# Continuing Education for Electricians

CETC CONNECTICUT ELECTRICAL Training Center, LLC

**2023 Edition**

# EVALUATION FORMS:

The procedure for submitting the evaluation form for electrical continuing education courses has been moved to an online format. Please access the following link to complete and submit the form:

**https://portal.ct.gov/ELCeval**

# 2023 Continuing Education for Electricians

**(For All Electrical License Holders)**

## Part 1 - Connecticut General Statutes

## Sec. 20-340. Exemptions from licensing requirements

The provisions of this chapter shall not apply to: (1) Persons employed by any federal, state or municipal agency; (2) employees of any public service company regulated by the Public Utilities Regulatory Authority or of any corporate affiliate of any such company when the work performed by such affiliate is on behalf of a public service company, but in either case only if the work performed is in connection with the rendition of public utility service, including the installation or maintenance of wire for community antenna television service, or is in connection with the installation or maintenance of wire or telephone sets for single-line telephone service located inside the premises of a consumer; (3) employees of any municipal corporation specially chartered by this state; (4) employees of any contractor while such contractor is performing electrical-line or emergency work for any public service company; (5) persons engaged in the installation, maintenance, repair and service of electrical or other appliances of a size customarily used for domestic use where such installation commences at an outlet receptacle or connection previously installed by persons licensed to do the same and maintenance, repair and service is confined to the appliance itself and its internal operation; (6) employees of industrial firms whose main duties concern the maintenance of the electrical work, plumbing and piping work, solar thermal work, heating, piping, cooling work, sheet metal work, elevator installation, repair and maintenance work, automotive glass work or flat glass work of such firm on its own premises or on premises leased by it for its own use; (7) employees of industrial firms when such employees' main duties concern the fabrication of glass products or electrical, plumbing and piping, fire protection sprinkler systems, solar, heating, piping, cooling, chemical piping, sheet metal or elevator installation, repair and maintenance equipment used in the production of goods sold by industrial firms, except for products, electrical, plumbing and piping systems and repair and maintenance equipment used directly in the production of a product for human consumption; (8) persons performing work necessary to the manufacture or repair of any apparatus, appliances, fixtures, equipment or devices produced by it for sale or lease; (9) employees of stage and theatrical companies performing the operation, installation and maintenance of electrical equipment if such installation commences at an outlet receptacle or connection previously installed by persons licensed to make such installation; (10) employees of carnivals, circuses or similar transient amusement shows who install electrical work, provided such installation shall be subject to the approval of the State Fire Marshal prior to use as otherwise provided by law and shall comply with applicable municipal ordinances and regulations; (11) persons engaged in the installation, maintenance, repair and service of glass or electrical, plumbing, fire protection sprinkler systems, solar, heating, piping, cooling and sheet metal equipment in and about single-family residences owned and occupied or to be occupied by such persons; provided any such installation, maintenance and repair shall be subject to inspection and approval by the building official of the municipality in which such residence is located and shall conform to the requirements of the State Building Code; (12) persons who install, maintain or repair glass in a motor vehicle owned or leased by such persons; (13) persons or entities holding themselves out to be retail sellers of glass products, but not such persons or entities that also engage in automotive glass work or flat glass work; (14) persons who install preglazed or preassembled windows or doors in residential or commercial buildings; (15) persons registered under chapter 400 who install safety-backed mirror products or repair or replace flat glass in sizes not greater than thirty square feet in residential buildings; (16) sheet metal work performed in residential

buildings consisting of six units or less by new home construction contractors registered pursuant to chapter 399a, by home improvement contractors registered pursuant to chapter 400 or by persons licensed pursuant to this chapter, when such work is limited to exhaust systems installed for hoods and fans in kitchens and baths, clothes dryer exhaust systems, radon vent systems, fireplaces, fireplace flues, masonry chimneys or prefabricated metal chimneys rated by Underwriters Laboratories or installation of stand-alone appliances including wood, pellet or other stand-alone stoves that are installed in residential buildings by such contractors or persons; (17) employees of or any contractor employed by and under the direction of a properly licensed solar contractor, performing work limited to the hoisting, placement and anchoring of solar collectors, photovoltaic panels, towers or turbines; (18) persons performing swimming pool maintenance and repair work authorized pursuant to section 20-417aa; and (19) any employee of the Connecticut Airport Authority covered by a state collective bargaining agreement.

