiring on roof decking with concrete slab	

Statement of Problem and Substantiation for Public Input

An exception is needed here to recognize construction techniques using poured concrete on top of the metal roof decking. In these instances there is virtually zero chance of sheet metal screws penetrating wiring methods or light fixtures (luminaires) installed below the deck. The 1 1/2 inch spacing requirements should be relaxed for this type of construction.

Related Public Inputs for This Document

Related Input	Relationship
Public Input No. 369-NFPA 70-2020 [Section No. 300.4(E)]	concrete slabs on metal roof decking

Submitter Information Verification

Submitter Full Name: Russ Leblanc

Organization: Leblanc Consulting Services

Street Address:

City:

State:

Zip:

Submittal Date: Sun Jan 26 14:55:04 EST 2020

Committee: NEC-P18


Concrete slab poured on top of metal corrugated roof decking


Concrete slab poured on top of metal currugated roof decking is visible near skylight oipening
EMT installed below metal currugated roof decking where a concrete slab was poured on top of metal roof deckingh.
01 . 13 . 2020

Public Input No. 1541-NFPA 70-2020 [Section No. 410.16(A)]

(A) Luminaire Types Permitted in clothes closet storage space .

Only luminaires of the following types shall be permitted in a clothes closet:

(1) Surface-mounted or recessed incandescent or LED luminaires with completely enclosed light sources

(2) Surface-mounted or recessed fluorescent luminaires

(3) Surface-mounted fluorescent or LED luminaires identified as suitable for installation within the clothes closet storage space

Statement of Problem and Substantiation for Public Input

If it is called clothes closet storage space in 410.2 definitions, that wording should be in the general text

Submitter Information Verification

Submitter Full Name: Steven Froemming

Organization: City of Franklin

Street Address:

City:

State:

Zip:

Submittal Date: Mon Jun 15 23:41:07 EDT 2020

Committee: NEC-P18

Public Input No. 1542-NFPA 70-2020 [Section No. 410.16(C)]

(C) Location.

The minimum clearance between luminaires installed in clothes closets and the nearest point of a clothes closet storage space shall be as follows:

(1) 300 mm (12 in.) for surface-mounted ~~incandescent or LED luminaires with a completely enclosed light source~~ incandescent installed on the wall above the door or on the ceiling.

(2) 150 mm (6 in.) for surface-mounted fluorescent luminaires or LED luminaires with a completely enclosed light source installed on the wall above the door or on the ceiling.

(3) 150 mm (6 in.) for recessed incandescent or LED luminaires with a completely enclosed light source installed in the wall or the ceiling.

(4) 150 mm (6 in.) for recessed fluorescent luminaires installed in the wall or the ceiling.

(5) Surface-mounted fluorescent or LED luminaires shall be permitted to be installed within the clothes closet storage space where identified for this use.

Statement of Problem and Substantiation for Public Input

Fully enclosed modern LED lighting is not any more hazardous that open fluorescent tubes and should allow the same clearances.

Submitter Information Verification

Submitter Full Name: Steven Froemming
Organization: City of Franklin
Street Address:
City:
State:
Zip:
Submittal Date: Mon Jun 15 23:47:25 EDT 2020
Committee: NEC-P18

Public Input No. 2621-NFPA 70-2020 [Section No. 410.16(C)]

(C) Location.

The minimum clearance between luminaires installed in clothes closets and the nearest point of a clothes closet storage space shall be as follows:

(1) 300 mm (12 in.) for surface-mounted incandescent ~~or LED luminaires~~ with a completely enclosed light source installed on the wall above the door or on the ceiling.

(2) 150 mm (6 in.) for surface-mounted fluorescent ~~luminaires~~ orLED luminaires installed on the wall above the door or on the ceiling.

(3) 150 mm (6 in.) for recessed incandescent or LED luminaires with a completely enclosed light source installed in the wall or the ceiling.

(4) 150 mm (6 in.) for recessed fluorescent luminaires installed in the wall or the ceiling.

(5) Surface-mounted fluorescent or LED luminaires shall be permitted to be installed within the clothes closet storage space where identified for this use.

Statement of Problem and Substantiation for Public Input

This input is being submitted on behalf of the Minnesota Department of Labor and Industry. The Department's 15 office/field staff, and 65 plus contract electrical inspectors complete over 150,000 electrical inspections annually and are involved in the daily enforcement and interpretation of the National Electrical Code.
Due to the fact that LED luminaires typically do not generate the heat similar to that of a incandescent, at worse case, they should fall in the same category as fluorescent luminaires and not be grouped with incandescent luminaires.

Submitter Information Verification

Submitter Full Name: Dean Hunter
Organization: Minnesota Department of Labor
Street Address:
City:
State:
Zip:
Submittal Date: Wed Aug 26 08:31:54 EDT 2020
Committee: NEC-P18

Public Input No. 992-NFPA 70-2020 [New Section after 410.30(B)]

410.30(B)(7)

(7) Circuits for conductors in metal poles used as vertical raceways in the following locations shall have ground-fault protection for the metal pole not exceeding 30 mA:

(a) pool and spa areas

(b) parking lots for arenas, stadiums, theme parks, playgrounds, restaurants, movie theaters, shopping centers, supermarkets, strip stores, malls, office complexes, medical and dental offices, warehouses and distribution centers, government buildings, schools, colleges, and hospitals

(c) playgrounds

(d) parks, water parks and parking lots for parks, water parks, and public pools

Statement of Problem and Substantiation for Public Input

Ground-fault protection of equipment (GFPE) is used many times throughout the NEC. For years, there have been problems unique to metal light poles. I think we can do something about this. We have the technology. We have the ability to correct this situation. I don't have to tell the panel to google "light pole electrocution." Most code panel members inherently realize both the unique maintenance challenges and shock hazards with respect to metal light poles.

Insulation can become compromised due to winds that gently rock the pole, causing the wires to bang against the interior wall. This event can happen with even moderate winds; high winds are not necessary to cause this condition. The sound can even become audible on a very windy day. This can result in either a temporary or intermittent hazard, where the metal light pole becomes energized for a short period of time due to the damaged insulation. We can protect the pole using GFP which would shut down the circuit, thereby alerting maintenance staff to a potentially dangerous condition. This would also provide a level of protection for people at some level, even though GFP is equipment protection only.

Another issue unique to metal light poles is the amount of unqualified people who service the and maintain the poles. This is just a fact. The net result is that compromised metal poles are exposed not just to these unqualified maintenance people, but to ordinary citizens who may lean on and touch the pole with their hands. This can be a jogger who leans on the pole to get a moment of rest, or a child in a playground, or someone's wife that went shopping. The location of metal light poles (easily reached or touched by the public) makes it an inherently more dangerous structure, in and of itself. We need better codes to address dangers associated with metal light poles.

A final issue unique to metal light poles is that some people remove the cover in order to steal or to "tap" the electrical power. Many times the covers do not get put back on properly. Sometimes, they don't get put back at all. The panel may wish to also consider requiring that the handhole covers be lockable, such that ordinary tools such as screwdrivers cannot be used to remove the handhole covers.

I thought the most appropriate place for this change was in 410, where the Article speaks to metal poles. This would be the correct section, IMO.

Accidents involving metal light poles are not uncommon:
https://www.fox4news.com/news/teen-recovering-after-being-shocked-at-cleburne-park

https://www.21cpw.com/usps-worker-electrocuted-at-shannon-street-post-office/

Here is another incident below. Although this is a city light pole and not a pole that would fall under the scope of my proposed language, I want to draw attention to the “human nature” aspect of this accident – the fact that people love to touch metal light poles. Like a moth to the flame, people are drawn to touch, lean on, and rest on metal poles. This is human nature. This is simply what people do:

"I had my ankle weights on," he said. "I leaned up against the pole. I tried to relax and take a little break and try to stretch on the pole."

https://6abc.com/jogger-shocked-runner-traffic-light-utility-pole/1487092/

I believe this change is warranted. Metal light poles have unique characteristics that are not common to other pieces of equipment, and are in need of equipment protection. Requiring GFPE can solve a plethora of issues with regard to metal light poles.

Related Public Inputs for This Document

Related Input	Relationship
Public Input No. 997-NFPA 70-2020 [Section No. 410.30(B)]	

Submitter Information Verification

Submitter Full Name: Nick Sasso

Organization: Clark County Building and Fire

Street Address:

City:

State:

Zip:

Submittal Date: Thu May 07 10:37:54 EDT 2020

Committee: NEC-P18

Public Input No. 997-NFPA 70-2020 [Section No. 410.30(B)]

(B) Metal or Nonmetallic Poles Supporting Luminaires.

Metal or nonmetallic poles shall be permitted to be used to support luminaires and as a raceway to enclose supply conductors, provided the following conditions are met:

(1) A pole shall have a handhole not less than 50 mm × 100 mm (2 in. × 4 in.) with a cover suitable for use in wet locations to provide access to the supply terminations within the pole or pole base.

Exception No. 1: No handhole shall be required in a pole 2.5 m (8 ft) or less in height abovegrade where the supply wiring method continues without splice or pull point, and where the interior of the pole and any splices are accessible by removing the luminaire.

Exception No. 2: No handhole shall be required in a pole 6.0 m (20 ft) or less in height abovegrade that is provided with a hinged base.

(2) Where raceway risers or cable is not installed within the pole, a threaded fitting or nipple shall be brazed, welded, or attached to the pole opposite the handhole for the supply connection.

(3) A metal pole shall be provided with an equipment grounding terminal as follows:

(4) A pole with a handhole shall have the equipment grounding terminal accessible from the handhole.

(5) A pole with a hinged base shall have the equipment grounding terminal accessible within the base.

Exception to (3): No grounding terminal shall be required in a pole 2.5 m (8 ft) or less in height abovegrade where the supply wiring method continues without splice or pull, and where the interior of the pole and any splices are accessible by removing the luminaire.

(6) A metal pole with a hinged base shall have the hinged base and pole bonded together.

(7) Metal raceways or other equipment grounding conductors shall be bonded to the metal pole with an equipment grounding conductor recognized by 250.118 and sized in accordance with 250.122.

(8) Conductors in vertical poles used as raceway shall be supported as provided in 300.19.

(9) Handhole covers shall be lockable or require a specialized tool for access.

Statement of Problem and Substantiation for Public Input

************I did not propose any changes to (3)(a) or (3)(b) but Terra says that I did. Terra also magically changed (3)(a) and (3)(b) to (4) and (5) and renumbered everything.

My only proposed language should display as (7) about the handhole cover, and should not display as (9):

"Handhole covers shall be lockable or require a specialized tool for access"

We live in strange times. Homeless, vagrants, and electrical thieves are on the rise. I've personally

seen people pull into parking lots and illegally tap power from light poles.
The proposed language would not only put this issue to rest, but may also help to ensure that only the qualified person(s) has access to the wiring in the handhole.
Please consider supporting this language.

Related Public Inputs for This Document

Related Input	Relationship
Public Input No. 992-NFPA 70-2020 [New Section after 410.30(B)]	

Submitter Information Verification

Submitter Full Name:	Nick Sasso
Organization:	Clark County Building and Fire
Street Address:	
City:	
State:	
Zip:	
Submittal Date:	Thu May 07 17:06:20 EDT 2020
Committee:	NEC-P18

Public Input No. 3423-NFPA 70-2020 [Section No. 410.36]

410.36 Means of Support.

(A) Luminaires Supported By Outlet Boxes.

Luminaires shall be permitted to be supported by outlet boxes or fittings installed as required by 314.23. The installation shall comply with the following requirements:

(1) The outlet boxes or fittings shall comply with 314.27(A)(1) and 314.27(A)(2).

(2) In habitable rooms, hallways, and foyers of one- and two-family dwellings, a listed weight supporting ceiling receptacle (WSCR), and a compatible weight supporting attachment fitting (WSAF) installed in accordance with 314.27(E) and (F) shall be installed in all ceiling outlet boxes for luminaires.

> ***Exception No. 1:*** *A WSCR shall not be required in ceiling outlet boxes for electric-discharge, LED tube-type luminaires or track lighting.*
>
> ***Exception No. 2:*** *A WSCR shall not be required in ceiling outlet boxes for recessed luminaires.*
>
> **Exception No. 3:** A WSCR shall not be required in outlet boxes for use with cove lighting.

(3) Luminaires installed on vertical surfaces shall be permitted to be supported in accordance with 314.27(E) and (F) .

~~Outlet~~

(4) Outlet boxes complying with 314.27(E) shall be considered lighting outlets as required by 210.70(A) , (B), and (C).

(B) Suspended Ceilings.

Framing members of suspended ceiling systems used to support luminaires shall be securely fastened to each other and shall be securely attached to the building structure at appropriate intervals. Luminaires shall be securely fastened to the ceiling framing member by mechanical means such as bolts, screws, or rivets. Listed clips identified for use with the type of ceiling framing member(s) and luminaire(s) shall also be permitted.

(C) Luminaire Studs.

Luminaire studs that are not a part of outlet boxes, hickeys, tripods, and crowfeet shall be made of steel, malleable iron, or other material suitable for the application.

(D) Insulating Joints.

Insulating joints that are not designed to be mounted with screws or bolts shall have an exterior metal casing, insulated from both screw connections.

(E) Raceway Fittings.

Raceway fittings used to support a luminaire(s) shall be capable of supporting the weight of the complete fixture assembly and lamp(s).

(F) Busways.

Luminaires shall be permitted to be connected to busways in accordance with 368.17(C).

(G) Trees.

Outdoor luminaires and associated equipment shall be permitted to be supported by trees.

Informational Note No. 1: See 225.26 for restrictions for support of overhead conductors.

Informational Note No. 2: See 300.5(D) for protection of conductors.

Revise

Additional Proposed Changes

File Name	Description	Approved
SupportingMaterialFinal2.pdf	Additional Supporting Material	

Statement of Problem and Substantiation for Public Input

WHY SHOULD THIS SECTION BE MODIFIED? The "plug and play" receptacle (WSCR) increases safety by simplifying installation and most importantly, reducing the need to touch exposed conductors while installing luminaires. By engineering out the hazard, the human factors contributing to injuries or deaths are mitigated. Section 410.36(A)(2) should be revised to require connection and support via weight supporting ceiling receptacles (WSCR) and weight supporting attachment fittings (WSAF) to increase safety for the initial installation and for future exchanges of luminaires in one- and two-family dwellings. Three exceptions are proposed where the WSCR is not presently practical or not necessary due to configuration issues. While the requirement is for ceiling outlet boxes, the WSCR would be permitted for installation of luminaires mounted on wall (vertical) surfaces as provided in the new 410.36(A)(3). The WSCR has been determined to be compatible with all known ceiling outlet boxes.

Many times when reviewing data, you just get a small sense of issues in the field without the true magnitude, due to reporting issues. We all know that people can get injured or fall while installing luminaires. One example of a data set is from the CPSC, which shows 32 emergency room visits in a 5-year period that resulted from falls during luminaire installation. OSHA requires reporting of all accidents in the workplace. However, CPSC doesn't learn about every accident involving consumers because consumers aren't obligated to report accidents to the commission. In fact, most consumers would not report the accident because it had nothing to do with a defective product. So the reporting only includes the incidents that have come to the attention of the CPSC. The CDC data clearly indicates that the number one cause of accidents in the workplace and at home is falls. See the additional supporting material provided with this PI that provides more detailed data. The CDC data does not necessarily capture what the person was doing when he or she fell. It does prove that work on ladders and other platforms is dangerous and can lead to injuries. Work on electrical equipment while on ladders introduces an additional level of complexity to an already dangerous situation. The person is joining wires, using tools and supporting the weight of the equipment, all while trying to maintain balance. For many, the work is the equivalent of juggling on a ladder. The weight supporting ceiling receptacle (WSCR) in concert with the weight supporting attachment fitting (WSAF) will significantly reduce the juggling and overall amount of time spent on ladders.

For new construction, the wiring is not normally energized until after the installation is complete. But for existing dwellings, one should always shut off the circuit breakers to mitigate the electrical hazard. The reality is that professional electricians, handymen and homeowners either may not turn off the breaker or may turn off the wrong breaker. After the initial installation of the WSCR, there is no need to turn off the breaker to change or exchange the luminaire.
Three exceptions are proposed where the WSCR is not presently practical or not necessary due to configuration issues. While the requirement is for ceiling outlets, the WSCR would be permitted for installation of luminaires mounted on wall (vertical) surfaces.

PLACEMENT. The proposed text is recommended for placement in Article 410 because it relates to support of luminaires. Once installed, the WSCR will provide shock protection during cleaning, maintenance and replacement by reducing the need to work inside outlet boxes where there are energized conductors. It will provide fall protection by limiting both falls from unbalance and from the shock hazards during cleaning, maintenance and replacement that can result in falls and by reducing the time spent on ladders. Similar language is proposed for 422.18 for paddle fans. The revised text correlates with the requirements in 314.27.

NAME CHANGE. The name of the “locking support mounting receptacle” is proposed to be simplified due to feedback from users and enforcers. It is proposed to be identified as “weight supporting ceiling receptacle (WSCR)”, which better describes its function and features. Similarly, the attachment fitting is redesignated as “weight supporting attachment fitting (WSAF)”, which also better describes its function and features and precludes confusion with unrelated fittings that attach, used elsewhere in the Code. See PIs 2690 and 2691 where the definitions are proposed

DATA TO SUBSTANTIATE – SUMMARY OF SUPPORTING MATERIAL. A significant amount of information was collected and analyzed for this public input, including information from the U.S. Census Bureau, OSHA, NIOSH, CPSC, and CDC. It is included in the attached supporting material.

DIYers AND NON-ELECTRICIANS. A fundamental premise is that much of the home improvement work today is done by the do-it-yourselfer. The information on renovations is from the American Housing Survey, which is a report generated every two years by the U.S. Census Bureau. This report accumulates information on all aspects of housing. We have highlighted information that contrasts professional installations and do-it-yourself projects. It should be noted that licensing requirements vary among jurisdictions. A professional installer may not necessarily be licensed as an electrician. Information of the number of home improvement centers and hardware stores is provided to present a perspective on the size of the support network for home improvement. Home improvement stores are now a major factor in the US economy.

RENOVATION DATA. This report includes all of the residential renovations for each reporting period. Some of the larger renovation projects reported would have included electrical work, which was not separately categorized. Summary charts are provided on all renovations along with a single chart that reports on projects that were only classified as electrical.

DEATHS AND INJURIES REPORTED. Information from OSHA, NIOSH, CPSC, and CDC is based on reported accidents. OSHA and NIOSH data is reported in accordance with workplace accident reporting regulations. CPSC data is based on incidents that come to the attention of CPSC. Persons who are injured are not required to report their injuries to CPSC, so the information may be incomplete.

The data on falls is based on reports from hospitals and clinics, which is contained in the WISQARS database. Two separate reports are presented, one for fatalities and one for non-fatal injuries.

