

All text has now been reviewed at least once. **All Text is Agreed**, blue text may be used in PI's but probably not if a single PI is filed.

Yellow highlighted names (only shown on 840.160 PI) were, by my recollection at the 5/19 call and indicated consent to be listed. Non-highlighted ones need to be checked with.

Suggested Statement/Substantiation for The PoE Task Group PIs

Section 840.160 Powering Circuits. Communications cables, listed in accordance with 800.179, in addition to carrying the communications circuit, shall also be permitted to carry circuits for powering communications equipment listed in accordance with 800.170. The power source shall be listed in accordance with 840.170(G). ~~Where the power supplied over a communications cable to communications equipment is greater than 60 watts, communication cables and the power circuit~~ Installations of listed communications cables shall comply with 725.144 where listed communications cables are used in place of substituted for Class 2 and Class 3 cables in accordance with 725.154(A).

Exception: Compliance with 725.144 shall not be required for installations of listed 4-pair communications cables where the nominal current does not exceed 0.3 amperes in any conductor.

Statement of Problem and Substantiation for Public Input

The existing text does not identify important listing requirements for communications cables, communications equipment and powering equipment when associated with powering applications. The proposed text clarifies that listing is an important safety requirement for the communications cables, the powered communications equipment and the power source in 840.160.

The proposed revised text provides improved distinction between powering applications associated with lower level communications applications and those powering applications appropriately covered in Article 725.

The existing text of 840.160 requires communications cables to be used in place of the Class 2 and Class 3 cables in 725.144. The proposed text clarifies that these cable substitutions must comply with the existing cable substitution rules in 725.154(A).

The existing text requires compliance with 725.144 when the power supplied is over 60W. Panel 16 based this on the assumption that the voltage was always 50 volts and all 8 conductors were used for the power as described in the *Fact Finding Report on Power over Local Area Network Type Cables (4-Pair Data / Communications Cables)* <with errata 1 revisions>, dated September 25, 2015 (<http://www.plasticsindustry.org/sites/plastics.dev/files/SPI%20Fact%20Finding%20Report%20%28Issued%202015-09-25%29%2BErrata%201%20C%20A9UL%26SPL.pdf>). The existing text would allow systems which deviate from these assumptions (e.g., supply 24 volts or supply only on 2 conductors) to operate with currents greater than 0.3 amperes per conductor, and possibly result in the overheating that 725.144 was meant to avoid. Additionally, the proposed text clarifies that it is the cable installation that generally must comply with 725.144. The proposed exception clearly states that deviation from wiring in accordance with 725.144 is only permitted for listed 4-pair communications cables, and only when the nominal current does not exceed 0.3 amperes in any conductor. The exception is based on the UL Fact-Finding investigation which showed that all the configurations tested did not overheat (exceed the cable temperature rating) when all the conductors carried 0.3 A. 60 watts is equivalent to 0.3 A in a typical Power over Ethernet powering scheme when a 50 volt, 8 conductor power source is used.

[This is a companion Public Input associated with several other Public Inputs for Article 725. – not part of the text, reminder to identify this if it is a PI.]

The NEC Correlating Committee, at the direction of the NFPA Standards Council, formed the Power over Ethernet Task Group (PoE Task Group) to address issues regarding the provision of power over Ethernet and communications conductors. Members of the PoE Task Group, including members of NEC Panel 3, NEC Panel 16 and the NEC Correlating Committee, are as follows: E. Gallo – Chair, M. A. Cardona, W. J. McCoy, R. Kusuma, R. Emplit, R. Foster, S. Kaufman, M. Shariff, A. Tassone, G. Straniero, J. Kacperski, R. Ivans, T. Pope, T. C. Coleman, J. Brunssen, J. Goergen, G. A. Zimmerman, M. W. Earley, M. J. Johnston, L. Ayer, P. Vanderlaan, R. Anderson, C. Bullock, S. Stene, M. Ode, and T. Olechna. The PoE Task Group prepared this Public Input. In accordance with the Standards Council’s instructions, the task group was broad based and specifically included representation of those with knowledge and experience in telecommunications and Ethernet communications.

