



705.12 Load-Side Source Connections.

The output of an interconnected electric power source shall be permitted to be connected to the load side of the service disconnecting means of the other source(s) at any distribution equipment ~~on the or premises wiring~~. Where distribution equipment or ~~feeders are~~ premises wiring are fed simultaneously by a primary source of electricity and one or more other power source(s), the ~~feeders or distribution equipment power source connections~~ shall comply with relevant sections of 705.12(A) ~~and through~~ 705.12(B C). Currents from power source connections to feeders, busbars, or busbars branch circuits shall be based on the maximum circuit currents calculated in 705.28(A). The ampacity of feeders and taps shall comply with 705.12(A), ~~and~~ the ampere ratings of busbars shall comply with 705.12(B), and the ampacity of branch circuits shall comply with 705.12(C).

(A) Feeders and Feeder Taps.

Where the power source output connection is made to a feeder, all of the following shall apply:

- (1) The feeder ampacity shall be greater than or equal to 125 percent of the power-source output circuit current.
- (2) Where the power-source output connection is made at a location other than the opposite end of the feeder from the primary source OCPD, that portion of the feeder on the load side of the power source output connection shall be protected by one of the following:
 - a. The feeder ampacity shall be not less than the sum of the rating of the primary source OCPD and 125 percent of the powersource output circuit current.
 - b. An OCPD at the load side of the power source connection point shall be rated not greater than the ampacity of the feeder.
- (3) For taps sized in accordance with 240.21(B)(2) or 240.21(B)(4), the ampacity of tap conductors shall not be less than one-third of the sum of the rating of the OCPD protecting the feeder plus the ratings of any power source OCPD connected to the feeder.

(B) Busbars.

For power source connections to distribution equipment with no specific listing and instructions for combining multiple sources, one or more of the following methods shall be used to determine the required ampere ratings of busbars:

- (1) The sum of 125 percent of the power source(s) output circuit current and the rating of the OCPD protecting the busbar shall not exceed the busbar ampere rating.
- (2) Where two sources, one being a primary power source and the other another power source, are located at opposite ends of a busbar that contains loads, the following shall apply:
 - (3) The sum of 125 percent of the powersource output circuit currents and the rating of the OCPD protecting the busbar shall not exceed 120 percent of the busbar ampere rating.
 - (4) A permanent warning label shall be applied to the distribution equipment adjacent to the power source OCPD that displays the following or equivalent wording:

WARNING:

POWER SOURCE OUTPUT. DO NOT RELOCATE THIS OVERCURRENT DEVICE.

- (5) The sum of the ampere ratings of all OCPDs protecting circuits connected to panelboards, both load and supply devices, excluding the rating of the OCPD protecting the busbar, shall not exceed the ampacity of the busbar. The rating of the OCPD protecting the busbar shall not exceed the rating of the busbar. Permanent warning labels shall be applied to distribution equipment displaying the following or equivalent wording:

WARNING:

EQUIPMENT FED BY MULTIPLE SOURCES. TOTAL RATING OF ALL OVERCURRENT DEVICES EXCLUDING MAIN SUPPLY OVERCURRENT DEVICE SHALL NOT EXCEED AMPACITY OF BUSBAR.

- (6) A connection at either end of a center-fed panelboard in dwellings shall be permitted where the sum of 125 percent of the powersource output circuit currents and the rating of the OCPD protecting the busbar does not exceed 120 percent of the busbar ampere rating. The warning label in 705.12(B)(2) shall be applied to the power source OCPDs complying with 705.12(B)(4).
- (7) Connections shall be permitted on busbars of panelboards that supply lugs connected to feed-through conductors or are supplied by feed-through conductors in accordance with the following:
 - (8) The feed-through conductors shall be sized in accordance with 705.12(A).
 - (9) Where an OCPD is installed at either end of the feed-through conductors, panelboard busbars on either side of the feed-through conductors shall be permitted to be sized in accordance with 705.12(B)(1) through 705.12(B)(3).
- (10) Connections shall be permitted on switchgear, switchboards, and panelboards in configurations other than those permitted in 705.12(B)(1) through 705.12(B)(5) where designed under engineering supervision that includes available fault-current and busbar load calculations.

Informational Note: See UL 1741, *Inverters, Converters, Controllers and Interconnection System Equipment for Use With Distributed Energy Resources*. Specifically designed equipment exists for the combination and distribution of sources to supply loads. The options provided in 705.12(B) are for equipment with no specific listing for combining sources.