<SEE ATTACHMENT FOR SUPPORTING DATA>

THAT NEXT HOME IMPROVEMENT – IS IT SAFE? People are always dreaming of that next home improvement or update. One of the most desirable ways to do that is by changing luminaires and adding or updating ceiling paddle fans.

As more DIYers are doing this improvement work, safety concerns grow exponentially. Some of the biggest safety issues are falls from ladders, electric shocks and electrocutions. A solution exists that you can employ in your products that mitigates all these very real hazards.

So, shouldn’t the desires of the DIYers be accommodated safely? Benefits to you could be increased sales of luminaires or paddle fans – if we could just make it easier and safer.

…BECAUSE IT WAS ALWAYS DONE THAT WAY…? When overhead general lighting is going to be installed, why does the initial luminaire installation or future luminaire changes have to be hard-wired? Now technology exists to mitigate the hazards, as discussed here and should become mandatory for safety.

Safety in the NEC is a continuing evolution. When the screw shell lampholder design was standardized, why wasn’t a weight supporting quick-connect option for luminaires and ceiling fans also included? Simply put, because the technology didn’t exist. When looking around the home, most electrical equipment is plug and play, except ceiling luminaires and paddle fans. Furthermore, experience demonstrates that occupants would like to be able to change both luminaires and paddle fans.

One example of code and technology evolution is the use of a 2-wire lighting socket screw-shell adapter to power appliances. Evolution brought 2-wire receptacles for this purpose and these evolved to 3-wire grounded receptacles, some of which became GFCI-type receptacles. Advancements in technology coupled with the need to improve safety is the fundamental principle of the NEC.

DANGERS OF DOING IT THE “OLD” WAY. From your own experience, you understand the dangers of working on a ladder (with or without the luminaire or paddle fan) while wiring. Do you realize that, excluding motor vehicle accidents, falls are the #1 cause of injuries in construction (US Census Bureau BLS, 2019), which includes electricians? The data in the attached report validates your own experiences of strains and falls. Shouldn’t the wiring be done once, similar to any other receptacle, and the luminaire or paddle fan simply plugged in afterwards?

IT IS TIME TO TAKE ANOTHER STEP IN THE EVOLUTION TO FURTHER IMPROVE SAFETY.

DIYs ARE A LARGE SEGMENT OF RESIDENTIAL REMODELING

-- DIYers do between 36 - 38% of all home improvement projects (US Census Bureau, 2017)

-- DIYers do between 35.2 - 35.9% of all electrical home improvement projects (US Census Bureau, 2017).

-- Luminaires and paddle fans are two of the most popular electrical improvements.

-- HGTV, DIY Network, YouTube encourage DIY projects.

    -- House flipping is popular among DIYers, encouraged by HGTV programming.

-- There are several thousand home improvement stores nationwide to support DIY projects

HAZARDS FROM THE DIY INSTALLATION

-- Incorrect installations go undetected

    -- Incorrect wiring causing shorts and shocks

    -- Incorrect support causing luminaires/paddle fans to fall or damage wires

    --Loss of grounding/bonding connections

-- Falls from ladders during installation from:

    -- Shocks

    -- Unsteadiness and losing balance

    -- Awkwardness of handling luminaires/paddle fans while connecting wires

-- Shocks during installation of replacement luminaires/paddle fans due to exposure of live wires

The extent of the DIY problem installations is not really known. There is rarely an electrical inspection initially, and subsequent real estate home inspectors often have a low level of electrical training. Also, there is no one or entity that is keeping statistics.

SIMPLER MAINTENANCE

-- Easy removal for cleaning luminaires/paddle fans and bulb replacement

-- Easy removal and reinstallation for painting the ceiling

-- Quick install/removal of luminaires/paddle fans

IF THE WORK IS DONE BY PROFESSIONALS, WHO ARE “PROFESSIONALS” INSTALLING LIGHTING/CEILING FANS? How many of the professional home improvement projects include an electrical professional on the team? Is the electrical work being performed by painters? Carpenters? Drywallers? Home handymen?

-- The CPSC estimates there are 4 electrocution deaths per year associated with lighting products (Hnatov, 2009) that they have been able to identify. One death is one too many.

-- CPSC data from the National Electronic Injury Surveillance System (NEISS) database (CPSC, 2019) from 2009 to 2013 revealed 38 incidents resulting in hospital emergency room visits involving the installation of luminaires; 32 of those incidents involved falls and at least four of those incidents involved the victims being shocked.

CEILING FAN RECALLS

The CPSC website lists a number of ceiling fan and luminaire recalls (CPSC, 2018). If the new technology receptacle had been installed, the luminaire could be easily replaced by the homeowner, minimizing shock and fall hazards.

THE SOLUTION

The proposed solution is an innovative advance that makes the installation of luminaires/paddle fans safer not just for the current installation, but for future replacements. With this new technology installed during initial construction by electrical professionals there is:

-- a quick connect/disconnect capability (similar to a standard receptacle)

-- support of the weight of the luminaire/paddle fan

-- no supporting the weight or bulk of the luminaire/paddle fan during the receptacle installation

-- no additional rewiring necessary to install the new luminaire/paddle fan

-- no shock hazard during the quick connect of the luminaire/paddle fan

The WSCR is an advance that makes the installation of luminaires and paddle fans safer not just for the current installation, but for future replacements. For the initial installation, the only “weight” the installer has to deal with is the WSCR which is ounces not pounds.

Without the weight/bulk, the falls may not have occurred. With the new technology WSCR in place, the initial installation of the luminaire and any replacement is a quick connect and no shock would have occurred.

If the WSCR and WSAF are required, homeowners and other installers would be protected from shock and fall accidents. They would also be more able to change luminaires/paddle fans at will, which would significantly increase the market.

The solution makes the initial installation safer and provides that future lighting replacements do not require the homeowner to come in contact with potentially live wiring. The WSCR and WSAF configurations protect homeowners and other DIY installers and make lighting replacements simple.

PUBLIC SAFETY.

The WSCR and WSAF would increase overall public safety; a previously installed WSCR (female portion in the ceiling) will:

-- REDUCE installation time and time on ladders (due to ease of installation)

-- REDUCE time standing on something substituting for a ladder (chair, table, sofa, etc.)

-- ELIMINATE homeowners splicing of wiring especially while on ladders

-- REDUCE incorrect installations that could lead to fires or shock hazards

-- REDUCE injuries and deaths from

-- shock and electrocution

-- falls

-- PROMOTES robust and safe first-time installation by professionals

-- ALLOWS quick connect for initial and future installations

-- ELIMINATE straining of conductors and connectors holding the weight of luminaire during installation

-- ELIMINATE the need to support the weight of the luminaire or ceiling paddle fan during wiring; the WSCR weighs ounces.

-- FACILITATES safety when the inspector verifies polarity of the wiring to the WSCR via a circuit tester (versus no polarity verification of luminaires/paddle fans currently).

ADDITIONAL BENEFITS TO MANUFACTURERS WHO LICENSE TECHNOLOGY. This submission complies with the ANSI/NFPA Essential Patent Policy, and the necessary documentation has been provided to NFPA. The WSCR and WSAF would benefit manufacturers as follows:

-- REDUCE liability exposure

-- INCREASE purchasing of luminaires/paddle fans due to

-- reduced installation costs

-- ease of installation

-- INCREASE purchasing of different types or themed luminaires/paddle fans could be easily quick connected/disconnected based on events/holidays/formality

-- DECREASE time get a certificate of occupancy once WSCR is installed in ceiling

-- INCREASE purchasing of WSCR by homebuilders who wish to maximize spec homes (easy switch out of luminaires/paddle fans based on customer preference)

-- REDUCE procrastination of remodeling (entire construction industry benefits)

-- INCREASE interchangeability by promoting standardization

-- INCREASED business - interchangeability that anyone's luminaire/paddle fan can be replaced with yours

-- DECREASE costs since multiple designs of connectors are not necessary

-- INCREASE product lines containing the "quick connect/disconnect" feature

CROSS REFERENCE. Cross-reference PIs 2690 and 2691, definitions for "Weight Supporting Ceiling Receptacle" and "Weight Supporting Attachment Fittings", respectively; and PI 2693 for Section 210.8 incorporating WSCR and WSAF.

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September 2020

PROBLEMS AND SOLUTIONS SUMMARY

Problem: Traditional wiring

Existing practices allow wiring of luminaires and paddle fans that can result in faulty installations or hazards that can include:

- **Shocks, electrocutions, injuries & death**
- **Fires & shorts**
- **Exposure & contacting energized conductors**
- **Incorrect & sloppy wiring**
- **Splicing wires while on a ladder**
- **Straining of conductors & connectors holding the weight of luminaire during installation**
- **Incorrect installations go undetected**
  - **Loss of grounding/bonding connections**
- **Incorrect support causing luminaires/paddle fans to fall or damage wires**
- **Falls from ladders during installation from:**
  - **Shocks**
  - **Unsteadiness and losing balance**
  - **Awkwardness - handling while connecting wires**

Solution: Weight Supporting Ceiling Receptacle (WSCR)

Plugging-in luminaires & paddle fans using the WSCR & Weight Supporting Attachment Fitting (WSAF) will eliminate and/or reduce risk of faulty wire installations and can:

- **Reduce shocks, electrocutions, injuries & deaths**
- **Eliminate the need to touch wires; no exposed wires**
- **Prevent fires due to incorrect or sloppy wiring**
- **Provide a means to check polarity**
- **Eliminate straining of conductors & connectors holding the weight of luminaire during installation**
- **Eliminate splicing wires while on a ladder**
- **Reduce majority of time on ladders (unsteadiness & losing balance**
- **Reduce awkwardness of handling luminaires/paddle fans while connecting wires**

September 2020

Supporting Data for Public Input

REQUIREMENTS FOR WEIGHT SUPPORTING CEILING RECEPTACLE (WSCR) AND WEIGHT SUPPORTING ATTACHMENT FITTING (WSAF)

formerly Locking Support and Mounting Receptacle and Attachment Fitting

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MANY DIY'ERS MAKE THIS TECHNOLOGY CRUCIAL FOR SAFETY

Large Support Network for Do It Yourselfers

There is a significant market for do-it-yourself home improvement. Big-box retailers have sprung up across North America that supply products directly to the consumer. There are 2,286 North American Home Depot stores, 2155 Lowe's Stores, 5000 Ace Hardware stores, 3800 True Value stores, 4500 Do it Best stores, 1000 Harbor Freight stores and others that supply inexpensive tools to many of the DIYers. The DIY market is also supported by all sorts of You Tube videos, some of which is vendor supported, but much of which is generated by someone who may not be an expert. In addition, the Home and Garden TV Network (HGTV) has convinced many that they can make large profits by buying distressed existing home and flipping them. This has also encouraged homeowners to improve their own homes.

The big box stores are known for having large lighting departments that have extensive displays of fixtures. Many can arrange for a local contractor to do the installation. However, many consumers are taking on the project themselves or having some unlicensed handyman do the installation work.

The public inputs will propose to require that lighting outlets utilize listed WSCR and WSAF (locking support-type receptacles to connect to compatible attachment fittings) on luminaires and paddle fans. The use of the WSCR and WSAF simplify the replacement of luminaires and paddle fans. The use of the WSCR and WSAF limits the exposure to energized parts for future fixture replacements. Falls from ladders are a safety problem for professionals in the workplace. They are also a safety problem in the home. Simplifying the replacement process limits the time spent on ladders, and reduces the extended reach from higher ladder steps, minimizing the number of falls.

Fixtures have varying degrees of installation complexity and a variety of fastening means. There is also a lot of variety of degrees of assembly that is required. Some of assembly might take place on the ladder. With WSCR and WSAF, all of the assembly can take place off the ladder and the completed assembly can simply be raised into position and plugged in.

Renovation Statistics

The American Housing Survey, produced by the Census Bureau is generated every two years[1]. One of the many factors analyzed is home renovations. The survey analyzes professional and DIY renovations. The statistics appear to show a level percentage of DIY renovations out of the total number of renovations for each reporting period. Some renovations can easily be

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[1] *U. S. Census Bureau, American Housing Survey*. (n.d.). Retrieved July 20, 2020, from https://www.census.gov/programs-surveys/ahs/data/interactive/ahstablecreator.html?s_areas=00000&s_year=2011&s_tablename=TABLE16&s_bygroup1=24&s_bygroup2=1&s_filtergroup1=1&s_filtergroup2=1.

performed by the homeowner. Surprisingly, the statistics also show a fairly consistent percentage of electrical renovations that are DIY. Permits are rarely taken out for DIY equipment replacements or renovations. That is sometimes the case with flipped homes. As a result, DIY work is rarely inspected by jurisdictional electrical inspectors. Even when permits are taken out, there is no guarantee that the work will be performed by professionals or that it will be inspected. Many jurisdictions will only spot check the work of homeowners because inspections cost money and if there is no inspection, the jurisdiction can just collect the permit fee. For those who are classified as professional, how many of the practitioners are electricians? How many are just handymen? Figures 1 through 4 illustrate the percentages of home improvement projects for a two-year period ending in 2017, 2015, 2013, and 2011. Figure 5 illustrates all of the electrical home improvement projects reported by the survey from 2010 through 2017. The background data is in Annex A.

FIGURES 1-4: LARGE PERCENTAGE OF HOME IMPROVEMENTS DONE BY DIY'ers; "PROFESSIONALS" CAN INCLUDE PAINTERS AND HANDYMEN, NOT ALWAYS ELECTRICIANS.

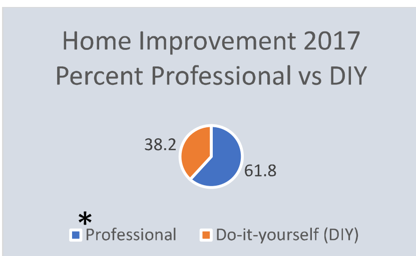


Figure 1.

* Professionals include handyman/painters/electricians

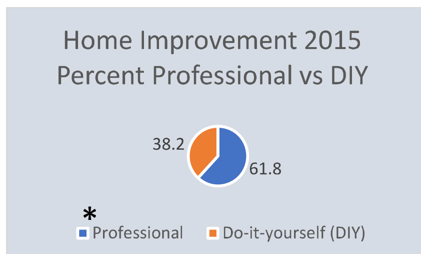


Figure 2.

* Professionals include handyman/painters/electricians

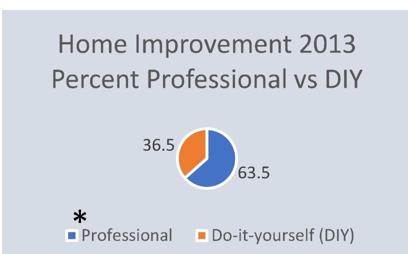


Figure 3.

* Professionals include handyman/painters/electricians

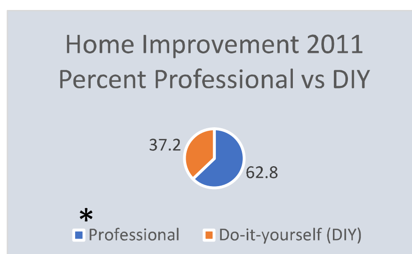
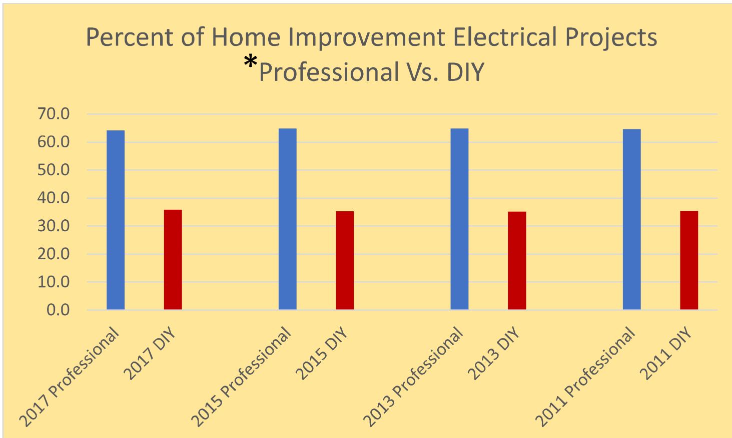


Figure 4.

* Professionals include handyman/painters/electricians

Electrical Home Improvement Projects

The number of people who are willing to do electrical work themselves has been a similar percentage to that of all DIY projects. It has also remained steady over the study periods of the survey. The raw statistics are included to provide a clearer picture of the types of home improvement projects undertaken. Many of the interior renovations likely include some electrical work, which may or may not be included separately as electrical work.



*Professionals include handyman/painters/electricians

Figure 5.

NFPA Residential Fire Statistics

NFPA estimates that 17,600 home fires in the US that are caused by faulty wiring connected with ceiling fans and lights (https://www.nfpa.org/-/media/Files/News-and-Research/Fire-statistics-and-reports/Building-and-life-safety/oshomes.pdf) The report notes "Electrical distribution or lighting equipment was the leading cause of home fire property damage. An average of 35,000 such fires caused 500 deaths; 1,130 injuries; and $1.4 billion in direct property damage per year. Wiring and related equipment accounted for 7 percent of all home fires and 10 percent of all home fire deaths. Cords or plugs were involved in only 1 percent of the fires but 6 percent of the deaths. Extension cords dominated the cord or plug category. More information is available in the NFPA report, *Electrical Fires*[2]."

[2] Campbell, R. (2019, March). *Electrical Fires* (Tech.). Retrieved July 20, 2020, from National Fire Protection Association website: https://www.nfpa.org/News-and-Research/Data-research-and-tools/Electrical/Electrical

The following table notes fire statistics for lighting and distribution equipment. This is a rather broad category. There is a separate category for ceiling fans. It appears that fans category includes bathroom vent fans. It may also include kitchen exhaust fans.

Table 5.
Home Fires Involving Electrical Failure or Malfunction as Factor Contributing to Ignition by Equipment Involved in Ignition, 2012-2016 Annual Averages

Equipment Involved	Fires		Civilian Deaths		Civilian Injuries		Direct Property Damage (in Millions)	
Electrical distribution and lighting equipment	**22,620**	**(50%)**	**310**	**(71%)**	**700**	**(56%)**	**$786**	**(62%)**
Wiring and related equipment	17,600	(39%)	190	(43%)	440	(35%)	$588	(46%)
Cord or plug	2,080	(5%)	100	(23%)	130	(11%)	$85	(7%)
Lamp, bulb or lighting	1,850	(4%)	10	(3%)	70	(5%)	$64	(5%)
Transformers and power supplies	1,080	(2%)	10	(2%)	60	(5%)	$49	(4%)

Later on, NFPA's *Electrical Fires* report contains the following table, which, for the same time period has different and larger numbers:

Table 14.
Home Fires Involving Electrical Distribution and Lighting Equipment, by Equipment Involved in Ignition 2012-2016 Annual Averages

Equipment Involved	Fires		Civilian Deaths		Civilian Injuries		Direct Property Damage (in Millions)	
Wiring and related equipment	24,780	(67%)	270	(55%)	640	(53%)	$853	(67%)
Lamp, bulb or lighting	4,970	(13%)	40	(9%)	200	(17%)	$164	(13%)
Cord or plug	3,330	(11%)	160	(33%)	230	(19%)	$143	(11%)
Transformers and power supplies	2,060	(9%)	20	(3%)	130	(11%)	$108	(9%)
Other known equipment involved in ignition	20	(0%)	0	(0%)	0	(0%)	$0	(0%)
Total	35,150	(100%)	490	(100%)	1,200	(100%)	$1,270	(100%)

Injury Reports

OSHA Reports. Falls from ladders are a frequent hazard. They happen in commercial and industrial settings as well as in residential situations. For example: in the OSHA electrocution training materials, an OSHA Fatal Fact is presented[3] that details a union electrician's death by electrocution during trouble shooting with lamps. The shock caused the electrician to fall off the ladder (OSHA Incident Report #0418800).[4]

Another example: in 2011, an electrician was electrocuted when the wires of a light fixture he was attempting to hang became stripped energizing the light fixture. As he grabbed one of the attached steel hanging cables, he received a fatal shock (OSHA Incident Report #0317700).[5] It is reasonable to conclude that this incident could have been avoided if the new technology receptacle/attachment fitting technology had been used because the fixture could not have become energized, as there would be no access to electricity through the disconnected fixture.