**Sec. 20-332b. Hiring ratios re apprentices, journeymen and contractors. Electrical, plumbing, heating, piping and cooling, sprinkler fitter and sheet metal work. Regulations.**

**Sec. 20-332b.**

Hiring ratios re apprentices, journeymen and contractors. Electrical, plumbing, heating, piping and cooling, sprinkler fitter and sheet metal work. Regulations. The Commissioner of Consumer Protection shall amend existing regulations of Connecticut state agencies adopted pursuant to section 20-332 to specify the following allowable hiring ratios regarding apprentices, journeymen and contractors for the following trades:

TRADE

Electrical, Plumbing, Heating, Piping and Cooling,
Sprinkler Fitter and Sheet Metal Work

| Apprentices | Licensees (Journeymen or Contractors) |
|---|---|
| 1 | 1 |
| 2 | 2 |
| 3 | 3 |
| 4 | 6 |
| 5 | 9 |
| 6 | 12 |
| 7 | 15 |
| 8 | 18 |
| 9 | 21 |
| 10 | 24 |

Ratio continues at 3 Journeypersons
To 1 Apprentice

(P.A. 10-27, S. 1; P.A. 17-76, S. 2.)

History: P.A. 10-27 effective May 10, 2010; P.A. 17-76 amended licensee numbers corresponding to apprentice numbers 3 to 10, effective June 27, 2017.

**Sec. 20-332-15a. Employment of apprentices**

(a) Nothing in Chapter 393 of the General Statutes shall be construed to prohibit the employment of apprentices.

(b) An apprentice may perform the work for which he is being trained only in the presence and under the direct supervision of a licensed contractor or journeyman in his trade, and shall comply with all the regulations pertaining thereto.

(c) No apprentice shall at any time engage in any of the work for which a license is required without direct supervision. Direct supervision shall mean under the guidance of a licensed contractor or journeyman and within the sight and/or hearing of said licensed person.

(d) Any person who encourages or permits an apprentice or helper to so engage in the work or occupation for which a license is required without direct supervision shall also be subject to appropriate disciplinary action. The contractor who obtains the permit for the work for which a license is required shall be deemed to have encouraged or permitted the apprentice or helper to work without direct supervision for the purpose of disciplinary action by the appropriate board.

**(f) How to register as an apprentice.**

(1) No apprentice shall perform the work of any occupation covered by Chapter 393 of the General Statutes unless he has first obtained a card of registration from the Connecticut Department of Labor.

(2) Prior to employing an apprentice, the contractor shall communicate immediately with the Connecticut Department of Labor to request registration of said apprentice.

(3) When registration is requested for an area of the trade which is not available through the Connecticut Department of Labor, said contractor shall make his request to the appropriate board prior to the employment of the apprentice.

**Sec. 20-332-16. Prohibited acts. Records. Lettering on commercial vehicles**

(a) Any licensee who installs, performs or directs the performance of work in violation of any applicable state statute, state code, or state regulation, any municipal code or ordinance, any of these regulations, or who violates generally accepted basic trade practices shall be subject to disciplinary action by the appropriate board.

(b) Licensed contractors alone shall be permitted to acquire building permits to perform work covered by chapter 393 of the General Statutes and the regulations promulgated thereunder. In order to apply for a building permit to perform work covered by chapter 393 of the General Statutes and the regulations adopted thereunder a contractor shall be directly employed by the business on a regular and full time basis. In applying for the building permit to perform work covered by chapter 393 of the General Statutes and the regulations promulgated thereunder the contractor is attesting to the fact that he is responsible for and will directly supervise the work

being performed under said permit. Except as provided for in Section 20-338b of the General Statutes, the licensed contractor must sign each building permit application personally and may not delegate the signing of the permit to any employee, subcontractor or other agent. Any licensed contractor who violates these regulations shall be subject to disciplinary action by the appropriate board.
(c) No licensee shall engage in or offer to engage in business under any name other than that stated on his application for a license unless he has notified the board ten days prior to using the new name.
(d) Any holder of a journeyman's license who performs work without being in the direct and regular employ of a properly licensed contractor shall be subject to disciplinary action by the appropriate board.
(e) All licensed contractors shall keep a record of all employees they employ and exhibit such records to the Commissioner or her agents upon request.
(f) No one shall perform any work beyond the limitations stated on his license regardless of the type of license his employer holds. Further, no one holding a limited


or unlimited journeyman's license can perform any work beyond the limitations of the license held by the contractor for whom he is employed.
(g) The lettering of the state license numbers required to be displayed on all commercial vehicles used in the contractor's business shall be at least one inch high and legible.
(h) Any holder of a contractor's license who installs, performs or directs the performance of work for which a building permit is required shall cause said performance of work to be performed by a person licensed or registered under the provisions of Section 20-334 of the General Statutes. The contractor who obtains the building permit shall be deemed to have caused or directed the performance of all work performed under the building permit.
(i) No person shall use solder containing mre than 0.2 per cent lead in making joints and fitting in any public or private plumbing, heating or cooling system, or fire protection system as defined in Sections 20-330 (3), 20-330- (5) and 20-330 (9) of the general statutes.