Section 725.2 Definitions

Insert the following new definition and Informational Note.

Nominal Current. The designated current per conductor as specified by equipment design.

Informational Note: One example of nominal current is 4-pair Power over Ethernet (PoE) applications based on IEEE Std 802.3-2015, *IEEE Standard for Ethernet*, that supplies current over 2 or 4 twisted pairs. The nominal current for 60 watt PoE power sourcing equipment is 0.3 amperes per conductor, where the current in one conductor can be 0.36 amperes and another conductor can be 0.24 amperes.

Statement of Problem and Substantiation for Public Input

The new definition, “Nominal Current” is necessary to account for deviations in conductor current due to circuit imbalances and is used in proposed revisions to Sections 725.121(C), 725.144(A) and (B), 725.170 and the exception to Section 840.160. These deviations are found in commonly deployed systems. The new definition is necessary to avoid adverse impact on these systems. Panel 16’s existing text for 840.160 attempted to provide an exception for systems at 0.3 amperes or less, for which there are no demonstrated safety concerns. However, the text in 840.160 inadvertently used only the power and not current to provide an exception, an issue corrected in a companion input. The use of maximum current in 725.144 and the lack of any current level below which there is an exception is inconsistent with the treatment of existing low-power devices in 840.160. The concept of nominal current to account for imbalance and the exception for less than or equal to 0.3 amperes nominal current is applied to 725.144 as well. The Informational Note further clarifies the term “Nominal Current” by providing an example of a common powering arrangement and identifies permissible current imbalances per industry-accepted standards.

[This is a companion Public Input associated with several other Public Inputs for Article 725 and Section 840.160.]

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The new definition, “Nominal Current” is necessary to account for deviations in conductor current due to circuit imbalances and is used in proposed revisions to Sections 725.121(C), 725.144(A) and (B), 725.170 and the exception to Section 840.160. The identical definition is proposed to be added to both 840.2 and to 725.2 in a companion submission. These deviations are found in commonly deployed systems. The new definition is necessary to avoid adverse impact on these systems. Panel 16’s existing text for 840.160 attempted to provide an exception for systems at 0.3 amperes or less, for which there are no demonstrated safety concerns. However, the text in 840.160 inadvertently used only the power and not current to provide an exception, an issue corrected in a companion input. The use of maximum current in 725.144 and the lack of any current level below which there is an exception is inconsistent with the treatment of existing low-power devices in 840.160. The concept of nominal current to account for imbalance and the exception for less than or equal to 0.3 amperes nominal current is applied to 725.144 as well. The Informational Note further clarifies the term “Nominal Current” by providing an example of a common powering arrangement and identifies permissible current imbalances per industry-accepted standards.

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Section 725.121(C)

Section 725.121(C) Marking. The power sources for limited power circuits in 725.121(A)(3) and limited power circuits for listed audio/video, information, and communications technology (equipment), and listed industrial equipment in 725.121(A)(4) shall have a label indicating the maximum voltage and maximum current or maximum voltage and nominal current output for each connection point. Where multiple connection points have the same rating, a single label shall be permitted to be used. The effective date shall be January 1, 2018.

Exception: Marking shall not be required for power sources providing 0.3 amperes nominal current or less per conductor.

Statement of Problem and Substantiation for Public Input

There are several proposed revisions to Article 725 to accommodate circuits that transmit power and data to a powered device. The proposed revisions to Section 725.121(C) include identification of communications equipment as an appropriate component of remote powering technology, identification of the necessary labeling (marking) to help ensure that proper current limits are observed and, with the term “nominal current”, alerting the NEC user that current may vary (within acceptable limits) because of circuit imbalances. The proposed *exception* excepts circuits operating at 0.3 amperes or less from the labeling (marking) requirement in keeping with the conclusions of the UL *Fact Finding Report on Power over Local Area Network Type Cables (4-Pair Data/Communications Cables)* dated September 25, 2015 (<http://www.plasticsindustry.org/sites/plastics.dev/files/SPI%20Fact%20Finding%20Report%20%28Issue%202015-09-25%29%2BErrata%201%2C%29%26SPL.pdf>). The existing text of 725.121(c) requires additional labeling of all power sources by January 2018, even though nearly half a billion ports of these power sources have shipped over the past 15 years without any demonstrated record of loss, and they provide less than 0.3 amperes nominal current per conductor – a level that aligns with the results of the UL *Fact Finding Report on Power over Local Area Network Type Cables (4-Pair Data / Communications Cables)*, dated September 25, 2015, and the proposed code agrees is safe. Updating the large variety, breadth and number of these types of power sources represents an undue burden on industry. Changing the labeling to align with the ‘nominal current’ specification of the other changes removes this burden.