NIOSH Reports. The National Institute for Occupational Safety and Health (NIOSH) conducts the Fatal Accident Circumstances and Epidemiology (FACE) Project. Data are collected from a sample of fatal accidents, including electrical-related fatalities.

For example: NIOSH FACE Report 87-55[6] summarized a 1987 electrocution of a North Carolina electrician. While repairing a fluorescent light fixture over a kitchen sink in a single-family residence, a 33-year-old journeyman electrician was electrocuted when he contacted an energized wire on the load side of the ballast (400 volts). The ballast had been replaced. However, he could not get the light to operate properly. The electrician was sitting on the sink when he apparently contacted an energized wire on the load side of the ballast. The circuit had not been de-energized at the panel box or at the single-pole switch on the wall beside the sink.

It is reasonable to conclude that this incident might have been avoided if the WSCR/WSAF technology had been used. The receptacle would've already been installed, and the fixture could've been taken down through a simple quick disconnect for examination. If the fixture was determined to be in working order, additional work could be completed with the fixture

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[3] Construction Focus Four: Electrocution Hazards, Instructor Guide. OSHA Training Institute, OSHA Directorate of Training and Education, April 2011. Document can be found online at https://www.osha.gov/dte/outreach/construction/focus_four/electrocution/electr_ig.pdf

[4] OSHA Report ID: 0418800 can be found at https://www.osha.gov/pls/imis/establishment.inspection_detail?id=18396960

[5] OSHA Report ID: 0317700 can be found at https://www.osha.gov/pls/imis/establishment.inspection_detail?id=314163627[6] NIOSH Face Reports 1982 to 2005 including 87-55 can be found at http://wwwn.cdc.gov/NIOSH-FACE/Default.cshtml?state=ALL&Incident_Year=ALL&Category2=0006&Submit=Submit#.VFjs8y7-DK0.email. This particular report can be located directly at http://www.cdc.gov/niosh/face/In-house/full8755.html

[6] NIOSH Face Reports 1982 to 2005 including 87-55 can be found at http://wwwn.cdc.gov/NIOSH-FACE/Default.cshtml?state=ALL&Incident_Year=ALL&Category2=0006&Submit=Submit#.VFjs8y7-DK0.email. This particular report can be located directly at http://www.cdc.gov/niosh/face/In-house/full8755.html

[7] 2004 Electrocutions Associated with Consumer Products, By Matthew V. Hnatov. Hazard Analysis Division, Directorate for Epidemiology, Consumer Products Safety Commission. April 2009

quickly disconnected and out of the vicinity so full attention could be given to the wiring. If the new technology had been used, the electrocution might have been avoided.

CPSC Data. It is important to note that CPSC data includes only the data the CPSC becomes aware of, and it is understood that there are many other incidents that are not reported or do not come to their attention. Consumers are not obligated to report incidents to the CPSC. The research from the National Electronic Injury Surveillance System (NEISS) database from 2009 to 2013 included the following:

- CPSC estimates 4 electrocution deaths per year associated with lighting products.[7]
- There were 38 incidents involving the installation of light fixtures that resulted in hospital emergency room visits;
- 32 of those incidents involved falls and at least four of those incidents involved the victims being shocked.

With the new technology, after the receptacle is installed in the ceiling, there is no additional wiring necessary, no weight or bulk of the fixture during the initial receptacle installation, certainty of connection of the fixture to the equipment grounding conductor, and no shock hazard during the quick connect of the fixture. Without the weight/bulk, the falls may not have occurred. With the new technology receptacle in place, installation of the luminaire is a quick connect and no shock would have occurred.

- There were 418 incidents involving changing light bulbs that resulted in hospital emergency room visits;
- 390 involved falls and at least six of those incidents involved the victims being shocked.
- There were 9 additional incidents associated with cleaning the light fixture that resulted in hospital emergency room visits; 8 of those involved falls.

Many of these incidents could have been avoided or minimized if the new technology receptacle/attachment fitting technology had been used. The fixture is simply disconnected and any bulb or fixture maintenance or cleaning can be done on a table, not at an elevation, thereby reducing the time at an elevated level, thereby reducing the hazard.

- There were 55 incidents involving a luminaire falling from the ceiling onto the victim that resulted in hospital emergency room visits.

If the receptacle/attachment fitting (WSCR/WSAF) technology had been used, many of these incidents could have been avoided or minimized. The new technology must pass weight support requirements in the UL product safety standards well beyond what the NEC permits.

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[7] 2004 Electrocutions Associated with Consumer Products, By Matthew V. Hnatov. Hazard Analysis Division, Directorate for Epidemiology, Consumer Products Safety Commission. April 2009

The NEC does not permit the assembly to support a luminaire weighing more than 50 lbs or a ceiling fan weighing more than 70 lbs, therefore the fixtures would not fall.

CDC Data. According to the Centers for Disease Control and Prevention (CDC), falls are the number one cause of injury. From 2001-2017, there were 144,895,242 falls reported to CDC. During the same period, there were 443,576 deaths from falls. It is not unreasonable to assume that many of these falls involved working on a luminaire. Ladder related accidents are common. In addition, some will resort to stools, chairs, and chairs with boxes or books on them to get to the right height. Detailed information can be found in Annex B. There is little information on what the victims were doing when they fell.

In 1997, Industrial Safety and Hygiene News (ISHN) noted "According the American Academy of Orthopedic Surgeons, every year 500,000 people are treated for ladder-related injuries and approximately 300 of these incidents prove to be fatal. The Liberty Mutual Research Institute for Safety found that in 2007 alone, more than 400 people died as a result of falls on or from ladders or scaffolding[8].

Summary

When viewing data contained in the Annexes, it is important to note that there is no way to know the exact number of improper installations. For example, if there were one million annual installations of luminaires (it could be argued that there are significantly *more* annual installations per Annex A) and just 2% of them were improperly installed by an untrained do-it-yourselfers, that would result in 20,000 improperly installed luminaires.

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8 500,000 Falls from Ladders Annually; 97 Percent Occur at Home or on Farms. (July 6, 2017). *Industrial Safety and Hygiene News*. Retrieved July 20, 2020, from https://www.ishn.com/articles/106830-000-falls-from-ladders-annually-97-percent-occur-at-home-or-on-farms

Annex A. Home Renovations Reported in the American Housing Survey

Survey Notes: Estimates and Margins of Error in thousands of housing units, except as indicated. Medians are rounded to four significant digits as part of disclosure avoidance protocol. Margin of Error is calculated at the 90% confidence interval. Weighting consistent with Census 2010. Blank cells represent zero; Z rounds to zero; '.' Represents not applicable or no cases in sample; S represents estimates that did not meet publication standards or withheld to avoid disclosure.

Characteristics	Professional/Do-It-Yourself Total Estimate	Professional Estimate	Do-It-Yourself Estimate
HOME IMPROVEMENT ACTIVITY IN LAST TWO YEARS (2017)			
Total			
Number of projects (1,000)	113,155	69,975	43,181
Median expenditures ($)	1,364	2,408	600
Total expenditures (1,000)	450,089,818	368,366,827	81,722,991
Disaster Repairs			
Earthquake			
Number of projects (1,000)	S	S	S
Median expenditures ($)	S	S	300
Total expenditures (1,000)	S	S	S
Tornado/hurricane			
Number of projects (1,000)	418	303	115
Median expenditures ($)	7,000	7,000	S
Total expenditures (1,000)	4,490,105	3,276,862	S
Landslide			
Number of projects (1,000)	S	S	.
Median expenditures ($)	6,020	6,020	.
Total expenditures (1,000)	S	S	.
Fire			

Number of projects (1,000)	113	85	S
Median expenditures ($)	10,000	10,000	S
Total expenditures (1,000)	S	S	S
Flood			
Number of projects (1,000)	197	121	76
Median expenditures ($)	S	13,500	S
Total expenditures (1,000)	5,283,698	S	S
Other			
Number of projects (1,000)	867	734	133
Median expenditures ($)	9,500	10,500	3,800
Total expenditures (1,000)	10,898,601	10,190,039	708,562
Room Additions and Renovations			
Bedroom			
Number of projects (1,000)	419	184	235
Median expenditures ($)	7,000	23,000	2,000
Total expenditures (1,000)	7,289,971	6,000,692	1,289,280
Bath			
Number of projects (1,000)	274	162	112
Median expenditures ($)	6,400	10,000	4,000
Total expenditures (1,000)	3,258,882	2,493,137	765,746
Recreation Room			
Number of projects (1,000)	196	105	91
Median expenditures ($)	S	24,000	3,750
Total expenditures (1,000)	4,880,565	3,875,457	S
Kitchen			
Number of projects (1,000)	159	94	65
Median expenditures ($)	S	30,000	S
Total expenditures (1,000)	4,559,506	3,686,182	S
Other			

Number of projects (1,000)	827	444	383
Median expenditures ($)	6,500	12,500	S
Total expenditures (1,000)	13,508,584	11,125,843	2,382,741
Remodeling			
Bath			
Number of projects (1,000)	5,739	3,001	2,738
Median expenditures ($)	3,000	5,250	1,500
Total expenditures (1,000)	35,305,520	26,856,855	8,448,665
Kitchen			
Number of projects (1,000)	4,184	2,358	1,826
Median expenditures ($)	6,000	10,000	3,000
Total expenditures (1,000)	49,553,906	37,772,420	11,781,486
Exterior Additions and Replacements			
Attached garage/carport			
Number of projects (1,000)	736	389	347
Median expenditures ($)	2,800	4,500	2,200
Total expenditures (1,000)	6,120,015	4,365,016	1,754,999
Porch/deck/patio/terrace			
Number of projects (1,000)	3,331	1,798	1,533
Median expenditures ($)	2,500	4,400	1,000
Total expenditures (1,000)	18,805,519	14,757,663	4,047,856
Roofing			
Number of projects (1,000)	6,766	5,656	1,110
Median expenditures ($)	6,000	6,800	2,200
Total expenditures (1,000)	50,222,041	45,937,650	4,284,391
Siding			
Number of projects (1,000)	1,937	1,264	672
Median expenditures ($)	3,000	4,800	920

Total expenditures (1,000)	9,468,686	8,030,873	1,437,813
Windows/doors			
Number of projects (1,000)	7,443	4,799	2,644
Median expenditures ($)	1,400	2,300	500
Total expenditures (1,000)	24,777,309	21,119,910	3,657,399
Chimney/stairs/other exterior additions			
Number of projects (1,000)	1,531	1,087	444
Median expenditures ($)	1,072	1,440	480
Total expenditures (1,000)	3,856,308	3,133,861	722,448
Interior Additions and Replacements			
Insulation			
Number of projects (1,000)	2,712	1,451	1,261
Median expenditures ($)	750	1,250	400
Total expenditures (1,000)	3,886,216	2,948,857	937,359
Water pipes			
Number of projects (1,000)	3,014	1,792	1,221
Median expenditures ($)	550	1,000	200
Total expenditures (1,000)	4,549,002	3,972,440	576,562
Plumbing fixtures			
Number of projects (1,000)	8,192	3,924	4,268
Median expenditures ($)	400	700	250
Total expenditures (1,000)	10,766,188	8,227,445	2,538,743
Electrical wiring/fuse boxes/breaker switches			
Number of projects (1,000)	4,487	2,879	1,609
Median expenditures ($)	600	1,000	300
Total expenditures (1,000)	6,388,526	5,088,660	1,299,866
Security system			
Number of projects (1,000)	4,286	2,933	1,353

Median expenditures ($)	400	400	400
Total expenditures (1,000)	2,605,279	1,732,909	872,370
Flooring/carpeting/paneling/ceiling tiles			
Number of projects (1,000)	10,438	6,364	4,074
Median expenditures ($)	2,000	2,875	920
Total expenditures (1,000)	33,135,645	26,515,795	6,619,850
HVAC			
Number of projects (1,000)	9,930	8,571	1,359
Median expenditures ($)	3,600	4,000	2,000
Total expenditures (1,000)	43,413,330	39,616,745	3,796,585
Septic tank			
Number of projects (1,000)	355	300	55
Median expenditures ($)	3,000	3,000	S
Total expenditures (1,000)	1,474,779	1,387,439	S
Water heater/dishwasher/garbage disposal			
Number of projects (1,000)	14,569	8,457	6,113
Median expenditures ($)	500	700	400
Total expenditures (1,000)	10,813,487	7,882,752	2,930,735
Other interior			
Number of projects (1,000)	1,901	1,250	651
Median expenditures ($)	1,700	2,143	1,000
Total expenditures (1,000)	S	S	1,348,948
Lot or Yard Additions & Replacements			
Driveways/walkways			
Number of projects (1,000)	3,858	2,627	1,231
Median expenditures ($)	1,800	2,640	550
Total expenditures (1,000)	12,015,598	10,545,199	1,470,399
Fencing/walls			

Number of projects (1,000)	4,449	2,303	2,146
Median expenditures ($)	1,300	2,600	601
Total expenditures (1,000)	10,140,802	7,603,533	2,537,269
Swimming pool/tennis court/recreational structures			
Number of projects (1,000)	967	537	431
Median expenditures ($)	3,500	7,500	748
Total expenditures (1,000)	11,131,910	10,170,999	960,911
Shed/detached garage/other building			
Number of projects (1,000)	2,337	1,095	1,243
Median expenditures ($)	2,000	3,100	1,000
Total expenditures (1,000)	11,680,657	7,570,385	4,110,272
Landscaping/sprinkler system			
Number of projects (1,000)	5,541	2,279	3,262
Median expenditures ($)	900	2,000	500
Total expenditures (1,000)	13,390,741	9,353,303	4,037,438
Other			
Number of projects (1,000)	964	612	352
Median expenditures ($)	2,000	3,000	500
Total expenditures (1,000)	4,583,936	4,169,719	414,217

Characteristics	Professional/Do-It-Yourself Total Estimate	Professional Estimate	Do-It-Yourself Estimate
HOME IMPROVEMENT ACTIVITY IN LAST TWO YEARS (2015)			
Total			
Number of projects (1,000)	123,481	76,277	47,204
Median expenditures ($)	1,200	2,000	600
Total expenditures (1,000)	431,497,494	347,110,853	84,386,641
Disaster Repairs			
Earthquake			
Number of projects (1,000)	23	13	S
Median expenditures ($)	S	S	S
Total expenditures (1,000)	194,698	172,620	S
Tornado/hurricane			
Number of projects (1,000)	339	263	76
Median expenditures ($)	6,000	7,000	S
Total expenditures (1,000)	3,171,864	2,692,720	S
Lightning/fire			
Number of projects (1,000)	142	92	50
Median expenditures ($)	S	S	S
Total expenditures (1,000)	5,161,751	S	S
Flood			
Number of projects (1,000)	211	139	72
Median expenditures ($)	8,150	8,685	S
Total expenditures (1,000)	2,999,016	S	S
Other			
Number of projects (1,000)	823	708	115

Median expenditures ($)	8,550	9,000	3,000
Total expenditures (1,000)	10,029,780	9,309,961	S
Room Additions and Renovations			
Bedroom			
Number of projects (1,000)	516	259	257
Median expenditures ($)	5,000	17,000	2,000
Total expenditures (1,000)	10,997,017	8,903,760	2,093,257
Bath			
Number of projects (1,000)	303	162	141
Median expenditures ($)	S	10,000	2,500
Total expenditures (1,000)	3,463,143	2,847,832	615,311
Recreation Room			
Number of projects (1,000)	253	124	130
Median expenditures ($)	S	15,000	2,800
Total expenditures (1,000)	3,036,052	2,510,855	525,197
Kitchen			
Number of projects (1,000)	198	133	65
Median expenditures ($)	12,110	15,000	5,000
Total expenditures (1,000)	4,355,845	3,925,883	S
Other			
Number of projects (1,000)	861	453	408
Median expenditures ($)	5,000	8,000	2,000
Total expenditures (1,000)	9,920,768	7,905,575	2,015,193
Remodeling			
Bath			
Number of projects (1,000)	6,547	3,406	3,141
Median expenditures ($)	3,000	5,000	1,500
Total expenditures (1,000)	37,537,408	28,304,879	9,232,529

Kitchen			
Number of projects (1,000)	4,740	2,595	2,145
Median expenditures ($)	5,000	7,000	3,000
Total expenditures (1,000)	47,380,831	34,471,023	12,909,808
Exterior Additions and Replacements			
Attached garage/carport			
Number of projects (1,000)	717	403	314
Median expenditures ($)	4,000	5,000	2,500
Total expenditures (1,000)	5,304,691	3,745,563	1,559,127
Porch/deck/patio/terrace			
Number of projects (1,000)	3,616	1,953	1,663
Median expenditures ($)	2,500	4,000	1,200
Total expenditures (1,000)	18,899,196	14,824,455	4,074,741
Roofing			
Number of projects (1,000)	8,035	6,543	1,492
Median expenditures ($)	5,500	6,000	2,500
Total expenditures (1,000)	52,948,893	47,088,310	5,860,584
Siding			
Number of projects (1,000)	2,275	1,607	667
Median expenditures ($)	3,000	4,000	1,000
Total expenditures (1,000)	12,524,667	10,787,609	1,737,057
Windows/doors			
Number of projects (1,000)	8,693	5,580	3,114
Median expenditures ($)	1,500	2,000	600
Total expenditures (1,000)	27,257,002	22,199,593	5,057,410
Chimney/stairs/other exterior additions			
Number of projects (1,000)	1,479	983	496
Median expenditures ($)	1,050	1,500	450
Total expenditures (1,000)	3,427,485	2,944,792	482,694