**Sec. 20-335. License fee.** Continuing professional education requirements. Expiration and renewal. Any person who has successfully completed an examination for such person's initial license under this chapter shall pay to the Department of Consumer Protection a fee of one hundred fifty dollars for a contractor's license or a fee of one hundred twenty dollars for any other such license. All such licenses shall expire annually. No person shall carry on or engage in the work or occupations subject to this chapter after the expiration of such person's license until such person has filed an application bearing the date of such person's registration card with the appropriate board. Such application shall be in writing, addressed to the secretary of the board from which such renewal is sought and signed by the person applying for such renewal. A licensee applying for renewal shall, at such times as the commissioner shall by regulation prescribe, furnish evidence satisfactory to the board that the licensee has completed any continuing professional education required under sections 20-330 to 20-341, inclusive, or any regulations adopted thereunder. The board may renew such license if the application for such

renewal is received by the board no later than one month after the date of expiration of such license, upon payment to the department of a renewal fee of one hundred fifty dollars in the case of a contractor and of one hundred twenty dollars for any other such license. For any completed renewal application submitted pursuant to this section that requires a hearing or other action by the applicable examining board, such hearing or other action by the applicable examining board shall occur not later than thirty days after the date of submission for such completed renewal application. The department shall issue a receipt stating the fact of such payment, which receipt shall be a license to engage in such work or occupation. A licensee who has failed to renew such licensee's license for a period of over one year from the date of expiration of such license shall have it reinstated only upon complying with the requirements of section 20-333. All license fees and renewal fees paid to the department pursuant to this section shall be deposited in the General Fund.

**Sec. 20-338. License as contractor and journeyman.** Valid throughout state. The Department of Consumer Protection shall issue a separate license to persons qualified to engage in work as contractors and as journeymen. Any person licensed under this chapter shall be permitted to perform the work or occupation covered by such license in any town or municipality of this state without further examination or licensing by any town or municipality.

**Sec. 20-338a. Work required to be performed by licensed persons.** Any contractor who applies for a building permit from a local building official for any work required to be performed by a person licensed under the provisions of this chapter, shall cause such work to be performed by a person licensed under the provisions of this chapter.

**Sec. 20-338b. Building permit applications.** Who may sign. Any licensed contractor who seeks to obtain a permit from a building official may sign the building permit application personally or delegate the signing of the building permit application to an employee, subcontractor or other agent of the licensed contractor, provided, the licensed contractor's employee, subcontractor or other agent submits to the building official a dated letter on the licensed contractor's letterhead, signed by the licensed contractor, stating that the bearer of the letter is authorized to sign the building permit application as the agent of the licensed contractor. The letter shall not be a copy or a facsimile, but shall be an original letter bearing the original signature of the licensed contractor. The letter shall also include: (1) The name of the municipality where the work is to be performed; (2) the job name or a description of the job; (3) the starting date of the job; (4) the name of the licensed contractor; (5) the name of the licensed contractor's agent; and (6) the license numbers of all contractors to be involved in the work.

**Sec. 20-338c. Work not to commence until permit obtained.** No person licensed pursuant to sections 20-330 to 20-341, inclusive, shall commence work within the scope of sections 20-330 to 20-341, inclusive, unless each applicable permit with respect to the specific work being performed by such licensee has been obtained as required pursuant to local ordinances and the general statutes.

**Sec. 20-340. Exemptions from licensing requirements.** The provisions of this chapter shall not apply to: (1) Persons employed by any federal, state or municipal agency; (2) employees of any