The text as written would require a label per connection point. However, the changes applied to 725.121(C) in the 2017 NEC code cycle were intended to apply to high-density multi-port power sources, such as Power over Ethernet switches. These have many connection points of the same rating in a small front panel space, making a label per connection point impractical. The proposed change inserts text (which was omitted in the 2017 NEC) to specifically permit a single label in the case where multiple connection points have the same voltage and current outputs.

Additionally, the proposed revision makes an editorial revision to align with the title of the relevant UL document, (UL 62368-1-2014, *Safety of audio/video, information and communication technology equipment*)

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Section 725.144

725.144 Transmission of Power and Data. The requirements of 725.144(A) and (B) shall apply to Class 2 and Class 3 circuits that transmit power and data to a powered device. The requirements of Parts I and III of Article 725 and 300.11 shall apply to Class 2 and Class 3 circuits that transmit power and data. The conductors that carry power for the data circuits shall be copper. The current in the power circuit shall not exceed the current limitation of the connectors.

Informational No. 1: One example of the use of cables that transmit power and data is the connection of closed-circuit TV cameras (CCTV).

Informational Note No. 2: The 8P8C connector is in widespread use with powered communications systems. IEC 60603-7 specifies ~~These~~ these connectors are to have a current carrying capacity per contact of typically rated at 1.03 1.0 amperes maximum at 60°C (140°F). See IEC 60603-7, *Connectors for electronic equipment – Part 7: Detail specification for 8-way, unshielded, free and fixed connectors*; for more information on current carrying capacity at higher and lower temperatures.

Informational Note No. 3: The requirements of Table 725.144 were derived for carrying power and data over 4-pair copper balanced twisted-pair cabling. This type of cabling is described in ANSI/TIA 568-C.2-2009, *Commercial Building Telecommunications Cabling Standard Part 2: Balanced Twisted-Pair Cabling and Components Standard*.

Informational Note No. 4: See TIA-TSB-184-A, *Guidelines for Supporting Power Delivery Over Balanced Twisted-Pair Cabling*, for information on installation and management of balanced twisted-pair cabling supporting power delivery.

Statement of Problem and Substantiation for Public Input

Informational Note No. 2 was included in NEC 2017 to inform the NEC user of the maximum current rating of commonly used connectors. The proposed change updates the current rating and provides temperature limitations, as well as reference standards, associated with the 8P8C connector widely used in telecommunications and data applications. Informational Note No. 3 and No. 4 are added to identify the specificity of Table 725.144 and to provide the appropriate reference standards that address the cables covered in the Table. Table 725.144 is based on evaluation of the specific 4-pair cabling described in ANSI/TIA-568C.2-2009, and not just any cabling with 4 pairs. The new informational notes 3 and 4 provide the reader with references describing the type of cabling referred to by Table 725.144 as well as practices for installation and management of balanced twisted-pair cabling supporting power delivery.

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M. J. Johnston, L. Ayer, P. Vanderlaan, R. Anderson, C. Bullock, S. Stene, M. Ode, and T. Olechna. The PoE Task Group prepared this Public Input. In accordance with the Standards Council's instructions, the task group was broad based and specifically included representation of those with knowledge and experience in telecommunications and Ethernet communications.