Interior Additions and Replacements			
Insulation			
Number of projects (1,000)	3,531	1,862	1,669
Median expenditures ($)	750	1,200	400
Total expenditures (1,000)	4,991,329	3,779,128	1,212,201
Water pipes			
Number of projects (1,000)	3,540	2,080	1,461
Median expenditures ($)	500	900	200
Total expenditures (1,000)	5,259,795	4,233,234	1,026,561
Plumbing fixtures			
Number of projects (1,000)	9,116	4,313	4,804
Median expenditures ($)	400	550	250
Total expenditures (1,000)	9,667,129	6,882,298	2,784,831
Electrical wiring/fuse boxes/breaker switches			
Number of projects (1,000)	5,018	3,249	1,769
Median expenditures ($)	600	916	240
Total expenditures (1,000)	7,302,161	6,141,821	1,160,340
Security system			
Number of projects (1,000)	3,707	2,943	764
Median expenditures ($)	350	300	400
Total expenditures (1,000)	2,194,706	1,705,733	488,973
Flooring/carpeting/paneling/ceiling tiles			
Number of projects (1,000)	12,051	7,224	4,827
Median expenditures ($)	1,674	2,300	800
Total expenditures (1,000)	32,026,087	24,970,431	7,055,656
HVAC			
Number of projects (1,000)	10,301	8,915	1,387
Median expenditures ($)	3,150	3,429	1,800
Total expenditures (1,000)	40,379,006	36,507,489	3,871,517

Septic tank			
Number of projects (1,000)	387	319	68
Median expenditures ($)	3,000	3,000	900
Total expenditures (1,000)	1,584,211	1,255,016	S
Water heater/dishwasher/garbage disposal			
Number of projects (1,000)	15,838	9,316	6,522
Median expenditures ($)	500	700	400
Total expenditures (1,000)	11,087,649	7,899,118	3,188,531
Other interior			
Number of projects (1,000)	1,661	1,192	469
Median expenditures ($)	1,200	1,500	754
Total expenditures (1,000)	4,660,744	3,947,101	713,642
Lot or Yard Additions and Replacements			
Driveways/walkways			
Number of projects (1,000)	4,099	2,712	1,387
Median expenditures ($)	1,500	2,000	500
Total expenditures (1,000)	10,744,436	9,123,787	1,620,649
Fencing/walls			
Number of projects (1,000)	4,369	2,289	2,080
Median expenditures ($)	1,000	2,000	600
Total expenditures (1,000)	9,239,951	6,722,489	2,517,462
Swimming pool/tennis court/recreational structures			
Number of projects (1,000)	806	445	361
Median expenditures ($)	4,000	7,000	800
Total expenditures (1,000)	8,864,172	7,345,981	1,518,191
Shed/detached garage/other building			
Number of projects (1,000)	2,359	1,023	1,337
Median expenditures ($)	1,500	2,500	1,000

Total expenditures (1,000)	9,333,571	5,637,621	3,695,950
Landscaping/sprinkler system			
Number of projects (1,000)	6,096	2,467	3,630
Median expenditures ($)	800	2,000	500
Total expenditures (1,000)	12,123,260	8,640,867	3,482,393
Other			
Number of projects (1,000)	829	514	315
Median expenditures ($)	1,500	2,250	S
Total expenditures (1,000)	3,429,179	2,945,964	483,215

Characteristics	Professional/Do-It-Yourself Total Estimate	Professional Estimate	Do-It-Yourself Estimate
HOME IMPROVEMENT ACTIVITY IN LAST TWO YEARS (2013)			
Total			
Number of projects (1,000)	93,558	59,411	34,147
Median expenditures ($)	1,000	2,000	500
Total expenditures (1,000)	300,831,306	246,338,538	54,492,768
Remodeling			
Kitchen			
Number of projects (1,000)	2,954	1,700	1,253
Median expenditures ($)	5,000	6,200	3,000
Total expenditures (1,000)	26,626,680	18,827,473	7,799,207
Bath			
Number of projects (1,000)	4,064	2,168	1,896
Median expenditures ($)	2,500	4,000	1,500
Total expenditures (1,000)	18,685,777	13,962,662	4,723,115
Room Additions and Renovations			
Kitchen			
Number of projects (1,000)	45	34	11
Median expenditures ($)	35,000	35,821	15,000
Total expenditures (1,000)	1,584,009	1,441,692	142,317
Bath			
Number of projects (1,000)	546	293	253
Median expenditures ($)	5,000	8,221	3,000
Total expenditures (1,000)	4,600,965	3,556,359	1,044,605

Bedroom			
Number of projects (1,000)	907	451	456
Median expenditures ($)	3,343	8,500	1,600
Total expenditures (1,000)	12,578,231	10,045,582	2,532,649
Recreation Room			
Number of projects (1,000)	320	136	184
Median expenditures ($)	5,000	6,627	3,700
Total expenditures (1,000)	2,899,929	1,581,672	1,318,257
Other			
Number of projects (1,000)	1,624	798	826
Median expenditures ($)	3,500	6,866	1,848
Total expenditures (1,000)	14,945,765	11,958,530	2,987,235
Systems and Equipment			
Plumbing/pipes			
Number of projects (1,000)	2,767	1,716	1,051
Median expenditures ($)	500	800	200
Total expenditures (1,000)	3,604,401	3,009,925	594,475
Electrical system			
Number of projects (1,000)	3,716	2,409	1,307
Median expenditures ($)	500	800	200
Total expenditures (1,000)	4,269,937	3,549,517	720,420
Plumbing fixtures			
Number of projects (1,000)	6,881	3,437	3,444
Median expenditures ($)	331	500	200
Total expenditures (1,000)	5,957,561	4,210,317	1,747,244
HVAC			
Number of projects (1,000)	7,250	6,340	910
Median expenditures ($)	3,000	3,200	1,500
Total expenditures (1,000)	26,516,143	24,496,257	2,019,885

Appliances/major equipment			
Number of projects (1,000)	14,838	9,177	5,661
Median expenditures ($)	400	500	334
Total expenditures (1,000)	8,617,672	6,333,578	2,284,094
Exterior Additions and Replacements			
Roofing			
Number of projects (1,000)	5,851	4,876	975
Median expenditures ($)	5,000	5,500	1,800
Total expenditures (1,000)	36,079,462	33,223,391	2,856,071
Siding			
Number of projects (1,000)	1,677	1,219	458
Median expenditures ($)	3,000	4,200	500
Total expenditures (1,000)	7,437,346	6,749,185	688,161
Windows/doors			
Number of projects (1,000)	6,491	4,108	2,383
Median expenditures ($)	1,100	1,800	500
Total expenditures (1,000)	16,670,157	13,622,788	3,047,369
Interior Additions and Replacements			
Insulation			
Number of projects (1,000)	2,681	1,617	1,065
Median expenditures ($)	573	955	300
Total expenditures (1,000)	3,060,617	2,498,934	561,683
Flooring/paneling/ceiling			
Number of projects (1,000)	14,241	8,534	5,706
Median expenditures ($)	1,000	1,647	500
Total expenditures (1,000)	27,522,730	21,585,632	5,937,098
Other interior			
Number of projects (1,000)	1,761	1,236	524

Median expenditures ($)	1,200	1,500	800
Total expenditures (1,000)	5,620,345	4,070,664	1,549,681
Other Additions and Replacements			
Deck/porch			
Number of projects (1,000)	489	282	207
Median expenditures ($)	3,000	5,373	1,200
Total expenditures (1,000)	2,625,615	2,236,047	389,568
Patio/terrace/detached deck			
Number of projects (1,000)	2,737	1,534	1,203
Median expenditures ($)	2,000	3,500	1,000
Total expenditures (1,000)	11,324,775	9,034,084	2,290,691
Garage			
Number of projects (1,000)	94	73	21
Median expenditures ($)	18,000	24,000	500
Total expenditures (1,000)	2,206,566	2,140,830	65,736
Carport			
Number of projects (1,000)	94	58	37
Median expenditures ($)	1,400	2,269	500
Total expenditures (1,000)	440,123	381,558	58,565
Shed			
Number of projects (1,000)	1,547	746	801
Median expenditures ($)	1,400	2,500	800
Total expenditures (1,000)	8,344,883	6,885,567	1,459,315
Swimming pool/tennis court/recreational structures			
Number of projects (1,000)	628	359	269
Median expenditures ($)	3,000	5,075	600
Total expenditures (1,000)	4,951,069	4,436,168	514,901
Other exterior			
Number of projects (1,000)	7,548	4,620	2,928

Median expenditures ($)	1,500	2,000	500
Total expenditures (1,000)	19,708,734	16,325,326	3,383,408
Disaster Repairs			
Number of projects (1,000)	1,807	1,490	316
Median expenditures ($)	7,000	7,600	2,000
Total expenditures (1,000)	23,951,815	20,174,799	3,777,017
Other interior			
Number of projects (1,000)	1,661	1,192	469
Median expenditures ($)	1,200	1,500	754
Total expenditures (1,000)	4,660,744	3,947,101	713,642
Lot or Yard Additions and Replacements			
Driveways/walkways			
Number of projects (1,000)	4,099	2,712	1,387
Median expenditures ($)	1,500	2,000	500
Total expenditures (1,000)	10,744,436	9,123,787	1,620,649
Fencing/walls			
Number of projects (1,000)	4,369	2,289	2,080
Median expenditures ($)	1,000	2,000	600
Total expenditures (1,000)	9,239,951	6,722,489	2,517,462
Swimming pool/tennis court/recreational structures			
Number of projects (1,000)	806	445	361
Median expenditures ($)	4,000	7,000	800
Total expenditures (1,000)	8,864,172	7,345,981	1,518,191
Shed/detached garage/other building			
Number of projects (1,000)	2,359	1,023	1,337
Median expenditures ($)	1,500	2,500	1,000
Total expenditures (1,000)	9,333,571	5,637,621	3,695,950

Landscaping/sprinkler system			
Number of projects (1,000)	6,096	2,467	3,630
Median expenditures ($)	800	2,000	500
Total expenditures (1,000)	12,123,260	8,640,867	3,482,393
Other			
Number of projects (1,000)	829	514	315
Median expenditures ($)	1,500	2,250	S
Total expenditures (1,000)	3,429,179	2,945,964	483,215

Characteristics	Professional/Do-It-Yourself		
	Total	Professional	Do-It-Yourself
HOME IMPROVEMENT ACTIVITY IN LAST TWO YEARS (2011)			
Total			
Number of projects (1,000)	116,263	73,015	43,248
Median expenditures ($)[1]	1,000	1,999	500
Total expenditures (1,000)	348,536,558	287,026,972	61,509,586
Remodeling[2]			
Kitchen			
Number of projects (1,000)	3,608	2,081	1,527
Median expenditures ($)[1]	5,000	7,993	3,000
Total expenditures (1,000)	34,661,061	26,886,023	7,775,039
Bath			
Number of projects (1,000)	4,825	2,503	2,323
Median expenditures ($)[1]	2,500	4,000	1,500
Total expenditures (1,000)	22,723,885	16,388,045	6,335,840
Room Additions and Renovations[2]			
Kitchen			
Number of projects (1,000)	63	52	11
Median expenditures ($)[1]	27,353	30,000	8,000
Total expenditures (1,000)	1,830,275	1,683,443	146,832
Bath			
Number of projects (1,000)	713	392	321
Median expenditures ($)[1]	3,500	5,882	2,000
Total expenditures (1,000)	4,523,881	3,460,385	1,063,497
Bedroom			

Number of projects (1,000)	1,142	506	636
Median expenditures ($)	2,500	5,000	1,500
Total expenditures (1,000)	8,537,461	5,954,937	2,582,524
Recreation Room			
Number of projects (1,000)	490	202	288
Median expenditures ($)	3,000	6,882	1,600
Total expenditures (1,000)	3,486,584	2,662,713	823,871
Other			
Number of projects (1,000)	1,978	997	981
Median expenditures ($)	3,000	5,000	1,500
Total expenditures (1,000)	16,627,399	13,298,699	3,328,700
Systems and Equipment			
Plumbing/pipes			
Number of projects (1,000)	3,312	2,082	1,231
Median expenditures ($)	500	900	180
Total expenditures (1,000)	4,506,681	3,955,534	551,146
Electrical system			
Number of projects (1,000)	4,434	2,864	1,569
Median expenditures ($)	500	800	200
Total expenditures (1,000)	4,976,258	4,231,366	744,892
Plumbing fixtures			
Number of projects (1,000)	7,944	3,811	4,133
Median expenditures ($)	305	500	200
Total expenditures (1,000)	6,207,328	4,125,458	2,081,870
HVAC			
Number of projects (1,000)	9,574	8,365	1,209
Median expenditures ($)	3,000	3,176	1,500
Total expenditures (1,000)	33,214,557	30,498,058	2,716,499
Appliances/major equipment			

Number of projects (1,000)	17,913	11,276	6,637
Median expenditures ($)[1]	400	500	320
Total expenditures (1,000)	10,213,056	7,588,909	2,624,147
Exterior Additions and Replacements[2]			
Roofing			
Number of projects (1,000)	7,269	5,950	1,319
Median expenditures ($)[1]	4,800	5,276	1,807
Total expenditures (1,000)	42,534,922	38,896,570	3,638,351
Siding			
Number of projects (1,000)	2,154	1,444	710
Median expenditures ($)[1]	3,000	4,500	762
Total expenditures (1,000)	10,342,508	8,965,278	1,377,230
Windows/doors			
Number of projects (1,000)	8,676	5,629	3,047
Median expenditures ($)[1]	1,282	2,000	500
Total expenditures (1,000)	23,145,692	19,648,147	3,497,546
Interior Additions and Replacements[2]			
Insulation			
Number of projects (1,000)	4,085	2,116	1,970
Median expenditures ($)[1]	500	1,000	300
Total expenditures (1,000)	4,287,875	3,214,117	1,073,757
Flooring/paneling/ceiling			
Number of projects (1,000)	18,320	10,907	7,413
Median expenditures ($)[1]	1,000	1,510	500
Total expenditures (1,000)	31,910,709	25,087,900	6,822,809
Other interior			
Number of projects (1,000)	1,780	1,218	561
Median expenditures ($)[1]	1,000	1,500	500

Total expenditures (1,000)	4,129,829	3,416,024	713,805
Other Additions and Replacements[2]			
Deck/porch			
Number of projects (1,000)	505	287	217
Median expenditures ($)[1]	2,000	3,000	1,342
Total expenditures (1,000)	2,701,309	2,290,101	411,208
Patio/terrace/detached deck			
Number of projects (1,000)	3,500	1,835	1,665
Median expenditures ($)[1]	2,000	3,176	1,000
Total expenditures (1,000)	13,022,905	9,963,322	3,059,583
Garage			
Number of projects (1,000)	158	87	71
Median expenditures ($)[1]	15,000	20,250	5,000
Total expenditures (1,000)	2,621,310	2,165,996	455,314
Carport			
Number of projects (1,000)	158	82	76
Median expenditures ($)[1]	1,500	1,600	1,300
Total expenditures (1,000)	399,581	240,654	158,927
Shed			
Number of projects (1,000)	2,098	977	1,121
Median expenditures ($)[1]	1,429	2,600	800
Total expenditures (1,000)	8,599,423	5,927,181	2,672,242
Swimming pool/tennis court/recreational structures			
Number of projects (1,000)	713	414	300
Median expenditures ($)[1]	2,500	6,000	500
Total expenditures (1,000)	7,417,915	7,102,007	315,908
Other exterior			
Number of projects (1,000)	9,003	5,419	3,584
Median expenditures ($)[1]	1,247	2,000	500

Total expenditures (1,000)	22,898,421	18,263,708	4,634,713
Disaster Repairs			
Number of projects (1,000)	1,846	1,519	327
Median expenditures ($)	7,000	8,000	2,736
Total expenditures (1,000)	23,015,733	21,112,396	1,903,337
Other interior			
Number of projects (1,000)	1,661	1,192	469
Median expenditures ($)	1,200	1,500	754
Total expenditures (1,000)	4,660,744	3,947,101	713,642
Lot or Yard Additions & Replacements			
Driveways/walkways			
Number of projects (1,000)	4,099	2,712	1,387
Median expenditures ($)	1,500	2,000	500
Total expenditures (1,000)	10,744,436	9,123,787	1,620,649
Fencing/walls			
Number of projects (1,000)	4,369	2,289	2,080
Median expenditures ($)	1,000	2,000	600
Total expenditures (1,000)	9,239,951	6,722,489	2,517,462
Swimming pool/tennis court/recreational structures			
Number of projects (1,000)	806	445	361
Median expenditures ($)	4,000	7,000	800
Total expenditures (1,000)	8,864,172	7,345,981	1,518,191
Shed/detached garage/other building			
Number of projects (1,000)	2,359	1,023	1,337
Median expenditures ($)	1,500	2,500	1,000
Total expenditures (1,000)	9,333,571	5,637,621	3,695,950
Landscaping/sprinkler system			
Number of projects (1,000)	6,096	2,467	3,630

Median expenditures ($)	800	2,000	500
Total expenditures (1,000)	12,123,260	8,640,867	3,482,393
Other			
Number of projects (1,000)	829	514	315
Median expenditures ($)	1,500	2,250	S
Total expenditures (1,000)	3,429,179	2,945,964	483,215

Annex B - CDC Injury Data

2001 - 2017, United States
Fall Deaths and Rates per 100,000
All Races, Both Sexes, All Ages
ICD-10 Codes: W00-W19,X80,Y01,Y30

Number of Deaths	Population***	Crude Rate	Age-Adjusted Rate**
443,576	5,200,918,231	8.53	7.93

Reports for All Ages include those of unknown age.

* Rates based on 20 or fewer deaths may be unstable. Use with caution.

** Standard Population is 2000, all races, both sexes.

*** Population estimates are aggregated for multi-year reports to produce rates.

Produced by: National Center for Injury Prevention and Control, CDC
Data Source: NCHS Vital Statistics System for numbers of deaths. Bureau of Census for population estimates.