public service company regulated by the Public Utilities Regulatory Authority or of any corporate affiliate of any such company when the work performed by such affiliate is on behalf of a public service company, but in either case only if the work performed is in connection with the rendition of public utility service, including the installation or maintenance of wire for community antenna television service, or is in connection with the installation or maintenance of wire or telephone sets for single-line telephone service located inside the premises of a consumer; (3) employees of any municipal corporation specially chartered by this state; (4) employees of any contractor while such contractor is performing electrical-line or emergency work for any public service company; (5) persons engaged in the installation, maintenance, repair and service of electrical or other appliances of a size customarily used for domestic use where such installation commences at an outlet receptacle or connection previously installed by persons licensed to do the same and maintenance, repair and service is confined to the appliance itself and its internal operation; (6) employees of industrial firms whose main duties concern the maintenance of the electrical work, plumbing and piping work, solar thermal work, heating, piping, cooling work, sheet metal work, elevator installation, repair and maintenance work, automotive glass work or flat glass work of such firm on its own premises or on premises leased by it for its own use; (7) employees of industrial firms when such employees' main duties concern the fabrication of glass products or electrical, plumbing and piping, fire protection sprinkler systems, solar, heating, piping, cooling, chemical piping, sheet metal or elevator installation, repair and maintenance equipment used in the production of goods sold by industrial firms, except for products, electrical, plumbing and piping systems and repair and maintenance equipment used directly in the production of a product for human consumption; (8) persons performing work necessary to the manufacture or repair of any apparatus, appliances, fixtures, equipment or devices produced by it for sale or lease; (9) employees of stage and theatrical companies performing the operation, installation and maintenance of electrical equipment if such installation commences at an outlet receptacle or connection previously installed by persons licensed to make such installation; (10) employees of carnivals, circuses or similar transient amusement shows who install electrical work, provided such installation shall be subject to the approval of the State Fire Marshal prior to use as otherwise provided by law and shall comply with applicable municipal ordinances and regulations; (11) persons engaged in the installation, maintenance, repair and service of glass or electrical, plumbing, fire protection sprinkler systems, solar, heating, piping, cooling and sheet metal equipment in and about single-family residences owned and occupied or to be occupied by such persons; provided any such installation, maintenance and repair shall be subject to inspection and approval by the building official of the municipality in which such residence is located and shall conform to the requirements of the State Building Code; (12) persons who install, maintain or repair glass in a motor vehicle owned or leased by such persons; (13) persons or entities holding themselves out to be retail sellers of glass products, but not such persons or entities that also engage in automotive glass work or flat glass work; (14) persons who install preglazed or preassembled windows or doors in residential or commercial buildings; (15) persons registered under chapter 400 who install safety-backed

mirror products or repair or replace flat glass in sizes not greater than thirty square feet in residential buildings; (16) sheet metal work performed in residential buildings consisting of six units or less by new home construction contractors registered pursuant to chapter 399a, by home improvement contractors registered pursuant to chapter 400 or by persons licensed pursuant to this chapter, when such work is limited to exhaust systems installed for hoods and fans in kitchens and baths, clothes dryer exhaust systems, radon vent systems, fireplaces, fireplace flues, masonry chimneys or prefabricated metal chimneys rated by Underwriters Laboratories or installation of stand-alone appliances including wood, pellet or other stand-alone stoves that are installed in residential buildings by such contractors or persons; (17) employees of or any contractor employed by and under the direction of a properly licensed solar contractor, performing work limited to the hoisting, placement and anchoring of solar collectors, photovoltaic panels, towers or turbines; and (18) persons performing swimming pool maintenance and repair work authorized pursuant to section 20-417aa.

**Sec. 20-341. Penalties for violations.** (a) Any person who wilfully engages in or practices the work or occupation for which a license is required by this chapter or chapter 399b without having first obtained an apprentice permit or a certificate and license for such work, as applicable, or who wilfully employs or supplies for employment a person who does not have a certificate and license for such work, or who wilfully and falsely pretends to qualify to engage in or practice such work or occupation, including, but not limited to, offering to perform such work in any print, electronic, television or radio advertising or listing when such person does not hold a license for such work as required by this chapter, or who wilfully engages in or practices any of the work or occupations for which a license is required by this chapter after the expiration of such person's license, shall be guilty of a class B misdemeanor, provided no criminal charges shall be instituted against such person pursuant to this subsection unless the work activity in question is reviewed by the Commissioner of Consumer Protection, or the commissioner's authorized agent, and the commissioner or such agent specifically determines, in writing, that such work activity requires a license and is not the subject of a bona fide dispute between persons engaged in any trade or craft, whether licensed or unlicensed. Notwithstanding the provisions of subsection (d) or (e) of section 53a-29 and subsection (d) of section 54-56e, if the court determines that such person cannot fully repay any victims of such person within the period of probation established in subsection (d) or (e) of section 53a-29 or subsection (d) of section 54-56e, the court may impose probation for a period of not more than five years. The penalty provided in this subsection shall be in addition to any other penalties and remedies available under this chapter or chapter 416.

(b) The appropriate examining board or the Commissioner of Consumer Protection may, after notice and hearing, impose a civil penalty on any person who engages in or practices the work or occupation for which a license or apprentice registration certificate is required by this chapter, chapter 394, chapter 399b or chapter 482 without having first obtained such a license or certificate, or who wilfully employs or supplies for employment a person who does not have such a license or certificate or who wilfully and falsely pretends to qualify to engage in or practice such work or occupation, or who engages in or practices any of the work or occupations for which a license or certificate is required by this chapter, chapter 394, chapter 399b or chapter

482 after the expiration of the license or certificate or who violates any of the provisions of this chapter, chapter 394, chapter 399b or chapter 482 or the regulations adopted pursuant thereto. Such penalty shall be in an amount not more than one thousand dollars for a first violation of this subsection, not more than one thousand five hundred dollars for a second violation of this subsection and not more than three thousand dollars for each violation of this subsection occurring less than three years after a second or subsequent violation of this subsection, except that any individual employed as an apprentice but improperly registered shall not be penalized for a first offense.