Section 725.144(A)

(A) Use of Class 2 or Class 3 Cables to Transmit Power and Data. Where Types CL3P, CL2P, CL3R, CL2R, CL3 or CL2 transmit power and data, ~~the following shall apply, as applicable: (1) The~~ the ampacity ratings in Table 725.144 shall apply to the nominal current at an ambient temperature of 30°C (86°F). ~~(2) For ambient temperatures above 30°C (86°F), the correction factors of 310.15(B)(2) shall apply.~~

Exception: Compliance with Table 725.144 shall not be required for installations where the nominal current does not exceed 0.3 amperes in any conductor.

Informational Note: One example of the use of Class 2 cables is a network of closed-circuit TV cameras using 24 AWG, 60°C rated, Type CL2R, Category 5e ~~local area network (LAN) cables~~ balanced twisted-pair cabling.

Statement of Problem and Substantiation for Public Input

NEC usability is enhanced by identifying applications where Table 725.144 need not be consulted. Systems where 24 AWG or larger conductors are used and the nominal current of the power supply is 0.3 amperes or less on all conductors are excepted from the requirements of Table 725.144. Existing subsections (1) and (2) are combined and revised to indicate that, because of system imbalances, it is the nominal current that is of interest. The new text provides a clear exception to widely deployed systems, supplying power at current levels that the UL Fact Finding Report on Power over Local Area Network Type Cables (4-Pair Data / Communications Cables), dated September 25, 2015 (<http://www.plasticsindustry.org/sites/plastics.dev/files/SPI%20Fact%20Finding%20Report%20%28Issue%202015-09-25%29%2BErrata%201%2C%29%26SPE.pdf>), found no cause for concern. The existing text is inconsistent with 840.160, which provides an exception below 60 watts (0.3 amperes nominal current). By omitting such an exception in 725.144, the existing text creates a circumstance where it has an adverse impact on the installation of conventional power-over-Ethernet equipment running over existing wiring, which the change seeks to remedy. Industry has shipped over half a billion ports of standards-compliant product over the past 15 years. These products have been supplying nominal current up to 0.3 A/conductor without any demonstrated record of loss. Additionally, the UL *Fact Finding Report on Power over Local Area Network Type Cables (4-Pair Data / Communications Cables)*, dated September 25, 2015, finds no concern with these current levels. Under the text of 725.144, as written, these systems and wiring may require consideration of the bundling by the user before installation, whereas today they are user-installable on existing data wiring. This change prevents the unjustified disruption of this ~100 million port per year market, yet retains the intended safety concerns for higher current devices.

Additionally, the informational note is changed to refer to delete the reference to “local area network (LAN) cables”, because it is undefined in the NEC, and to replace it with “balanced twisted-pair cabling” which aligns with the relevant cabling standard (ANSI/TIA-568-C.2-2009).

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Section 725.144(B)

(B) Use of Class 2-LP or Class 3-LP Cables to Transmit Power and Data. Types CL3P-LP, CL2P-LP, CL3R-LP, CL2R-LP, CL3-LP, or CL2-LP shall be permitted to supply power to equipment at a nominal current level up to the marked ampere current limit located immediately following the suffix LP and shall be permitted to transmit data to the equipment. Installation of LP cables in bundles of 192 or fewer cables shall be permitted to use the ampacities in Table 725.144. For ambient temperatures above 30°C (86°F), the correction factors of 310.15(B)(2) shall apply. The Class 2-LP and Class 3-LP cables shall comply with the following, as applicable:

~~Informational Note 1: The “(xxA)” following the suffix LP indicates the ampacity of each conductor in a cable. An example of a limited power (LP) cable is a cable marked Type CL2-LP(0.5A), 23 AWG.~~

~~Informational Note No. 2: An example of a limited power (LP) cable is a cable marked Type CL2-LP(0.5A), 23 AWG. A Type CL2-LP(0.5), 23 AWG could be used in any location where Type CL2 could be used; however, the LP cable would be suitable for carrying up to 0.5 A per conductor, regardless of the number of cables in a bundle. If used in a 7 cable bundle, the same cable could carry up to 1.2 amperes per conductor.~~

- (1) Cables with the suffix “-LP” shall be permitted to be installed in bundles, raceways, cable trays, communications raceways, and cable routing assemblies.
- (2) Cables with the suffix “-LP” and a marked ampere level current limit shall follow the substitution hierarchy of Table 725.154 and Figure 725.154(A) for the cable type without the suffix “LP” and without the marked current limit-ampere level.
- (3) System design shall be permitted by qualified persons under engineering supervision.