10 Leading Causes of Nonfatal Unintentional Emergency Department Visits, United States
2001 - 2017, All Races, Both Sexes, Disposition: All Cases

	Age Groups										
Rank	<1	1-4	5-9	10-14	15-24	25-34	35-44	45-54	55-64	65+	All Ages
1	Unintentional Fall 2,203,241	Unintentional Fall 14,695,505	Unintentional Fall 10,895,788	Unintentional Fall 10,193,254	Unintentional Struck by/ Against 16,379,505	Unintentional Fall 12,925,580	Unintentional Fall 12,965,891	Unintentional Fall 14,643,385	Unintentional Fall 13,392,906	Unintentional Fall 38,484,766	Unintentional Fall 144,895,252
2	Unintentional Struck by/ Against 533,293	Unintentional Struck by/ Against 6,058,063	Unintentional Struck by/ Against 6,868,690	Unintentional Struck by/ Against 9,721,402	Unintentional Fall 14,486,086	Unintentional Overexertion 11,152,537	Unintentional Overexertion 9,867,239	Unintentional Overexertion 7,534,235	Unintentional Struck by/ Against 4,040,364	Unintentional Struck by/ Against 4,271,311	Unintentional Struck by/ Against 74,260,233
3	Unintentional Other Bite/ Sting 211,421	Unintentional Other Bite/ Sting 2,496,959	Unintentional Cut/Pierce 1,921,531	Unintentional Overexertion 4,798,474	Unintentional MV-Occupant 12,889,729	Unintentional Struck by/ Against 10,888,727	Unintentional Struck by/ Against 8,646,276	Unintentional Struck by/ Against 6,849,399	Unintentional Overexertion 3,954,803	Unintentional Overexertion 3,338,390	Unintentional Overexertion 55,470,069
4	Unintentional Foreign Body 168,685	Unintentional Foreign Body 2,115,187	Unintentional Other Bite/ Sting 1,684,445	Unintentional Cut/Pierce 2,290,666	Unintentional Overexertion 12,057,868	Unintentional MV-Occupant 9,764,377	Unintentional MV-Occupant 7,404,124	Unintentional MV-Occupant 6,008,660	Unintentional MV-Occupant 3,674,071	Unintentional MV-Occupant 3,274,416	Unintentional MV-Occupant 46,257,031
5	Unintentional Fire/Burn 166,348	Unintentional Cut/Pierce 1,416,767	Unintentional Pedal Cyclist 1,438,614	Unintentional Pedal Cyclist 1,809,487	Unintentional Cut/Pierce 7,710,641	Unintentional Cut/Pierce 7,154,265	Unintentional Cut/Pierce 5,711,252	Unintentional Cut/Pierce 4,715,968	Unintentional Cut/Pierce 2,910,149	Unintentional Cut/Pierce 2,329,593	Unintentional Cut/Pierce 36,268,894
6	Unintentional Other Specified 134,502	Unintentional Overexertion 1,315,913	Unintentional Overexertion 1,354,807	Unintentional Unknown/ Unspecified 1,628,755	Unintentional Other Specified 4,030,764	Unintentional Other Specified 4,205,722	Unintentional Other Specified 4,087,399	Unintentional Other Specified 4,369,757	Unintentional Other Specified 2,336,522	Unintentional Other Bite/ Sting 1,433,760	Unintentional Other Specified 21,953,757
7	Unintentional Inhalation/ Suffocation 117,464	Unintentional Other Specified 932,167	Unintentional MV-Occupant 1,089,855	Unintentional MV-Occupant 1,437,342	Unintentional Other Bite/ Sting 2,956,648	Unintentional Other Bite/ Sting 2,807,584	Unintentional Poisoning 2,848,707	Unintentional Poisoning 3,189,281	Unintentional Poisoning 1,858,449	Unintentional Poisoning 1,409,344	Unintentional Other Bite/ Sting 18,634,091
8	Unintentional Cut/Pierce 106,012	Unintentional Fire/Burn 903,828	Unintentional Foreign Body 982,591	Unintentional Other Bite/ Sting 1,067,652	Unintentional Unknown/ Unspecified 2,697,889	Unintentional Poisoning 2,717,196	Unintentional Other Bite/ Sting 2,357,389	Unintentional Other Bite/ Sting 2,183,425	Unintentional Other Bite/ Sting 1,434,421	Unintentional Other Specified 1,124,089	Unintentional Poisoning 15,608,986
9	Unintentional Overexertion 94,101	Unintentional Poisoning 757,380	Unintentional Dog Bite 751,546	Unintentional Other Transport 903,792	Unintentional Poisoning 2,398,193	Unintentional Unknown/ Unspecified 1,865,642	Unintentional Unknown/ Unspecified 1,532,981	Unintentional Unknown/ Unspecified 1,303,370	Unintentional Unknown/ Unspecified 799,484	Unintentional Other Transport 1,096,837	Unintentional Unknown/ Unspecified 12,386,141
10	Unintentional Unknown/ Unspecified 90,681	Unintentional Unknown/ Unspecified 752,229	Unintentional Other Transport 689,682	Unintentional Dog Bite 598,757	Unintentional Other Transport 2,006,159	Unintentional Other Transport 1,563,933	Unintentional Other Transport 1,316,897	Unintentional Other Transport 1,149,322	Unintentional Other Transport 753,041	Unintentional Unknown/ Unspecified 1,054,400	Unintentional Foreign Body 9,979,708

National Center for Injury Prevention and Control, CDC

NEISS All Injury Program operated by the Consumer Product Safety Commission (CPSC).

Public Input No. 1120-NFPA 70-2020 [Section No. 410.36(B)]

(B) Suspended Ceilings.

Framing members of suspended ceiling systems used to support luminaires shall be securely fastened to each other and shall be securely attached to the building structure at appropriate intervals. Luminaires shall be ~~securely fastened to the ceiling framing member by mechanical means such as bolts, screws, or rivets. Listed clips identified for use with the type of ceiling framing member(s) and luminaire(s) shall also be permitted~~ supported independent of the grid support system and according to Article 300.11. Recessed lay-in type luminaires shall require a minimum of 2 grid wires per luminaire installed catty-corner to the luminaire. Flush and recessed can type luminaires shall require a minimum of one gride wire per luminaire. Other type luminaires shall require ample support and be installed according to manufacturer instructions. No luminaire or device may be supported by grid tile(s).

Exception: Exit light/egress luminaires and fire alarm devices shall be permitted to be supported by the grid support system .

Statement of Problem and Substantiation for Public Input

Presently, all electrical work installed above grid ceilings is required to be installed independent of the grid support system, other than luminaires. Luminaires should be supported independent of the grid support system, too. Many electricians have stores to tell about light fixtures crashing to the ground.

Often, grid tiles aren't substantial enough to support anything but themselves. Some tiles may have adequate strength but wording of this public input takes away job site debate. Code may address this enough already but direct NEC wording is needed.

Submitter Information Verification

Submitter Full Name:	Norman Feck
Organization:	State of Colorado
Street Address:	
City:	
State:	
Zip:	
Submittal Date:	Sun May 17 15:44:53 EDT 2020
Committee:	NEC-P18

Public Input No. 2650-NFPA 70-2020 [Section No. 410.36(G)]

(G) Trees.

Outdoor luminaires and associated equipment shall ~~be permitted to be~~ not be supported by trees.

Informational Note No. 1: See 225.26 for restrictions for support of overhead conductors.

Informational Note No. 2: See 300.5(D) for protection of conductors.

Statement of Problem and Substantiation for Public Input

Section 410.36(G) should be revised to not permit luminaires and associated equipment being supported by vegetation (trees). Section 225.26 currently prohibits outdoor branch circuits and feeders from being supported by vegetation. The 225.26 restriction currently permits an underground wiring method to be used for tree supported luminaires. Section 300.7(B) acknowledges that allowances shall be made for raceway expansion and contraction. Trees are living organisms that grow and will mostly likely destroy both conduit and conductors over time causing future safety hazards.

Submitter Information Verification

Submitter Full Name: William Gross

Organization: [Not Specified]

Street Address:

City:

State:

Zip:

Submittal Date: Thu Aug 27 00:50:35 EDT 2020

Committee: NEC-P18

Public Input No. 1720-NFPA 70-2020 [Section No. 410.40]

410.40 ~~General~~ Equipment Grounding Conductor .

Luminaires and lighting equipment shall be connected to an equipment grounding conductor ~~as required~~ in ~~Article 250 and Part V of this article.~~ accordance with 250.134.

Statement of Problem and Substantiation for Public Input

1. Revise the title to reflect the rule. We do not “ground” fixtures, we connect them to the circuit EGC.
2. Add the specific rule that contains the “connection” requirement.

Submitter Information Verification

Submitter Full Name: Mike Holt
Organization: Mike Holt Enterprises Inc
Street Address:
City:
State:
Zip:

Submittal Date: Thu Jun 25 15:03:15 EDT 2020
Committee: NEC-P18

Public Input No. 4220-NFPA 70-2020 [Section No. 410.40]

410.40 General.

Luminaires and lighting equipment shall be connected to an equipment grounding conductor as required in ~~Article~~ 250.112 and Part V of this article.

Statement of Problem and Substantiation for Public Input

Section 4.1.4 of the 2020 NEC(R) Style Manual prohibits references to an entire article, with the exception of Article 100. As such, it is proposed to revise the text to the specific section or part of the article to comply.

Submitter Information Verification

Submitter Full Name: Richard Holub

Organization: The DuPont Company, Inc.

Street Address:

City:

State:

Zip:

Submittal Date: Thu Sep 10 07:01:57 EDT 2020

Committee: NEC-P18

Public Input No. 1358-NFPA 70-2020 [Section No. 410.44]

410.44 Methods of Connection to the Equipment Grounding Conductor .

Luminaires and equipment shall be mechanically connected to an equipment grounding conductor as specified in 250.118 and sized in accordance with 250.122.

Exception No. 1: Replacement luminaires shall be permitted to connect an equipment grounding conductor in the same manner as replacement receptacles in compliance with 250.130(C). The luminaire shall then comply with 410.42.

Exception No. 2: Where no equipment grounding conductor exists at the outlet, replacement luminaires that are GFCI protected or do not have exposed conductive parts shall not be required to be connected to an equipment grounding conductor.

Statement of Problem and Substantiation for Public Input

According to the NFPA Style Manual, the Section Title needs to reflect the content of the rule. The rule is about the equipment grounding conductor, not about 'Grounding.'

Submitter Information Verification

Submitter Full Name: Mike Holt

Organization: Mike Holt Enterprises Inc

Street Address:

City:

State:

Zip:

Submittal Date: Mon Jun 01 17:45:58 EDT 2020

Committee: NEC-P18

Public Input No. 1384-NFPA 70-2020 [Section No. 410.46]

410.46 Equipment Grounding Conductor Attachment.

Luminaires with exposed metal parts shall be provided with a means for connecting an equipment grounding conductor, _ unless the exposed metal parts are separated from all live parts by a listed system of double insulation, are small isolated parts, or are part of a portable luminaire with a polarized attachment plug, as permitted in 410 . 42.

Statement of Problem and Substantiation for Public Input

Present wording of Section 410.46 conflicts with Section 410.42. Specifically, Section 410.42 specifies three conditions when an exposed conductive part is not required to be connected to an equipment grounding conductor: 1) When separated by a listed system of double insulation, 2) When the part is a small, isolated part, and 3) If part of a portable luminaire with a polarized attachment plug. This proposal resolves this conflict by identifying those conditions covered by 410.42 that would not require attachment to an equipment grounding conductor and providing a reference to the requirements in 410.42.

Submitter Information Verification

Submitter Full Name: Charles Kurten
Organization: UL LLC
Street Address:
City:
State:
Zip:
Submittal Date: Tue Jun 02 08:52:59 EDT 2020
Committee: NEC-P18

Public Input No. 4221-NFPA 70-2020 [Section No. 410.52]

410.52 Conductor Insulation.

Luminaires shall be wired with conductors having insulation suitable for the environmental conditions, current, voltage, and temperature to which the conductors will be subjected.

~~Informational Note: For ampacity of fixture wire, maximum operating temperature, voltage limitations, minimum wire size, and other information, see Article 402 .~~

Statement of Problem and Substantiation for Public Input

Section 4.1.4 of the 2020 NEC(R) Style Manual prohibits references to an entire article, with the exception of Article 100. As such, it is proposed to delete this informational note and if the CMP wishes to make reference to another article, they do so with an "Other Articles" section using a table as prescribed by Sections 2.5 and 2.3 of the Style Manual.

Submitter Information Verification

Submitter Full Name: Richard Holub
Organization: The DuPont Company, Inc.
Street Address:
City:
State:
Zip:

Submittal Date: Thu Sep 10 07:04:58 EDT 2020
Committee: NEC-P18

Public Input No. 1231-NFPA 70-2020 [Section No. 410.56(D)]

(D) Splices and Taps.

No unnecessary splices or taps shall be made within or on a luminaire.

Informational Note: For approved means of making connections, see 110.14.

<u>The language "No unnecessary splices or taps shall be made within or on a luminaire." The use of term "unnecessary" is inherently vague and subjective. Perhaps a degree of vagueness is necessary, if this is the case add language that the AHJ shall determine if a splice or tap is unnecessary.</u>

Statement of Problem and Substantiation for Public Input

The language "No unnecessary splices or taps shall be made within or on a luminaire." The use of term "unnecessary" is inherently vague and subjective. Perhaps a degree of vagueness is necessary, if this is the case add language that the AHJ shall determine if a splice or tap is unnecessary.

Submitter Information Verification

Submitter Full Name:	Gary Hein
Organization:	Submission is independent of employer.
Street Address:	
City:	
State:	
Zip:	
Submittal Date:	Sat May 23 12:10:48 EDT 2020
Committee:	NEC-P18

Public Input No. 2954-NFPA 70-2020 [Section No. 410.62(A)]

(A) Lampholders.

Where a metal lampholder is attached to a flexible cord, the inlet shall be equipped with an insulating bushing that, if threaded, is not smaller than metric designator 12 (trade size $^{3}/_{8}$) ~~pipe~~ raceway size. The cord hole shall be of a size appropriate for the cord, and all burrs and fins shall be removed in order to provide a smooth bearing surface for the cord.

Bushing having holes 7 mm ($^{9}/_{32}$ in.) in diameter shall be permitted for use with plain pendant cord and holes 11 mm ($^{13}/_{32}$ in.) in diameter with reinforced cord.

Statement of Problem and Substantiation for Public Input

Change the word 'pipe' to raceway...

Submitter Information Verification

Submitter Full Name: Mike Holt
Organization: Mike Holt Enterprises Inc
Street Address:
City:
State:
Zip:
Submittal Date: Thu Sep 03 13:46:43 EDT 2020
Committee: NEC-P18

Public Input No. 1475-NFPA 70-2020 [New Section after 410.62(C)(1)]

TITLE OF NEW CONTENT

(d) Cord connected Luminaries shall comply with the provisions of 400.10, Uses Permitted and 400.12, Uses Not Permitted

Statement of Problem and Substantiation for Public Input

Adding a (d) will give reference back to 400.10 and 400.12. There are LED Luminaries that are entering the market promoted for mobility and office flexibility for arrangement of the furniture that are to be daisy changed together, are not located below an outlet and supported from the cords structure of a a building. There should be a reference about the cords complying with 400.10 and 400.12. A cord application for a Luminaire should reference to the same Uses Permitted and Uses Not Permitted.

Submitter Information Verification

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Submittal Date: Sun Jun 07 00:52:30 EDT 2020
Committee: NEC-P18

Public Input No. 1023-NFPA 70-2020 [Section No. 410.116(A)]

(A) Clearance From Combustible Material .

(1) Non-Type IC.

A recessed luminaire that is not identified for contact with insulation shall have all recessed parts spaced not less than 13 mm (½ in.) from combustible materials. The points of support and the trim finishing off the openings in the ceiling, wall, or other finished surface shall be permitted to be in contact with combustible materials.

(2) Type IC.

A recessed luminaire that is identified for contact with insulation, Type IC, shall be permitted to be in contact with combustible materials at recessed parts, points of support, and portions passing through or finishing off the opening in the building structure.

Statement of Problem and Substantiation for Public Input

This title more adequately defines the subsection since 410.116(B) also talks of clearances.

Related Public Inputs for This Document

Related Input	Relationship
Public Input No. 1024-NFPA 70-2020 [Section No. 410.116(B)]	
Public Input No. 1024-NFPA 70-2020 [Section No. 410.116(B)]	

Submitter Information Verification

Submitter Full Name: Nick Sasso
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City:
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Zip:
Submittal Date: Mon May 11 12:14:02 EDT 2020
Committee: NEC-P18

Public Input No. 1024-NFPA 70-2020 [Section No. 410.116(B)]

(B) ~~Installation~~ Clearance From Thermal Insulation .

Thermal insulation shall not be installed above a recessed luminaire or within 75 mm (3 in.) of the recessed luminaire's enclosure, wiring compartment, ballast, transformer, LED driver, or power supply unless the luminaire is identified as Type IC for insulation contact.

Statement of Problem and Substantiation for Public Input

This title more adequately defines the subsection since 410.116(A) also talks of clearances.

Related Public Inputs for This Document

Related Input	Relationship
Public Input No. 1023-NFPA 70-2020 [Section No. 410.116(A)]	
Public Input No. 1023-NFPA 70-2020 [Section No. 410.116(A)]	

Submitter Information Verification

Submitter Full Name: Nick Sasso
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Submittal Date: Mon May 11 12:18:23 EDT 2020
Committee: NEC-P18

Public Input No. 2622-NFPA 70-2020 [Section No. 410.130(G)(1)]

(1) General.

In indoor locations other than dwellings and associated accessory structures, ~~fluorescent~~ LED luminaire drivers and fluorescent luminaires that utilize double-ended lamps and contain ballast(s) that can be serviced in place shall have a disconnecting means either internal or external to each luminaire. For existing installed luminaires without disconnecting means, at the time a ballast ~~is~~ or LED driver is replaced, a disconnecting means shall be installed. The line side terminals of the disconnecting means shall be guarded.

Exception No. 1: A disconnecting means shall not be required for luminaires installed in hazardous (classified) location(s).

Exception No. 2: A disconnecting means shall not be required for luminaires that provide emergency illumination required in 700.16.

Exception No. 3: For cord-and-plug-connected luminaires, an accessible separable connector or an accessible plug and receptacle shall be permitted to serve as the disconnecting means.

Exception No. 4: Where more than one luminaire is installed and supplied by other than a multiwire branch circuit, a disconnecting means shall not be required for every luminaire when the design of the installation includes disconnecting means, such that the illuminated space cannot be left in total darkness.

Statement of Problem and Substantiation for Public Input

This input is being submitted on behalf of the Minnesota Department of Labor and Industry. The Department’s 15 office/field staff, and 65 plus contract electrical inspectors complete over 150,000 electrical inspections annually and are involved in the daily enforcement and interpretation of the National Electrical Code.

In the 2005 NEC the disconnect requirement for fluorescent luminaires (for other than dwellings) was added. Today, the same hazards exist when we have LED drivers installed in luminaires. See 18-93 Log# 3421 – 2005 ROP.

Because many of the LED luminaires are being installed as a part of a retrofit, changing the driver out, or hardwiring the end sockets while the circuit feeding the luminaire is energized is a regular practice. For many reasons, maintenance individuals, and electricians do not disconnect the power while servicing. In some cases, the circuit may not be properly identified or at all, also when the circuit is de-energized the room becomes dark or the circuit may feed a large area and would create interruptions. As long as this is perceived as an acceptable practice, then progress in electrical safety will be slowed. Work practices alone will not change the electrical safety culture. Safety standards such as the NEC must provide equipment requirements that safeguard individuals who are exposed to the hazards of electricity while maintaining that equipment.

Submitter Information Verification

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Submittal Date:	Wed Aug 26 08:34:55 EDT 2020
Committee:	NEC-P18

Public Input No. 4222-NFPA 70-2020 [Section No. 410.137(C)]

(C) Wired Luminaire Sections.