(c) If an examining board or the Commissioner of Consumer Protection imposes a civil penalty under the provisions of subsection (b) of this section as a result of a violation initially reported by a municipal building official in accordance with subsection (c) of section 29-261, the commissioner shall, not less than sixty days after collecting such civil penalty, remit one-half of the amount collected to such municipality.

(d) A violation of any of the provisions of this chapter shall be deemed an unfair or deceptive trade practice under subsection (a) of section 42-110b.

(e) This section shall not apply to any person who (1) holds a license issued under this chapter, chapter 394, chapter 399b or chapter 482 and performs work that is incidentally, directly and immediately appropriate to the performance of such person’s trade where such work commences at an outlet, receptacle or connection previously installed by a person holding the proper license, or (2) engages in work that does not require a license under this chapter, chapter 394, chapter 399b or chapter 482.

**Substitute House Bill No. 6100**

**Public Act No. 21-37**

**AN ACT CONCERNING DEPARTMENT OF CONSUMER PROTECTION LICENSING AND ENFORCEMENT, ANTITRUST ISSUES AND THE PALLIATIVE USE OF MARIJUANA AND REVISIONS TO THE LIQUOR CONTROL ACT.**

Sec. 16. Section 21a-10 of the general statutes is repealed and the following is substituted in lieu thereof (Effective October 1, 2021):

(a) The Commissioner of Consumer Protection may establish, combine or abolish divisions, sections or other units within the Department of Consumer Protection and allocate powers, duties and functions among such units, but no function vested by statute in any officer, division, board, agency or other unit within the department shall be removed from the jurisdiction of such officer, division, board, agency or other unit under the provisions of this section.

(b) The Commissioner of Consumer Protection shall adopt regulations, in accordance with chapter 54, to designate a staggered schedule for the renewal of all licenses, certificates, registrations and permits issued by said department. If such designation of a staggered schedule results in the expiration of any license, certificate, registration or permit for a period of less than or more than one year, said commissioner may charge a prorated amount for such license, certificate, registration or permit. For any new license, certificate, registration or permit that is issued and for any guaranty fund fee that is imposed on or after January 1, 1995, the commissioner may charge a one-time prorated amount for such newly issued license, certificate, registration, permit or guaranty fund fee.

(c) For any Department of Consumer Protection license, certificate, registration or permit that requires the holder to complete continuing education requirements, the continuing education requirements shall be completed within the annual or biannual period that begins and ends three months prior to the renewal date for the applicable license, certificate, registration or permit, except for licenses issued pursuant to chapter 400j.

Sec. 23. (NEW) (Effective January 1, 2022) (a) No contract to perform work on a private residence, as defined in section 20-419 of the general statutes, by a contractor licensed pursuant to chapter 393 of the general statutes or any person who owns or controls a business engaged to provide the work or services licensed under the provisions of said chapter by persons licensed for such work, shall be valid or enforceable against an owner, as defined in section 20-419 of the general statutes, unless it: (1) Is in writing; (2) is signed by the owner and the contractor or business; (3) contains the entire agreement between the owner and the contractor or business; (4) contains the date of the transaction; (5) contains the name and address of the contractor and the contractor's license number or, in the case of a business, the name of the business owner, partner or limited liability member and the phone number and address of the business, partnership or limited liability company; (6) contains the name and

license number of any licensees performing the work, provided the name and the license number of a licensee may be amended in writing during the term of the contract; (7) contains a notice of the owner's cancellation rights in accordance with the provisions of chapter 740 of the general statutes; and (8) contains a starting date and completion date.

(b) Each change in the terms and conditions of a contract specified in subsection (a) of this section shall be in writing and shall be signed by the owner and contractor or business, except that the commissioner may, by regulations adopted pursuant to chapter 54 of the general statutes, dispense with the necessity for complying with such requirement.