Statement of Problem and Substantiation for Public Input

725.144(B) inadvertently omitted that the temperature correction factors of 310.15(B)(2) applies to the ampacity of LP cabling. The change inserts that text in the first paragraph of 725.144(B) as mandatory text.

Additionally, Informational Note No. 2 contains text that might be construed as a requirement and is deleted, and the requirement is moved to the main body paragraph of 725.144(B). The first sentence of what was Informational Note No. 2 is relocated as the remaining Informational Note. The remaining text from Informational Note No. 2 is revised to include that LP cables can be used above their marked LP rating in accordance with the appropriate ampacities of Table 725.144, and these statements are relocated to the main text of 725.144(B) as mandatory text in conformance to the NEC Style Manual. The word “current” is revised to “nominal current” to reflect variation in current because of system imbalances; the term “ampere limit” is editorially revised to “current limit”, the more appropriate terminology. Item (2) is editorially revised to replace the term “ampere level” with the technically correct term “current limit”.

[This is a companion Public Input associated with several other Public Inputs for Article 725 and Section 840.160.]

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Table 725.144

Title

Change “Data Cables” in Title of Table 725.144 to “Balanced Twisted-Pair Cables” as shown:

Table 725.144 Ampacities of Each Conductor in Amperes in 4-Pair Class 2 or Class 3 ~~Data~~ Balanced Twisted-Pair Cables Based on Copper Conductors at an Ambient Temperature of 30°C (86°F) with All Conductors in All Cables Carrying Current, 60°C (140°F), 75°C (167°F), and 90°C (194°F) Rated Cables

Informational Note

Delete the Informational Note and add new Informational Notes Nos. 1 and 2 as follows:

~~Informational Note: The conductor sizes in data cables in wide spread use are typically 22–24–26 AWG.~~

Informational Note 1: For information on practices for 4-pair balanced twisted-pair cabling see ANSI/TIA-568-C.2 and TIA-TSB-184-A, where data transmission performance is only specified up to 60°C (140°F). Elevated cable temperatures can reduce a cable’s data transmission performance.

Informational Note No. 2: The per-contact current rating of connectors can limit the maximum allowable current below the ampacity shown in Table 725.144.

The remainder of Table 725.144 remains unchanged.

Statement of Problem and Substantiation for Public Input

Title is changed to replace NEC undefined term “data cables” with language consistent with relevant industry standards (e.g., ANSI/TIA-568-C.2-2009) and consistent with language in other proposed inputs for this section.

The existing Informational Note is deleted as this information is inconsistent with current standardized practices. Additionally, the user of the code is advised that the elevated temperatures envisioned by Table 725.144 can adversely impact the data transmission performance of cables. The proposed new Informational Notes identify this potentially adverse condition, direct the NEC user to the appropriate industry standards for additional information, and alert the NEC user to the possible current limits that might need to be considered because of connector current rating limitations.

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Section 725.170

725.170 Listing and Marking of Equipment for Power and Data Transmission. The listed power source for circuits intended to provide power and data over Class 2 cables to remote equipment shall be as specified in 725.121(A)(1), (A)(2), (A)(3), or (A)(4). The current on individual conductors of the powering circuit shall be permitted to deviate from the nominal current up to +20% due to circuit imbalance provided this increased current is offset by a reduction of current in the other conductors. In accordance with 725.121(B), the power sources shall not have the output connections paralleled or otherwise interconnected, unless listed for such interconnection. Powered devices connected to a circuit supplying data and power shall be listed. Marking of equipment output connections shall be in accordance with 725.121(C).

Statement of Problem and Substantiation for Public Input

Circuit imbalance may cause the current on individual conductors to deviate from the nominal current up to +20%. The proposed revision alerts the reader that such elevated current may be observed in individual conductors, but is only permitted if offset by a reduction in current in other conductors. Additionally, the proposed revision limits the amount of imbalance that may be allowed as “nominal current”.

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