Wired luminaire sections are paired, with a ballast(s) or LED driver(s) supplying a light source or light sources in both. For interconnection between paired units, it shall be permissible to use metric designator 12 (trade size ⅜) flexible metal conduit in lengths not exceeding 7.5 m (25 ft), installed in ~~conformance~~ accordance with Part II of Article 348. Luminaire wire operating at line voltage, supplying only the ballast(s) or LED driver(s) of one of the paired luminaires, shall be permitted in the same raceway as the light source supply wires of the paired luminaires where the voltage rating of the light source supply wires is greater than the line voltage.

Statement of Problem and Substantiation for Public Input

Section 4.1.4 of the 2020 NEC(R) Style Manual prohibits references to an entire article, with the exception of Article 100. As such, it is proposed to revise the text to the specific part of the article to comply.

Submitter Information Verification

Submitter Full Name: Richard Holub

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Submittal Date: Thu Sep 10 07:09:09 EDT 2020

Committee: NEC-P18

Public Input No. 4225-NFPA 70-2020 [Section No. 410.140(D)]

(D) Additional Requirements.

In addition to complying with the general requirements for luminaires, such equipment shall comply with Part XIII of this article.

Informational Note: ~~For~~ See 600.1 for electric signs and outline lighting~~, see Article 600~~ ..

Statement of Problem and Substantiation for Public Input

Section 4.1.4 of the 2020 NEC(R) Style Manual prohibits references to an entire article, with the exception of Article 100. As such, it is proposed to revise the text to point to the scope of the article to comply. Additionally, it is reordered to comply with 4.1.3 of the 2020 NEC(r) Style Manual.

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Submittal Date: Thu Sep 10 07:14:42 EDT 2020
Committee: NEC-P18

Public Input No. 1359-NFPA 70-2020 [Section No. 410.155(B)]

(B) Equipment Grounding Conductor .

Lighting track shall be ~~grounded~~ connected to the circuit equipment grounding conductor in accordance with Article 250, and the track sections shall be securely coupled to maintain continuity of the circuitry, polarization, and grounding throughout.

Statement of Problem and Substantiation for Public Input

No. 1. According to the NFPA Style Manual, the Section Title needs to reflect the content of the rule. The rule is about the equipment grounding conductor, not about 'Grounding.'
No. 2 Text revised to make it clear that we the rule is about the connection to the equipment grounding conductor, not 'ground.'

Submitter Information Verification

Submitter Full Name: Mike Holt
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Submittal Date: Mon Jun 01 17:48:30 EDT 2020
Committee: NEC-P18

Public Input No. 4226-NFPA 70-2020 [Section No. 410.155(B)]

(B) Grounding.

Lighting track shall be grounded in accordance with Part VI of Article 250, and the track sections shall be securely coupled to maintain continuity of the circuitry, polarization, and grounding throughout.

Statement of Problem and Substantiation for Public Input

Section 4.1.4 of the 2020 NEC(R) Style Manual prohibits references to an entire article, with the exception of Article 100. As such, it is proposed to revise the text to the specific part of the article to comply.

Submitter Information Verification

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Submittal Date: Thu Sep 10 07:22:23 EDT 2020

Committee: NEC-P18

Public Input No. 811-NFPA 70-2020 [Section No. 410.160]

~~**410.160** Listing of Decorative Lighting.~~

~~Decorative lighting and similar accessories used for holiday lighting and similar purposes, in accordance with 590.3(B) , shall be listed.~~

Statement of Problem and Substantiation for Public Input

This matter is already covered in 410.6.

Submitter Information Verification

Submitter Full Name:	Ryan Jackson
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Submittal Date:	Mon Mar 30 15:54:58 EDT 2020
Committee:	NEC-P18

Public Input No. 812-NFPA 70-2020 [Section No. 410.172]

~~**410.172** Listing.~~

~~Lighting equipment identified for horticultural use shall be listed.~~

Statement of Problem and Substantiation for Public Input

410.6 covers this.

Submitter Information Verification

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Committee:	NEC-P18

Public Input No. 813-NFPA 70-2020 [Section No. 410.174]

~~**410.174** Installation and Use.~~

~~Lighting equipment identified for horticultural use shall be installed and used in accordance with the manufacturer's installation instructions and installation markings on the equipment as required by that listing.~~

Statement of Problem and Substantiation for Public Input

110.3(B) covers this.

Submitter Information Verification

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Submittal Date:	Mon Mar 30 15:57:19 EDT 2020
Committee:	NEC-P18

Public Input No. 814-NFPA 70-2020 [Section No. 410.180]

~~**410.180** Fittings and Connectors.~~

~~Fittings and connectors attached to flexible cords shall be provided as part of a listed horticultural lighting equipment device or system and installed in accordance with the instructions provided as part of that listing.~~

Statement of Problem and Substantiation for Public Input

410.6 and 110.3(B) cover this.

Submitter Information Verification

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Submittal Date: Mon Mar 30 15:58:27 EDT 2020

Committee: NEC-P18

Public Input No. 4228-NFPA 70-2020 [Section No. 410.182]

410.182 Grounding.

Lighting equipment identified for horticultural use shall be grounded as required in Part VI of Article 250 and Part V of this article.

Statement of Problem and Substantiation for Public Input

Section 4.1.4 of the 2020 NEC(R) Style Manual prohibits references to an entire article, with the exception of Article 100. As such, it is proposed to revise the text to the specific part of the article to comply.

Submitter Information Verification

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Submittal Date: Thu Sep 10 07:24:03 EDT 2020

Committee: NEC-P18

Public Input No. 815-NFPA 70-2020 [Section No. 410.182]

~~**410.182** Grounding.~~

~~Lighting equipment identified for horticultural use shall be grounded as required in Article 250 and Part V of this article.~~

Statement of Problem and Substantiation for Public Input

90.3 covers this.

Submitter Information Verification

Submitter Full Name:	Ryan Jackson
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Submittal Date:	Mon Mar 30 15:59:06 EDT 2020
Committee:	NEC-P18

Public Input No. 3748-NFPA 70-2020 [Section No. 410.184]

410.184 Ground-Fault Circuit-Interrupter Protection.

Lighting equipment identified for horticultural use employing flexible cord(s) with one or more ~~conductors~~ connectors shall be supplied by lighting outlets protected by a listed ground-fault circuit interrupter.

Statement of Problem and Substantiation for Public Input

When Part XVI was added, the word "connector" was replaced with "conductor" in the 2nd draft. However, "connector" was the correct term. Luminaires with "hard-wired" flexible cord connection, such as adjustable floodlight luminaires installed in compliance with 410.62 (B), are not required to be provided with GFCI protection. The combination of flexible cord with connectors was the construction that was the focus here. Because FCC regulations, EMI filters are required on electronic power supplies, drivers, and ballasts, to shunt high frequencies to ground. These filtered portions appear as leakage current. In sufficient quantities, such electronic loads connected to a GFCI protected circuit could cause tripping of the GFCI, due to the additive nature of the individual leakage currents. So it is important to limit the requirement to situations that warrant extra protection.

Submitter Information Verification

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Submittal Date:	Wed Sep 09 11:44:15 EDT 2020
Committee:	NEC-P18

Public Input No. 4359-NFPA 70-2020 [Section No. 410.184]

410.184 Ground-Fault Circuit-Interrupter Protection.

Lighting equipment identified for horticultural use employing flexible cord(s) with one or more conductors shall be supplied by lighting outlets protected by a listed ground-fault circuit interrupter.

Exception: Where the lighting equipment is supplied by a 480- or 277-volt circuit, it shall be permissible to install ground fault protection for equipment.

Statement of Problem and Substantiation for Public Input

It appears that during the deliberations for the 2020 NEC cycle the discussions regarding the requirement to provide GFCI protection for horticultural lighting employing flexible cords only considered 120-volt lighting circuits. However, due to the amount of power consumed by 120-volt lighting systems and the sophisticated nature of modern horticultural lighting, is it desirable to use 277-volt lighting branch circuits from a 480-volt, three phase, system. During a recent inspection of the electrical installation for a new horticultural facility under the 2020 NEC, it was realized there were no products available at the 277-volt level to comply with the GFCI protection requirement. Subsequently it was learned that UL 943, UL Standard for Safety Ground-Fault Circuit-Interrupters, does not cover 277-volt devices. Rather than exempt the additional safety requirement completely, although GFPE is not personnel protection, it was included in the exception for consideration as the product is available.

Submitter Information Verification

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Committee:	NEC-P18

Public Input No. 816-NFPA 70-2020 [Section No. 410.184]

410.184 Ground-Fault Circuit-Interrupter Protection.

~~Lighting equipment identified~~ Outlets for horticultural ~~use employing~~ lighting equipment supplied by flexible cord ~~(s) with one or more conductors~~ shall be ~~supplied by lighting outlets~~ protected by a listed ground-fault circuit interrupter.

Statement of Problem and Substantiation for Public Input

This should be viewed as editorial in natures (obviously a flexible cord has one or more conductors).

Submitter Information Verification

Submitter Full Name:	Ryan Jackson
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Submittal Date:	Mon Mar 30 15:59:53 EDT 2020
Committee:	NEC-P18

Public Input No. 328-NFPA 70-2020 [Section No. 410.186]

410.186 Support.

~~Special fittings~~ Fittings identified for support of horticultural lighting equipment shall be designed specifically for the horticultural lighting equipment on which they are installed ~~and~~ , shall be used in accordance with the installation instructions provided and shall be securely fastened.

Statement of Problem and Substantiation for Public Input

The word "special' is vague, unenforceable and does not support the requirement for the fittings to be identified. Grammatical revisions are also suggested by the removal of "and" in the sentence.

The NEC Style Manual states:
Paragraph 1.3 Regulatory Adoption
Because the NEC is intended to be suitable for adoption as a regulatory document, it is important that it contain clearly stated mandatory requirements in the Code text.

Paragraph 3.2.1 Unenforceable Terms
The NEC shall not contain references or requirements that are unenforceable or vague.

Submitter Information Verification

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Submittal Date: Tue Jan 21 12:26:06 EST 2020
Committee: NEC-P18

Public Input No. 817-NFPA 70-2020 [Section No. 410.186]

~~**410.186** Support.~~

~~Special fittings identified for support of horticultural lighting equipment shall be designed specifically for the horticultural lighting equipment on which they are installed and shall be used in accordance with the installation instructions provided and shall be securely fastened.~~

Statement of Problem and Substantiation for Public Input

This section tells me how to design "special fittings." Again, 410.6 and 110.3(B) cover the issue.

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Submittal Date:	Mon Mar 30 16:02:23 EDT 2020
Committee:	NEC-P18

Public Input No. 3694-NFPA 70-2020 [New Section after 410.188]

Special provisions for ultraviolet germicidal irradiation luminaires

See attached word file for proposed new text.

Additional Proposed Changes

File Name	Description	Approved
NEC_PI_for_UV_Disinfection_MOBoyle_Sept_9_2020.docx	NEW Article 410 Part. XVII Special Provisions for Ultraviolet Germicidal Irradiation Luminaires	

Statement of Problem and Substantiation for Public Input

UV radiation has been used to disinfect air, water, and surfaces for many years. Prompted by recent public health concerns, there has been an increased interest implementing:

- UV upper-air disinfection systems, where UV is applied in the upper portion of a room, above occupied space, and
- UV systems that apply direct surface & air UV disinfection only when the treated space is not occupied during the UV disinfection process,

Safety standard requirements addressing these applications are now available for:

- UL1598 – Standard for Safety, Luminaires.
- UL8802, Outline of Investigation for Germicidal Systems, and
- UL8750, LED Equipment

These product safety requirements address possible eye and skin/damage, in addition to traditional electrical & mechanical hazards. Ultraviolet germicidal irradiation luminaires, and any associated safeguard systems, must be designed and installed correctly. Product listings anticipate that correct site planning and installation will occur. Accordingly, it is very important that all installation instructions and markings provided by the equipment manufacturer, and prescribed by the product listing, be followed.

Submitter Information Verification

Submitter Full Name: Michael O`Boyle
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Submittal Date: Wed Sep 09 10:59:04 EDT 2020
Committee: NEC-P18

NEW Part. XVII Special Provisions for Ultraviolet Germicidal Irradiation Luminaires

410.190 General

410.191 Listing. Luminaires intended to emit ultraviolet radiation for germicidal purposes shall be listed and identified for the purpose.

410.193 Installation and Use.

(A) Installation - Luminaires intended to emit ultraviolet radiation shall be installed in accordance with the manufacturer's installation instructions and equipment markings.

(B) Maintenance – Luminaires intended to emit ultraviolet radiation shall be maintained in accordance with the manufacturer instructions and industry standards.

410.195 Locations Not Permitted.

(A) General Lighting. Luminaires intended to emit ultraviolet radiation shall not be installed as lighting for general illumination unless such use is indicated in the manufacturer's instructions.

(B) Installed Location. Luminaires intended to emit ultraviolet radiation shall not be installed where likely to be subject to physical damage.

(C) Dwellings. Luminaires intended to emit ultraviolet radiation shall not be installed in a dwelling unless listed and identified for use in dwellings.

(D) Mounting Height. Luminaires intended to emit ultraviolet radiation, installed in a building space that will be occupied during luminaire operation, shall be mounted not less than 2.1m (7ft.) above the finished floor, unless specifically listed for a lower installation height.

410.197 Ultraviolet Germicidal Irradiation Systems.

(A) Listing. An ultraviolet germicidal irradiation system, intended to provide a safeguard against UV exposure by ensuring that a building space will not be occupied during luminaire operation, shall be listed, and identified for the purpose.

(B) System Components. An ultraviolet germicidal irradiation system shall be provided with all components needed to complete an installation. A system assembled from listed parts identified for the use shall be permitted.

(C) Luminaires. Luminaires intended to be controlled by an ultraviolet germicidal system shall be identified for the **purpose.**

(D) Installation and Use. An ultraviolet germicidal irradiation system shall be installed in accordance with the manufacturer's installation instructions and installation markings on the equipment.

(E) Maintenance –An ultraviolet germicidal irradiation system shall be maintained in accordance with the manufacturer instructions and industry standards.

(F) Dwellings. An ultraviolet germicidal irradiation system shall not be installed in a dwelling unless listed and identified for use in dwellings.

Public Input No. 4229-NFPA 70-2020 [Section No. 410.188]

410.188 Hazardous (Classified) Locations.

Where installed in hazardous (classified) locations, horticultural lighting equipment shall conform to ~~Articles 500 through 517~~ the hazardous location requirements in addition to this article.

Statement of Problem and Substantiation for Public Input

Section 4.1.4 of the 2020 NEC(R) Style Manual prohibits references to an entire article, with the exception of Article 100. As such, it is proposed to revise the text to "hazardous location requirements" to comply. It is recommended that this PI also be submitted to CMP14 for information and/or comment.

Submitter Information Verification

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Submittal Date:	Thu Sep 10 07:25:04 EDT 2020
Committee:	NEC-P18

Public Input No. 818-NFPA 70-2020 [Section No. 410.188]

~~**410.188** Hazardous (Classified) Locations.~~

~~Where installed in hazardous (classified) locations, horticultural lighting equipment shall conform to Articles 500 through 517 in addition to this article.~~

Statement of Problem and Substantiation for Public Input

90.3 already covers this.

Submitter Information Verification

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Submittal Date: Mon Mar 30 16:03:29 EDT 2020
Committee: NEC-P18

Public Input No. 1703-NFPA 70-2020 [Article 411]

Article 411 Extra- Low-Voltage Lighting

411.1 Scope.

This article covers lighting systems and their associated components operating at no more than 30 volts ac or 60 volts dc. Where wet contact is likely to occur, the limits are 15 volts ac or 30 volts dc.

Informational Note: Refer to Article 680 for applications involving immersion.

411.3 Extra- Low-Voltage Lighting Systems.

~~Low~~ Extra-low voltage lighting systems shall consist of an isolating power supply, extra- low-voltage luminaires, and associated equipment that are all identified for the use. The output circuits of the power supply shall be rated for 25 amperes maximum under all load conditions.

411.4 Listing Required.

~~Low~~ Extra -low- voltage lighting systems shall comply with 411.4(A) or (B). Listed extra- low-voltage lighting systems or a lighting system assembled from listed parts shall not be permitted to be reconditioned.

(A) Listed System.

The luminaires, power supply, and luminaire fittings (including the exposed bare conductors) of an exposed bare conductor lighting system shall be listed for the use as part of the same identified lighting system.

(B) Assembly of Listed Parts.

A lighting system assembled from the following listed parts shall be permitted:

(1) ~~Low~~ Extra -low- voltage luminaires identified for the use

(2) Power supply identified for the use

(3) ~~Low~~ Extra -low- voltage luminaire fittings identified for the use

(4) Suitably rated cord, cable, conductors in conduit, or other fixed Chapter 3 wiring method for the secondary circuit

411.5 Specific Location Requirements.

(A) Walls, Floors, and Ceilings.

Conductors concealed or extended through a wall, floor, or ceiling shall be in accordance with (1) or (2):

(1) Installed using any of the wiring methods specified in Chapter 3

(2) Installed using wiring supplied by a listed Class 2 power source and installed in accordance with 725.130

(B) Pools, Spas, Fountains, and Similar Locations.

Lighting systems shall be installed not less than 3 m (10 ft) horizontally from the nearest edge of the water, unless permitted by Article 680.

411.6 Secondary Circuits.

(A) Grounding.

Secondary circuits shall not be grounded.

(B) Isolation.

The secondary circuit shall be insulated from the branch circuit by an isolating transformer.

(C) Bare Conductors.

Exposed bare conductors and current-carrying parts shall be permitted for indoor installations only. Bare conductors shall not be installed less than 2.1 m (7 ft) above the finished floor, unless specifically listed for a lower installation height.

411.7 Branch Circuit.

Lighting systems covered by this article shall be supplied from a maximum 20-ampere branch circuit.

411.8 Hazardous (Classified) Locations.

Where installed in hazardous (classified) locations, these systems shall conform with Articles 500 through 517 in addition to this article.

Statement of Problem and Substantiation for Public Input

Coordinate with proposed new definitions for low voltage and extra-low voltage.

Related Public Inputs for This Document

Related Input	Relationship
Public Input No. 1695-NFPA 70-2020 [New Definition after Definition: Voltage (of a circuit).]	Go together
Public Input No. 1695-NFPA 70-2020 [New Definition after Definition: Voltage (of a circuit).]	

Submitter Information Verification

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Submittal Date: Thu Jun 25 14:15:52 EDT 2020
Committee: NEC-P18

Public Input No. 2676-NFPA 70-2020 [Section No. 411.1]

411.1 Scope.

This article covers lighting systems and their associated components operating at no more than 30 volts ac or 60 volts dc. ~~Where wet~~

Exception: This article shall not apply to lighting systems and associated components that exceed 15 volts ac or 30 volts dc where wet contact is likely to occur~~, the limits are 15 volts ac or 30 volts dc~~ .

Informational Note: Refer to Article 680 for applications involving immersion.

Statement of Problem and Substantiation for Public Input

The scope statement establishes a voltage limit and then goes on to establish a second limit. The second limit is essentially a requirement. I have rewritten that second limit as an exception to the scope.