**House Bill No. 6378 Public Act No. 21-154 AN ACT CODIFYING PREVAILING WAGE CONTRACT RATES.**

Be it enacted by the Senate and House of Representatives in General Assembly convened: Section 1. Subsection (d) of section 31-53 of the general statutes is repealed and the following is substituted in lieu thereof (Effective October 1, 2021):

(d) For the purpose of predetermining the prevailing rate of wage on an hourly basis and the amount of payment, [or] contributions and member benefits paid or payable on behalf of each person to any employee welfare fund, as defined in subsection (i) of this section, in each town where such contract is to be performed, the Labor Commissioner shall [(1) hold a hearing at any required time to determine the prevailing rate of wages on an hourly basis and the amount of payment or contributions paid or payable on behalf of each person to any employee welfare fund, as defined in subsection (i) of this section, upon any public work within any specified area, and shall establish classifications of skilled, semiskilled and ordinary labor, or (2)] adopt the rate of wages on an hourly basis in accordance with the provisions of this section and section 31-76c and the amount of payment, contributions and member benefits, including health, pension, annuity and apprenticeship funds, as recognized by the United States Department of Labor and the Labor Commissioner paid or payable on House Bill No. 6378 Public Act No. 21-154 2 of 3 behalf of each person to any employee welfare fund, as defined in subsection (i) of this section, as established in the collective bargaining agreements or understandings between employers or employer associations and bona fide labor organizations for the same work in the same trade or occupation in the town in which the applicable building, heavy or highway works project is being constructed. For each trade or occupation for which more than one collective bargaining agreement is in effect for the town in which such project is being constructed, the collective bargaining agreement of historical jurisdiction shall prevail. For residential project rates and for each trade or occupation for which there is no collective bargaining agreement in effect for the town in which the building, heavy or highway works project is being constructed, the Labor Commissioner shall adopt and use such appropriate and applicable prevailing wage rate determinations as have been made by the Secretary of Labor of the United States under the provisions of the Davis-Bacon Act, as amended.

Sec. 2. Section 31-54 of the general statutes is repealed and the following is substituted in lieu thereof (Effective October 1, 2021):

The Labor Commissioner shall [hold a hearing at any required time to] determine the prevailing rate of wages upon any highway contract within any specified area on an hourly basis and the amount of payment or contributions paid or payable on behalf of each employee to any employee welfare fund, as defined in section 31-53, as amended by this act, upon any classifications of skilled, semiskilled and ordinary labor. Said commissioner shall determine the prevailing rate of wages on an hourly basis and the amount of payment or contributions paid or payable on behalf of each employee to any employee welfare fund, as defined in section 31-53, as amended by this act, in each locality where any highway or bridge is to be constructed, and the Commissioner of Transportation shall include such rate of wage on an hourly basis and the amount of payment or contributions paid or payable on behalf of each employee to any employee welfare fund, as defined in section 31- 53, as amended by this act, or in lieu thereof, in cash as part of wages each pay day, for each classification of labor in the proposal for the contract and in the contract. The rate and the amount so established shall, at all times, be considered as the minimum rate of wage on an hourly basis and the amount of payment or contributions to an employee welfare fund, or cash in lieu thereof, for the classification for which it was established. Any contractor who pays any person at a lower rate of wage on an hourly basis or the amount of payment or contributions paid or payable on behalf of each employee to any employee welfare fund, as defined in section 31-53, as amended by this act, or where he is not obligated by any agreement to make payment or contributions to the employee welfare funds, as defined in section 31- 53, as amended by this act, and fails to pay the amount of such payment or contributions directly to the employee as a part of his wages each pay day, than that so established for the classifications of work specified in any such contract shall be fined not more than two hundred dollars for each offense. The provisions of this section shall apply only to state highways and bridges on state highways.

Approved July 12, 2021

# 2023 Continuing Education for Electricians

**(For All Electrical License Holders)**

## Part 2 - Safety

| OSHA Standard | FY 2021 Preliminary Data | Previous Year's Data |
|---|---|---|
| **1. Fall Protection – General Requirements (1926.501)**<br>OSHA Fall Protection Defense Guide<br>Construction Fall Protection Standards | 5,271 Violations | No. 1 with 5,424 Violations |
| **2. Respiratory Protection (1910.134)**<br>Selecting and Using Particulate Respirators<br>Starting a Respiratory Protection Program | 2,521 Violations | No. 3 with 2,649 Violations |
| **3. Ladders (1926.1053)**<br>Are Your Ladders Compliant?<br>Ladder Safety Tips | 2,018 Violations | No. 5 with 2,129 Violations |
| **4. Scaffolding (1926.451)**<br>OSHA Scaffolding Requirements for Construction and General Industry | 1,943 Violations | No. 4 with 2,538 Violations |
| **5. Hazard Communication (1910.1200)**<br>OSHA's Revised Hazard Communication Standard | 1,939 Violations | No. 2 with 3,199 Violations |
| **6. Lockout/Tagout (1910.147)**<br>When Does the Lockout/Tagout Standard Apply? | 1,670 Violations | No. 6 with 2,065 Violations |
| **7. Fall Protection – Training Requirements (1926.503)** | 1,660 Violations | No. 8 with 1,621 Violations |

| | | |
|---|---|---|
| ANSI/ASSP Z359: Fall Protection Standards System | | |
| **8. Personal Protective and Life Saving Equipment – Eye and Face Protection (1926.102)**<br>PPE Requirements: Eye and Face Protection | 1,451 Violations | No. 9 with 1,369 Violations |
| **9. Powered Industrial Trucks (1910.178)**<br>Forklift Safety Training Guide | 1,404 Violations | No. 7 with 1,932 Violations |
| **10. Machine Guarding (1910.212)**<br>OSHA Requirements: Machine Guarding | 1,105 Violations | No. 10 with 1,313 Violations |