Statement of Problem and Substantiation for Public Input

NOTE: See additional proposal 2779 adding a new item (C) for branch circuit connections. Also, TerraView flagged existing subitem text as new material.

SUBSTANTIATION:

The NEC needs specific rules for the proper connection of sources to branch circuits. We have specific rules for feeders and busbars, however, branch circuits have similar characteristics that suggest that rules for these circuits will be helpful for users of the NEC. With the advent of power control systems (PCS), we are able to limit current on branch circuits so that the circuit stays within conductor ratings. While the current version of the charging paragraph of 705.12 does not specifically mention branch circuits, it does state that we can connect sources to “any distribution equipment on the premises.”

Recent legislative efforts across the United States are ongoing to encourage the use of “plug-in” solar PV systems (PIPV) provided they meet safety standards. The safety standards need clarity from the NEC so that the required installation instructions for certified equipment have specific direction on how to safely install these plug-in systems in homes and other buildings. Power sources plugged into receptacles are by definition connecting to branch circuits.

This Public Input specific to power source connections to branch circuits is similar to the requirements of feeders and busbars that have been effectively and safely applied in the NEC for over 10 years. The changes in the charging paragraph of 705.12 cleans up the language to be less repetitive as the branch circuit references are added to the paragraph.

The new language in 705.12(C)(1) provides for a single 360VA source connection to a single general-purpose branch circuit receptacle. The substantiation for allowing a single 360VA power source connection to these circuits is as follows. The 60°C ampacity of 14AWG wire is 15-amps. The NEC limits the ampacity of NM cable used for general-purpose branch circuits to the 60°C ampacity of a conductor. This is because NM is often bundled in hot attic spaces. Most NM is rated 90°C today, but older homes prior to 1988 have 60°C NM cable, so it is difficult to differentiate this issue for older homes. New homes are a special case that may allow larger systems. The 80% continuous current rating of the 14 AWG, 15-amp conductors is 12-amps. If a PIPV system produces 3-amps the downstream conductor remains within its allowable ampacity of 15-amps (12-amps from the thermal breaker and 3-amps from the PIPV). At 120Vac, 3-amps is 360 Volt-Amps at unity power factor. The 80% factor used for thermal breakers is based on the testing and rating of standard circuit breakers and the heating on the wire caused by the impedance of the breaker. Since the PIPV current is never passing through the circuit breaker, and the wire has sufficient ampacity, a 3-amp PIPV system can never damage a 14AWG copper conductor in a 15-amp general-purpose branch circuit.

The proposed 705.12(C)(2) closely compares with the feeder requirements in 705.12(A)(1) as the issues of ampacity of a branch circuit are similar to those of a feeder. In both cases, the conductor must be as large as the largest current that the conductor can experience on a continuous basis [705.12(C)(2)]. This provision covers both individual branch circuits and general-purpose branch circuits. The proposed requirements of 705.12(C)(3) are specific to general-purpose branch circuits and are similar to the concepts in 705.12(A)(2) by translating the requirements of 705.12(A)(2) as appropriate into 705.12(C)(3) and adding a third option of a listed PCS device installed to prevent overcurrent on the load side of the connection point to the branch circuit.

These provisions proposed for the 2029 NEC, in conjunction with the new safety standard, UL3700 Outline of Investigation for Interactive Plug-In PV (PIPV) Equipment and Systems, can effectively provide the safeties necessary to prevent overcurrent of branch circuits and distribution equipment in building electrical systems. In Germany alone there are millions of plug-in solar and plug-in energy storage systems (ESSs) currently operating. These systems have restrictions that are working for their installation codes and safety standards. The National Electrical Code needs to get out in front of this issue and provide specific direction for connections to branch circuits before too many of these systems are installed without the benefit of PCS or clear installation requirements that allow for the safe integration of these plug-in systems on premises wiring systems.

Related Public Inputs for This Document

<u>Related Input</u>	<u>Relationship</u>
Public Input No. 2779-NFPA 70-2026 [New Section after 705.12(B)]	Consider in tandem

Submitter Information Verification

Submitter Full Name: Charles Picard
Organization: Solar Energy Industries Association
Affiliation: Solar and Storage Industry Forum (SSIF)
Street Address:
City:
State:
Zip:
Submittal Date: Mon Apr 06 10:33:40 EDT 2026
Committee: NEC-P04

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