Submitter Information Verification

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Affiliation: Self
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Submittal Date: Thu Aug 27 19:07:11 EDT 2020
Committee: NEC-P18

Public Input No. 4230-NFPA 70-2020 [Section No. 411.1]

411.1 Scope.

This article covers lighting systems and their associated components operating at no more than 30 volts ac or 60 volts dc. Where wet contact is likely to occur, the limits are 15 volts ac or 30 volts dc.

Informational Note: ~~Refer to Article 680 for applications involving immersion~~ See 680.1 for Swimming Pools, Fountains, and Similar Installations .

Statement of Problem and Substantiation for Public Input

Section 4.1.4 of the 2020 NEC(R) Style Manual prohibits references to an entire article, with the exception of Article 100. As such, it is proposed to revise the text to point users to the scope of the article as shown. The order of the informational note was also changed to comply with Section 4.1.3 of the NEC(r) Style Manual.

Submitter Information Verification

Submitter Full Name: Richard Holub

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Submittal Date: Thu Sep 10 07:29:21 EDT 2020

Committee: NEC-P18

Public Input No. 288-NFPA 70-2020 [Section No. 411.4(A)]

(A) Listed System.

The luminaires, power supply, and luminaire fittings (including the exposed bare conductors) of ~~an exposed bare conductor lighting~~ a lighting system shall be listed ~~for the use~~ for use as part of the same identified lighting system, and intalled in accordance with the listing .

Statement of Problem and Substantiation for Public Input

Stating "bare conductors" twice is redundant. Adding "in accordance with the listing" emphasizes the intent of this section, and just seems to make sense.

Reason for change is clarity.

Submitter Information Verification

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Submittal Date:	Wed Jan 15 10:09:37 EST 2020
Committee:	NEC-P18

Public Input No. 1596-NFPA 70-2020 [Section No. 411.4(B)]

(B) Assembly of Listed Parts.

A lighting system assembled from the following listed parts shall be permitted:

(1) Low-voltage luminaires identified for the use

(2) Power supply identified for the use

(3) Low-voltage luminaire fittings identified for the use

(4) Suitably rated cord, cable, ~~conductors in conduit,~~ or other ~~fixed~~ Chapter 3 wiring method for the secondary circuit

Statement of Problem and Substantiation for Public Input

Delete the term 'conduit' for two reasons, maybe it would be installed in EMT or ENT or other 'raceway' that is not a conduit. No. 2, it's already covered by the reference to other Chapter 3 Wiring methods.

Submitter Information Verification

Submitter Full Name: Mike Holt
Organization: Mike Holt Enterprises Inc
Street Address:
City:
State:
Zip:
Submittal Date: Mon Jun 22 19:01:15 EDT 2020
Committee: NEC-P18

Public Input No. 289-NFPA 70-2020 [Section No. 411.4 [Excluding any Sub-Sections]]

> Low-voltage lighting systems shall comply with 411.4(A) or (B). Listed low-voltage lighting systems or a lighting system assembled from listed parts shall not be permitted to be altered or reconditioned, and shall be installed or assembled in accordance with the listing .

Statement of Problem and Substantiation for Public Input

Reason for change is clarity and emphasis on the intent of this section.

Submitter Information Verification

Submitter Full Name: Nick Sasso

Organization: Clark County Building and Fire

Street Address:

City:

State:

Zip:

Submittal Date: Wed Jan 15 10:13:30 EST 2020

Committee: NEC-P18

Public Input No. 1597-NFPA 70-2020 [Section No. 411.5(B)]

(B) Pools, Spas, Fountains, and Similar Locations.

Lighting systems shall be installed not less than ~~3 m~~ 1.5 m (~~10 ft~~ 5 ft) horizontally from the nearest edge of the water, unless permitted by Article 680.

Statement of Problem and Substantiation for Public Input

Section 680.22(B) allows 120, 240, 277, 480V lighting up to five feet from the water. No reason for Article 411 to have a default value of 10'.

Submitter Information Verification

Submitter Full Name:	Mike Holt
Organization:	Mike Holt Enterprises Inc
Street Address:	
City:	
State:	
Zip:	
Submittal Date:	Mon Jun 22 19:07:46 EDT 2020
Committee:	NEC-P18

Public Input No. 4233-NFPA 70-2020 [Section No. 411.5(B)]

(B) Pools, Spas, Fountains, and Similar Locations.

Lighting systems shall be installed not less than 3 m (10 ft) horizontally from the nearest edge of the water, unless permitted ~~by Article 680~~ elsewhere in the Code .

Statement of Problem and Substantiation for Public Input

Section 4.1.4 of the 2020 NEC(R) Style Manual prohibits references to an entire article, with the exception of Article 100. As such, it is proposed to revise the text to a more generic "unless permitted elsewhere in the Code" unless the CMP can determine a specific part of the article they intend to refer the user to.

Submitter Information Verification

Submitter Full Name: Richard Holub

Organization: The DuPont Company, Inc.

Street Address:

City:

State:

Zip:

Submittal Date: Thu Sep 10 07:37:08 EDT 2020

Committee: NEC-P18

Public Input No. 1050-NFPA 70-2020 [Section No. 411.6(A)]

(A) Grounding.

1. Secondary circuits that are not supplied by a Class 2 power source shall not be grounded.

2. Secondary circuits supplied by a Class 2 power source complying with the requirements of 725.121 shall be permitted to be grounded.

Statement of Problem and Substantiation for Public Input

Article 411 low voltage lighting systems have a relatively high power limitation of 1500VA, often utilize bare conductors, and are often installed in wet locations. Secondary grounding prohibition is appropriate for such systems

However, with the appearance of new lighting technologies such as LED's, Power over Ethernet (PoE), and similar distribution systems, there are now low voltage lighting systems that use Class 2 secondary circuits. These systems comply with the power limits of 725.121 and Table 11(B). A secondary grounding prohibition is not necessary or appropriate for such systems. However, the current wording of 411.6(A) is being incorrectly interpreted by NRTL's as applying to all low voltage lighting systems, even those using Class 2 power sources, Revised wording is needed to clarify that Class 2 low voltage lighting systems are allowed to have grounded secondaries, per article 725.

Related Public Inputs for This Document

Related Input	Relationship
Public Input No. 1040-NFPA 70-2020 [Section No. 250.22]	Correlates 250.22(4) with this PI.
Public Input No. 1040-NFPA 70-2020 [Section No. 250.22]	

Submitter Information Verification

Submitter Full Name: Steven Terry

Organization: Electronic Theatre Controls Inc

Affiliation: USITT

Street Address:

City:

State:

Zip:

Submittal Date: Wed May 13 13:28:00 EDT 2020

Committee: NEC-P18

Public Input No. 4235-NFPA 70-2020 [Section No. 411.8]

411.8 Hazardous (Classified) Locations.

Where installed in hazardous (classified) locations, these systems shall conform with ~~Articles 500 through 517~~ the hazardous location requirements in addition to this article.

Statement of Problem and Substantiation for Public Input

Section 4.1.4 of the 2020 NEC(R) Style Manual prohibits references to an entire article, with the exception of Article 100. As such, it is proposed to revise the text to a more generic "hazardous location requirements". It is recommended that this PI also be shared with CMP14 for information and/or comment.

Submitter Information Verification

Submitter Full Name:	Richard Holub
Organization:	The DuPont Company, Inc.
Street Address:	
City:	
State:	
Zip:	
Submittal Date:	Thu Sep 10 07:39:37 EDT 2020
Committee:	NEC-P18

Public Input No. 3824-NFPA 70-2020 [Section No. 600.2]

(Relocate all definitions in the 600. 2 to Article 100, arrange them in alphabetical order and without any subdivisions.)

600. 2 Definitions.

The definitions in this section shall apply only within this article.

Host Sign.

A sign or outline lighting system already installed in the field that is designated for field conversion of the illumination system with a retrofit kit.

LED Sign Illumination System.

A complete lighting system for use in signs and outline lighting consisting of light-emitting diode (LED) light sources, power supplies, wire, and connectors to complete the installation.

Neon Tubing.

Electric-discharge luminous tubing, including cold cathode luminous tubing, that is manufactured into shapes to illuminate signs, form letters, parts of letters, skeleton tubing, outline lighting, other decorative elements, or art forms and filled with various inert gases.

Photovoltaic (PV) Powered Sign.

A complete sign powered by solar energy consisting of all components and subassemblies for installation either as an off-grid stand-alone, on-grid interactive, or non-grid interactive system.

Retrofit Kit, General Use.

A kit consisting of primary parts, which does not include all the parts for a complete subassembly but includes a list of required parts and installation instructions to complete the subassembly in the field.

Retrofit Kit, Sign Specific.

A kit consisting of the necessary parts and hardware to allow for field installation in a host sign, based on the included installation instructions.

Section Sign.

A sign or outline lighting system, shipped as subassemblies, that requires field-installed wiring between the subassemblies to complete the overall sign. The subassemblies are either physically joined to form a single sign unit or are installed as separate remote parts of an overall sign.

Sign Body.

A portion of a sign that may provide protection from the weather but is not an electrical enclosure.

Skeleton Tubing.

Neon tubing that is itself the sign or outline lighting and is not attached to an enclosure or sign body.

Subassembly.

Component parts or a segment of a sign, retrofit kit, or outline lighting system that, when assembled, forms a complete unit or product.

Statement of Problem and Substantiation for Public Input

"The National Electrical Code has definitions in multiple parts in Article 100 and many definitions scattered through out the code many of them in the .2 section of the articles.
Most of the other standards under NFPA have their definitions in one location and this will allow the NEC the same requirement. The revisions to the NEC Style Manual require all the definitions to be relocated to Article 100. "

Submitter Information Verification

Submitter Full Name:	David Williams
Organization:	Delta Charter Township
Street Address:	
City:	
State:	
Zip:	
Submittal Date:	Wed Sep 09 13:42:31 EDT 2020
Committee:	NEC-P18

Public Input No. 838-NFPA 70-2020 [New Section after 600.4(E)]

TITLE OF NEW CONTENT

durability conditions would and should be UV Light Protected for exposed surfaces in exterior locations and or conditions.

Statement of Problem and Substantiation for Public Input

Equipment labels have a tendency to fade or discolor in exterior conditions when printed poorly creating important literature to become missing.

Submitter Information Verification

Submitter Full Name:	Emigdio Amador
Organization:	Elight Electric
Affiliation:	Apprentice
Street Address:	
City:	
State:	
Zip:	
Submittal Date:	Tue Apr 07 22:05:39 EDT 2020
Committee:	NEC-P18

Public Input No. 2949-NFPA 70-2020 [Section No. 600.4(E)]

(E) Durability.

Marking labels shall be permanent ~~, durable and, when in wet locations, weatherproof~~ and of sufficient durability to withstand the environment involved .

Statement of Problem and Substantiation for Public Input

The revised text is what is used in 110.21(B)(3). It just reads more complete.

Submitter Information Verification

Submitter Full Name:	Mike Holt
Organization:	Mike Holt Enterprises Inc
Street Address:	
City:	
State:	
Zip:	
Submittal Date:	Thu Sep 03 13:31:49 EDT 2020
Committee:	NEC-P18

Public Input No. 2399-NFPA 70-2020 [Section No. 600.4(F)]

(F) Installation Instructions.

All signs, outline lighting, skeleton tubing systems, and retrofit kits shall be installed in the field in accordance with manufacturer's instructions . Equipment shall be marked to indicate that installation, including field wiring ~~and~~ , shall be in accordance with the manufacturer's installation instructions ~~are required~~ .

Exception: Portable, cord-connected signs are not required to be marked.

Statement of Problem and Substantiation for Public Input

1) A mark is required to be put onto the equipment to say that installation instructions are required. However, there is no explicit requirement that installation instructions themselves be produced, leaving the possibility that there not be installation instructions, yet a requirement to follow them.
2) For other "installation instruction" references in code, the does not generally require installation instructions be produced of themselves, only that the installation shall be installed in compliance with the manufacturer's installation instructions. For a few examples, refer to; 314.28(E)(2), 315.25, 376.56(B)(2), 386.30, 388.30, 392.30(A), 393.30(A).

Submitter Information Verification

Submitter Full Name: John Blissett
Organization: Bernhard TME
Street Address:
City:
State:
Zip:

Submittal Date: Wed Aug 19 08:59:10 EDT 2020
Committee: NEC-P18

Public Input No. 1769-NFPA 70-2020 [Section No. 600.5(A)]

(A) Required Branch Circuit.

Each commercial building and each commercial occupancy accessible to pedestrians shall be provided with at least one outlet in an accessible location at each entrance to each tenant space for sign or outline lighting system use. The outlet(s) shall be supplied by a branch circuit rated at least 20 amperes that supplies no other load.~~ A~~

Exception No. 1: A sign or outline lighting outlet shall not be required at entrances for deliveries, service corridors, or service hallways that are intended to be used only by service personnel or employees.

Exception No. 2: The required branch circuit shall be permitted to supply loads directly related to the control of the sign such as time switches and/or photocontrols.

Statement of Problem and Substantiation for Public Input

The last sentence of the current section is an exception to the requirements and should be indicated as such.

Signs are often controlled by time switches or photocontrols, both of which would be considered "loads." Even photocontrols use a small amount of power, although it typically less than 1 volt-amp. The proposed second exception permits the required branch circuit to also service as the supply for a time switch or photocontrol which is directly related to the control of the sign.

Submitter Information Verification

Submitter Full Name: Jason Rohe

Organization: Schnackel Engineers

Street Address:

City:

State:

Zip:

Submittal Date: Tue Jun 30 09:06:14 EDT 2020

Committee: NEC-P18

Public Input No. 542-NFPA 70-2020 [Section No. 600.5(B)]

~~**(B)** Marking.~~

~~A disconnecting means for a sign, outline lighting system, or controller shall be marked to identify the sign, outline lighting system, or controller it controls.~~

~~*Exception: An external disconnecting means that is mounted on the sign body, sign enclosure, sign pole, or controller shall not be required to identify the sign or outline lighting system it controls.*~~

Statement of Problem and Substantiation for Public Input

This is already required by 110.22, and 90.3 covers the issue.

Submitter Information Verification

Submitter Full Name:	Ryan Jackson
Organization:	Ryan Jackson
Street Address:	
City:	
State:	
Zip:	
Submittal Date:	Thu Feb 27 14:33:10 EST 2020
Committee:	NEC-P18

Public Input No. 4401-NFPA 70-2020 [Section No. 600.5(D)(2)]

(2) Enclosures as Pull Boxes.

Ballast, Transformer ~~enclosures shall~~ , Electronic Power Supply, and Class 2 Power Source listed enclosures or metal electrical enclosures constructed in accordance with 600.8 shall be permitted to be used as pull or junction boxes for conductors supplying other adjacent signs, outline lighting systems, or floodlights that are part of a sign and shall be permitted to contain both branch and secondary circuit conductors, provided the sign disconnecting means de-energizes all ~~current-carrying conductors~~ ungrounded conductors in these enclosures.

Additional Proposed Changes

File Name	Description	Approved
PI_4401-NFPA_70-2020_CHRIS_VALTIERRA.pdf	PI 4401-NFPA 70-2020_CHRIS_VALTIERRA	

Statement of Problem and Substantiation for Public Input

1. The Code language does not address listed enclosures for Ballast, Electronic Power Supplies, and Class 2 Power Sources or a metal constructed sign enclosure as described in section 600.8. The AHJ is left to interpret neon transformer enclosures as the only type allowed to contain both branch and secondary circuit conductors that can supply adjacent signs, outline lighting, or floodlights. A listed Ballast, Electronic Power Supply, Class 2 Power Supply or metal sign enclosure are all installed under the same conditions but the AHJ is left to deny the installation because of the code language as written.

2. Adding the language of "all ungrounded" promotes consistency of disconnecting means language used in section 600.6. Also, if a neutral conductor installed as required in section 200.4(A) and cannot be used for more than one branch circuit which is the typical installation for most signs, language that states "de-energizes all current carrying conductors", is not applicable.

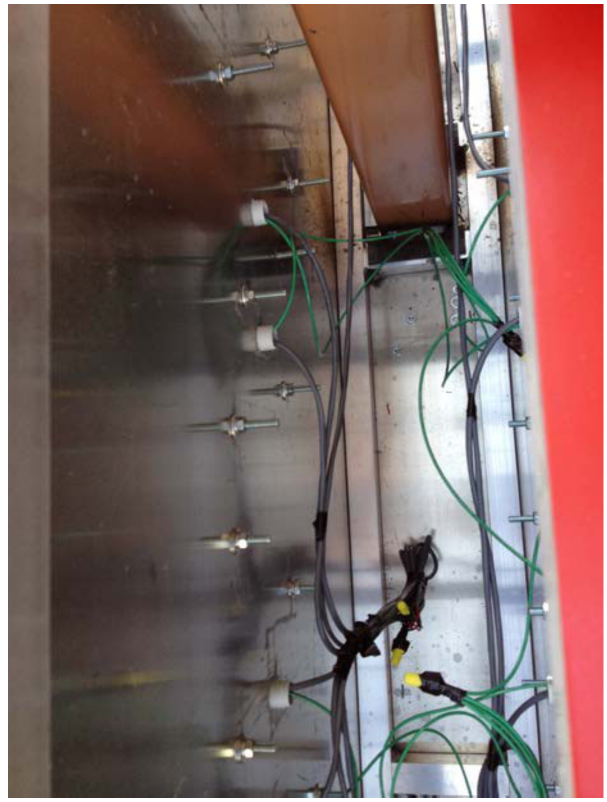
Submitter Information Verification

Submitter Full Name: Chris Valtierra
Organization: City of Waco TX
Street Address:
City:
State:
Zip:

Submittal Date: Thu Sep 10 12:08:54 EDT 2020
Committee: NEC-P18

PI 4401-NFPA 70-2020 Chris Valtierra

Listed Class 2 Power Supply Enclosure



Metal Electrical Sign Enclosure

Listed Transformer Enclosure

Public Input No. 544-NFPA 70-2020 [Section No. 600.5(D)(2)]

(2) Enclosures as Pull Boxes.

Transformer enclosures shall be permitted to be used as pull or junction boxes for conductors supplying other adjacent signs, outline lighting systems, or floodlights that are part of a sign and shall be permitted to contain both branch and secondary circuit conductors, provided the sign disconnecting means de-energizes all ~~current-carrying~~ ungrounded conductors in these enclosures.

Statement of Problem and Substantiation for Public Input

Requiring the neutral to be disconnected at the equipment is warranted to gas stations where the presence of flammable liquid-produced vapors exist [514.514.11], but to require it here does not seem necessary.

Submitter Information Verification

Submitter Full Name: Ryan Jackson
Organization: Ryan Jackson
Street Address:
City:
State:
Zip:

Submittal Date: Thu Feb 27 14:39:28 EST 2020
Committee: NEC-P18

Public Input No. 1237-NFPA 70-2020 [Section No. 600.6(A)(1)]

(1) At Point of Entry to a Sign.