# 2023 Continuing Education for Electricians

**(For All Electrical License Holders)**

## Part 3 – National Electrical Code

# Analysis of Changes – 2020 *NEC*

***Part 1 – NEC Chapters 1 through 4***

Training Presentation By:
International Association of Electrical Inspectors

1

## Licensing Agreement

- This program is licensed solely for the purpose of in-person electrical education and training by the licensee.
- *Analysis of Changes-NEC 2020* training presentation is prohibited from being further copied, broadcast, posted online, sublicensed, used for on-line training or in any way further distributed or displayed for any other purpose by the licensee.




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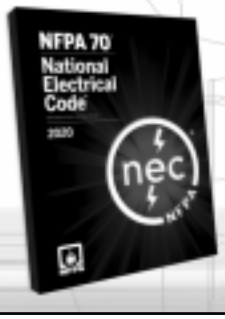





3

## Analysis of Changes – 2020 *NEC*





4

## Code-Wide Changes

5

## Code-Wide Changes

- There were a total of **3730** Public Inputs (PI) and **1930** Public Comments (PC) submitted from interested participants seeking changes to the 2020 *NEC*
- **Available Fault Current References.** Different terms like "available short-circuit current" and "short-circuit current" were previously used to describe large amounts of current capable of being delivered at a point on the system during a short-circuit condition. For the 2020 *NEC*, these large amounts of current descriptions were changed to "**available fault current**" throughout the *Code* for improved consistency
- **Reconditioned Equipment, Yes or No ?** Each Code Making Panel (CMP) was asked to review the equipment they have purview over and determine what equipment could be reconditioned and what equipment could not be reconditioned but rather replaced when necessary



6

## Code-Wide Changes *(cont.)*

- **Definition Statements.** Two distinct statements added at XXX.2 sections of the *Code*
  - "*The definitions in this section shall apply only within this article*."
  - "*The definitions in this section shall apply within this article and throughout the Code.*"
- **GFCI Requirements Alignment with 210.8.** Changes were proposed throughout the *Code* to align all GFCI requirements with the GFCI requirements of 210.8
- **"~~Allowable~~" Ampacity.** Several locations across the *NEC* where the term "allowable ampacity" was used and should have been simply stated as "**ampacity**" as it is the intent for those sections to determine the ampacity of a conductor based upon its conditions of use



7

## Code-Wide Changes *(cont.)*

- **Grounding Conductor Changed to Equipment Grounding Conductor.** The term "grounding conductor" *(not a defined term)* was replaced with mainly the proper term "equipment grounding conductor," but in some instances with the terms "grounding electrode conductor" or one of the several types of "bonding jumpers"



8

## Code-Wide Changes


9

## New Articles for the 2020 *NEC*

**Article 242 Overvoltage Protection (CMP-18)** This article provides the general requirements, installation requirements, and connection requirements for overvoltage protection and overvoltage protective devices. Part II covers surge-protective devices (SPDs) permanently installed on premises wiring systems of not more than 1000 volts, nominal, while Part III covers surge arresters permanently installed on premises wiring systems over 1000 volts, nominal.

**Article 337 Type P Cable (CMP-6)** This article covers the use, installation, and construction specifications for up through 2000-volt Type P cable (armored and unarmored). Type P cable is a factory assembly of one or more insulated flexible tinned copper conductors, with associated equipment grounding conductor(s), with or without a braided metallic armor and with an overall nonmetallic jacket.

**Article 311 Medium Voltage Conductors and Cable (CMP-6)** This article covers the use, installation, construction specifications, and ampacities for Type MV medium voltage conductors and cable. Type MV conductor and cable requirements that were previously found in Articles 310 (Conductors or General Use) and 328 (Medium Voltage Cable) were consolidated into one article.