The disconnect shall be located at the point the feeder circuit or branch circuit(s) supplying a sign or outline lighting system enters a sign enclosure, a sign body, or a pole in accordance with 600.5(D)(3). The disconnect shall be "accessible" (as applied to wiring methods). The disconnect shall open all ungrounded conductors where it enters the enclosure of the sign or pole.

Exception No. 1: A disconnect shall not be required for branch circuit(s) or feeder conductor(s) passing through the sign where not accessible and enclosed in a Chapter 3 listed raceway or metal-jacketed cable identified for the location.

Exception No. 2: A disconnect shall not be required at the point of entry to a sign enclosure or sign body for branch circuit(s) or feeder conductor(s) that supply an internal panelboard(s) in a sign enclosure or sign body. The conductors shall be enclosed where not accessible in a Chapter 3 listed raceway or metal-jacketed cable identified for the location. A field-applied permanent warning label that is visible during servicing shall be applied to the raceway at or near the point of entry into the sign enclosure or sign body. The warning label shall comply with 110.21(B) and state the following: "Danger. This raceway contains energized conductors." The marking shall include the location of the disconnecting means for the energized conductor(s). The disconnecting means shall be capable of being locked in the open position in accordance with 110.25.

Statement of Problem and Substantiation for Public Input

600.6 (A) (1) currently states that "The disconnect shall open all ungrounded where it enters the enclosure of the sign or pole." Many conductors enter a sign pole below grade.

A literal reading of 600.6 (A) (1) could be construed as requiring the disconnect to be installed below grade.

Submitter Information Verification

Submitter Full Name: Gary Hein

Organization: Submission is independent of employer.

Street Address:

City:

State:

Zip:

Submittal Date: Sat May 23 12:49:23 EDT 2020

Committee: NEC-P18

Public Input No. 2400-NFPA 70-2020 [Section No. 600.6(A)(2)]

(2) Within Sight of the Sign.

The disconnecting means shall be within sight of the sign or outline lighting system that it controls. Where the disconnecting means is out of the line of sight from any section that is able to be energized, the disconnecting means shall be lockable in accordance with 110.25. A permanent field-applied marking identifying the location of the disconnecting means shall be applied to the sign in a location visible during servicing. The ~~warning~~ label shall comply with the requirements for Field-Applied Hazard Markings in 110.21(B).

Statement of Problem and Substantiation for Public Input

The NEC invokes, by informational note, an abiding by the ANSI standard Z535.4 Sign and Label Requirements as in 110.16(B), 110.21(B). This standard reserves the use of the term "warning" to indicate a potentially hazardous situation which, if not avoided, could result in death or serious injury. Similarly, other terms in this standard have specific boundaries for use; danger, caution, notice, instruction. For consistency of code text, the word "warning" should be deleted.

Related Public Inputs for This Document

Related Input	Relationship
Public Input No. 2356-NFPA 70-2020 [Section No. 430.102(A)]	similarity on this topic
Public Input No. 2341-NFPA 70-2020 [Section No. 430.113]	similarity on this topic
Public Input No. 2401-NFPA 70-2020 [Section No. 110.21(B)]	similarity on this topic
Public Input No. 2356-NFPA 70-2020 [Section No. 430.102(A)]	
Public Input No. 2401-NFPA 70-2020 [Section No. 110.21(B)]	

Submitter Information Verification

Submitter Full Name: John Blissett
Organization: Bernhard TME
Street Address:
City:
State:
Zip:
Submittal Date: Wed Aug 19 09:36:24 EDT 2020
Committee: NEC-P18

Public Input No. 1816-NFPA 70-2020 [Section No. 600.6(A)(4)]

(4) Remote Location.

The disconnecting means, if located remote from the sign, sign body, or pole, shall be mounted at an accessible location available to first responders and service personnel. The location of the disconnect shall be marked with a label at the sign location and marked as the disconnect for the sign or outline lighting system. The label shall comply with 110.21(B) .

<u>Exception NO 1: Where the sign only houses conductors and lighting system feed from a remotely mounted class 2 power supply, The disconnect may be located next to the power supplies that feed the lighting system in the sign.</u>

<u>The intent if not worded correctly or in the right section of this article, is to address LED signs that ONLY contain 12v DC powered LEDs where in our industry are very common. Our common Practice is to mount the power supplies behind the LED sign interior to the building and locate the disconnect next to those power supplies disconnecting the primary power ahead of the power supplies.</u>

<u>We are looking for this clarification as to many times city by city they are requiring or not requiring breaker locks/labels indicating disconnect and panel info and the inspectors are saying the code does not define LED remote 12v DC feed signs so they are "interpreting" the code.</u>

Statement of Problem and Substantiation for Public Input

understanding the code when it comes to remote mounted led signs

Submitter Information Verification

Submitter Full Name: shawn wagner

Organization: phillips sign and lighting

Street Address:

City:

State:

Zip:

Submittal Date: Thu Jul 09 09:12:56 EDT 2020

Committee: NEC-P18

Public Input No. 1236-NFPA 70-2020 [Section No. 600.6(A) [Excluding any Sub-Sections]]

> The disconnecting means shall be “accessible” (as applied to wiring methods) and shall be permitted to be located in accordance with 600.6(A)(1), (A)(2), (A)(3), and (A)(4):

Statement of Problem and Substantiation for Public Input

Add language that clearly requires the disconnect to be “accessible” (as applied to wiring methods).

Submitter Information Verification

Submitter Full Name: Gary Hein

Organization: Submission is independent of employer.

Street Address:

City:

State:

Zip:

Submittal Date: Sat May 23 12:45:12 EDT 2020

Committee: NEC-P18

Public Input No. 4253-NFPA 70-2020 [Section No. 600.6(A) [Excluding any Sub-Sections]]

The disconnecting means shall be ~~permitted to be~~ located in accordance with 600.6(A)(1) , or 600.6 (A)(2), or 600.6 (A)(3)~~, and~~ . If the resulting location of the disconnecting means is remote from the sign it controls, it shall additionally comply with 600.6 (A)(4)~~:~~ .

Statement of Problem and Substantiation for Public Input

As written, the current text uses mandatory text on all four rules. It is obviously impossible to comply with all four rules at the same time, and the parent text does say "permitted", but then also references (4) which is always mandatory if it applies. This rewording clearly marks (1), (2) and (3) as written as open choices, and (4) as mandatory whenever applicable. This appears to fully implement the panel intent, which this submitter is attempting to support.

Submitter Information Verification

Submitter Full Name: Frederic Hartwell

Organization: Hartwell Electrical Services, Inc.

Affiliation: self

Street Address:

City:

State:

Zip:

Submittal Date: Thu Sep 10 08:35:49 EDT 2020

Committee: NEC-P18

Public Input No. 1512-NFPA 70-2020 [Section No. 600.6 [Excluding any Sub-Sections]]

Each sign and outline lighting system, feeder conductor(s), or branch circuit(s) supplying a sign, outline lighting system, or skeleton tubing shall be controlled by an externally operable switch or circuit breaker that opens all ungrounded conductors and controls no other load. The disconnecting means shall be of the indicating type and clearly indicate the open (off) and closed (on) position. The switch or circuit breaker shall open all ungrounded conductors simultaneously on multi-wire branch circuits in accordance with 210.4(B). Signs and outline lighting systems located within fountains shall have the disconnect located in accordance with 680.13.

Exception No. 1: A disconnecting means shall not be required for an exit directional sign located within a building.

Exception No. 2: A disconnecting means shall not be required for cord-connected signs with an attachment plug.

Informational Note: The location of the disconnect is intended to allow service or maintenance personnel and first responders complete and local control of the disconnecting means.

Statement of Problem and Substantiation for Public Input

This is necessary for safety and to prevent accidents.
I've been seeing a lot of sign companies that attempt to use a toggle switch with no "on" or "off" indication.

The only thing we have in the code presently is Article 404.7, which applies to enclosures as described in 404.3.
I really think that we need to have something in Article 600 to address this important safety concern with signs.

Reason for change is increased safety to people that have to work on electric signs.

Submitter Information Verification

Submitter Full Name: Nick Sasso
Organization: Clark County Building and Fire
Street Address:
City:
State:
Zip:

Submittal Date: Fri Jun 12 12:13:49 EDT 2020
Committee: NEC-P18

Public Input No. 1374-NFPA 70-2020 [Section No. 600.7(A)]

(A) Grounding.

(1) Equipment Grounding Conductor .

Metal equipment of signs, outline lighting, and skeleton tubing systems shall be grounded by connection to the equipment grounding conductor of the supply branch circuit(s) or feeder using the types of equipment grounding conductors specified in 250.118.

Exception: Portable cord-connected signs shall not be required to be connected to the equipment grounding conductor where protected by a system of double insulation or its equivalent. Double insulated equipment shall be distinctively marked.

(2) Size of Equipment Grounding Conductor.

The equipment grounding conductor size shall be in accordance with 250.122.

(3) Connections of Equipment Grounding Conductor .

Equipment grounding conductor connections shall be made in accordance with 250.130 and in a method specified in 250.8.

(4) Auxiliary Grounding Electrode.

Auxiliary grounding electrode(s) shall be permitted for electric signs and outline lighting systems covered by this article and shall meet the requirements of 250.54.

(5) Metal Building Parts.

Metal parts of a building shall not be permitted as a secondary return conductor or an equipment grounding conductor.

Statement of Problem and Substantiation for Public Input

Text was added so the rule uses the “proper term.”

Submitter Information Verification

Submitter Full Name: Mike Holt
Organization: Mike Holt Enterprises Inc
Street Address:
City:
State:
Zip:
Submittal Date: Mon Jun 01 20:20:11 EDT 2020
Committee: NEC-P18

Public Input No. 3166-NFPA 70-2020 [Section No. 600.7(A)(2)]

~~**(2)** Size of Equipment Grounding Conductor.~~

~~The equipment grounding conductor size shall be in accordance with 250.122 .~~

Statement of Problem and Substantiation for Public Input

Text in 600.7 (A) (2) of 2020 NEC does not supplement or modify the grounding requirements in 250.122, but simply repeats that general requirement. NEC 90.3 indicates those general requirements apply to special equipment without repeating the text.

Submitter Information Verification

Submitter Full Name:	Donald Cook
Organization:	Shelby County Department of De
Affiliation:	self
Street Address:	
City:	
State:	
Zip:	
Submittal Date:	Sun Sep 06 08:53:41 EDT 2020
Committee:	NEC-P18

Public Input No. 3171-NFPA 70-2020 [Section No. 600.7(A)(3)]

~~**(3)** Connections.~~

~~Equipment grounding conductor connections shall be made in accordance with 250.130 and in a method specified in 250.8 .~~

Statement of Problem and Substantiation for Public Input

Text in 600.7 (A) (3) of 2020 NEC does not supplement or modify the grounding requirements in 250.130 or 250.8, but simply repeats that general requirement. NEC 90.3 indicates those general requirements apply to special equipment without repeating the text.

Submitter Information Verification

Submitter Full Name:	Donald Cook
Organization:	Shelby County Department of De
Affiliation:	self
Street Address:	
City:	
State:	
Zip:	
Submittal Date:	Sun Sep 06 14:20:44 EDT 2020
Committee:	NEC-P18

Public Input No. 3172-NFPA 70-2020 [Section No. 600.7(A)(4)]

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

~~Auxiliary grounding electrode(s) shall be permitted for electric signs and outline lighting systems covered by this article and shall meet the requirements of 250.54 .~~

Statement of Problem and Substantiation for Public Input

Text in 600.7 (A) (4) of 2020 NEC does not supplement or modify the grounding requirements in 250.54, but simply repeats that general requirement. NEC 90.3 indicates those general requirements apply to special equipment without repeating the text.

Submitter Information Verification

Submitter Full Name:	Donald Cook
Organization:	Shelby County Department of De
Affiliation:	self
Street Address:	
City:	
State:	
Zip:	
Submittal Date:	Sun Sep 06 14:23:58 EDT 2020
Committee:	NEC-P18

Public Input No. 3173-NFPA 70-2020 [Section No. 600.7(B)(2)]

~~**(2)** Bonding Connections.~~

~~Bonding connections shall be made in accordance with 250.8 .~~

Statement of Problem and Substantiation for Public Input

Text in 600.7 (B) (2) of 2020 NEC does not supplement or modify the grounding requirements in 250.8, but simply repeats that general requirement. NEC 90.3 indicates those general requirements apply to special equipment without repeating the text.

Submitter Information Verification

Submitter Full Name:	Donald Cook
Organization:	Shelby County Department of De
Affiliation:	self
Street Address:	
City:	
State:	
Zip:	
Submittal Date:	Sun Sep 06 14:26:17 EDT 2020
Committee:	NEC-P18

Public Input No. 2483-NFPA 70-2020 [Section No. 600.7(B)(7)]

(7) Bonding Conductors.

Bonding conductors shall comply with (1) and (2).

(1) Bonding conductors shall be copper-clad aluminum or copper and not smaller than 14 AWG.

(2) Bonding conductors installed externally of a sign or raceway shall be protected from physical damage.

Statement of Problem and Substantiation for Public Input

As a conductor material for power applications, Copper-clad aluminum has been referenced by the NEC since the 1971 edition. Copper-clad aluminum is referenced for use as a bonding jumper in Table 250.102(C)(1) Grounded Conductor, Main Bonding Jumper, System Bonding Jumper, and Supply-Side Bonding Jumper for Alternating-Current Systems. As a conductor material, Copper-clad aluminum should not be omitted from this section.

14 AWG copper-clad aluminum is being considered for addition to the Ampacity tables in Article 310 for the 2023 NEC cycle as part of a coordinated effort by the Bimetals Special Task Group under the purview of the NEC Correlating Committee. 14 AWG Copper-clad aluminum will have a unique ampacity rating. 14 AWG CCA is safe and reliable, and brings alternatives to users of this Code. The NFPA Standards Council created in August 2019 the special Bimetals Task Group to study the subject of adding ampacity values to 14 AWG CCA in Table 310.16 and to create Public Inputs for this code cycle to expand its range of application. There are 19 Public Inputs being submitted by the NFPA Bimetals Task Group in support of adding 14 AWG CCA. This Public Input aims to prevent a correlation problem between this section and other Articles.

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Submittal Date:	Sun Aug 23 13:37:06 EDT 2020
Committee:	NEC-P18

Public Input No. 3403-NFPA 70-2020 [Section No. 600.7(B)(7)]

(7) Bonding Conductors.

Bonding conductors shall comply with (1) and (2).

(1) Bonding conductors shall be copper and not smaller than 14 AWG.

(2) Bonding conductors shall be copper-clad aluminum and not smaller than 12 AWG

(3) Bonding conductors installed externally of a sign or raceway shall be protected from physical damage.

Statement of Problem and Substantiation for Public Input

As a conductor material for power applications, Copper-clad aluminum has been referenced by the NEC since the 1971 edition. Copper-clad aluminum is referenced for use as a bonding jumper in Table 250.102(C)(1) Grounded Conductor, Main Bonding Jumper, System Bonding Jumper, and Supply-Side Bonding Jumper for Alternating-Current Systems. As a conductor material, Copper-clad aluminum should not be omitted from this section.

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Committee: NEC-P18

Public Input No. 1627-NFPA 70-2020 [Section No. 600.7(B)(8)]

(8) Signs in Fountains.

Signs or outline lighting installed inside a fountain shall have all metal parts bonded to the equipment grounding conductor of the branch circuit for the fountain recirculating system. ~~The bonding connection shall be as near as practicable to the fountain and shall be permitted to be made to metal piping systems that are bonded in accordance with 680.58 (4).~~

Informational Note: Refer to 600.32(J) for restrictions on length of high-voltage secondary conductors.

Statement of Problem and Substantiation for Public Input

Delete reference to 680.58(4), since there is no such rule.

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Submittal Date: Wed Jun 24 15:23:48 EDT 2020

Committee: NEC-P18

Public Input No. 1751-NFPA 70-2020 [Section No. 600.24(B)]

(B) Equipment Grounding Conductor.

Metal parts of Class 2 power supplies and power sources shall be ~~grounded by connecting~~ connected to the equipment grounding conductor.

Statement of Problem and Substantiation for Public Input

Metal parts are “connected/bonded” to the equipment grounding conductor, they are not “grounded” to the equipment grounding conductor. Ground is the Earth and connection to the EGC is just that. The title also needs to be revised to reflect the content of the rule. See 250.130 for an example.

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Committee: NEC-P18

Public Input No. 543-NFPA 70-2020 [Section No. 600.35]

~~**600.35** Retrofit Kits.~~

~~**(A)** General.~~

~~A general-use or sign-specific retrofit kit for a sign or outline lighting system shall include installation instructions and requirements for field conversion of a host sign. The retrofit kit shall be listed and labeled.~~

~~**(B)** Installation.~~

~~The retrofit kit shall be installed in accordance with the installation instructions.~~

~~**(1)** Wiring Methods.~~

~~Wiring methods shall be in accordance with Chapter 3.~~

~~*Exception: If powered from a Class 2 source, wiring methods shall be in accordance with 600.12(C) (1)(2) and (C)(2), 600.24 , and 600.33 .*~~

~~**(2)** Damaged Parts.~~

~~All parts that are not replaced by a retrofit kit shall be inspected for damage. Any part found to be damaged or damaged during conversion of the sign shall be replaced or repaired to maintain the sign or outline lighting system's dry, damp, or wet location rating.~~

~~**(3)** Workmanship.~~

~~Field conversion workmanship shall be in accordance with 110.12 .~~

~~**(4)** Marking.~~

~~The retrofitted sign shall be marked in accordance with 600.4(B) .~~

Statement of Problem and Substantiation for Public Input

None of this material is needed. See 600.3, 110.3(B), 110.8, 110.12, and 600.4(B). Why repeat it here when 90.3 already covers it?

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Submittal Date: Thu Feb 27 14:34:38 EST 2020
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Public Input No. 3830-NFPA 70-2020 [Section No. 605.2]

(Relocate all definitions in the 605. 2 to Article 100, arrange them in alphabetical order and without any subdivisions.)

605. 2 Definition.

The definition in this section shall apply within this article and throughout the *Code*.

Office Furnishing.

Cubicle panels, partitions, study carrels, workstations, desks, shelving systems, and storage units that may be mechanically and electrically interconnected to form an office furnishing system.

Statement of Problem and Substantiation for Public Input

"The National Electrical Code has definitions in multiple parts in Article 100 and many definitions scattered through out the code many of them in the .2 section of the articles.
Most of the other standards under NFPA have their definitions in one location and this will allow the NEC the same requirement. The revisions to the NEC Style Manual require all the definitions to be relocated to Article 100. "

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Committee:	NEC-P18

Public Input No. 975-NFPA 70-2020 [Part III.]

Part III. ~~Provisions at~~ Luminaire Outlet Boxes, Canopies, and Pans

Statement of Problem and Substantiation for Public Input

The words “Provisions at” are unnecessary and redundant.

Submitter Information Verification

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