**Article 800 General Requirements for Communications Systems (CMP-16)** This article covers general requirements for communications systems. These general requirements apply to communications circuits, community antenna television and radio distribution systems, network-powered broadband communications systems, and premises-powered broadband communications systems, unless modified by Articles 805, 820, 830, and or 840. *(Previous Article 800 (Communication Circuits) is now Article 805)*



10

# Article 90 Introduction

11

## 90.2(A) Scope

- Revision clarifies that the *NEC* covers installations **supplying shore power to** ships and watercraft, including monitoring of leakage current
- 90.2(B)(1) reveals that **installations in** ships and watercraft *(other than floating buildings)* are not covered by the *NEC*
  - This does not include electrical supply system **supplying shore power to** ships and watercraft
- Change intended for ships, boats, and other watercraft covered by **Article 555**
- New provision was necessary to address potential hazards created where shore power is supplied to ships and watercraft with a significant number of fatalities from **electric shock drowning (ESD)** associated with leakage of current from watercraft connected to shore power



12

13

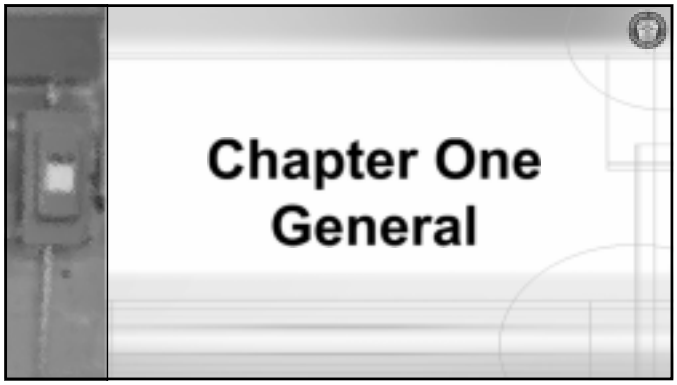
## 90.2(A) Scope

- A new (6) has been added to 90.2(A) to address installations used to **export power from electric vehicles to premises wiring**
- Bidirectional flow of power is typically accomplished using utility interactive inverters



14

15




16

## Article 100: Definitions - Scope

- Scope of Article 100 is modified to include **new Part III for Hazardous (Classified) Locations**
- During the 2017 *NEC* revision cycle, several definitions that applied to hazardous (classified) locations were relocated to Article 100 of the *NEC*
- Previously located at 500.2 *(2014 NEC)*
- Creating new Part III and the relocation of these definitions will add clarity and usability and help users of the *Code* understand that these definitions only apply to hazardous (classified) location articles located in Chapter 5



17

## Article 100 Part III Hazardous (Classified) Locations (CMP-14)


The hazardous (classified) location definitions will be moved to new Part III of Article 100 for added clarity and usability

18

## Article 100: Definitions – Scope *(cont.)*

- New sentence added to Scope of Article 100 to indicate that definitions can also be found at "**XXX.2 of other articles**"
- Two distinct statements added at XXX.2 sections of the *Code*
  - *"The definitions in this section shall apply only within this article*."
  - "*The definitions in this section shall apply within this article and throughout the Code*"
- This was in conjunction with an effort this *Code* cycle to make a distinction to definitions found throughout the *Code*, particularly at XXX.2 of individual articles



19

## Article 100: Definitions - Accessible

- **Accessible (as applied to equipment)**. Capable of being reached for operation, renewal, and inspection. (CMP-1)
- Definition revised for clarity and usability
- Previous definition seemed to contradict other sections of the *Code*
- By stating that equipment is not accessible, if "guarded by locked doors" was in contradiction with 110.26(F) *[electrical equipment rooms or enclosures housing electrical apparatus that are controlled by a lock(s) shall be considered accessible to qualified persons]*
- Former definition also stated that equipment could be considered not accessible by "elevation" while the *Code* demonstrates that equipment can still be considered accessible, despite being elevated *(above suspended ceiling)*



20


21

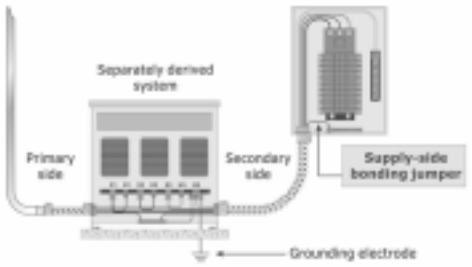
## Article 100: Definitions - SSBJ

- **Bonding Jumper, Supply-Side**. A conductor installed on the supply side of a service or within a service equipment enclosure(s), or for a separately derived system, that ensures the required electrical conductivity between metal parts required to be electrically connected. (CMP-5)
- Definition of a **Supply-Side Bonding Jumper** was relocated from 250.2 to Article 100
- Prior to 2011 *NEC*, the term “equipment bonding jumper” used at most locations to described a fault carrying conductor for a separately derived system
- Supply-side bonding jumper provides electrical continuity between the supply source *(such as the utility transformer enclosure)* and the various enclosures of the service equipment



22

## Article 100 - Supply-Side Bonding Jumper




**Bonding Jumper, Supply Side -** A conductor installed on the supply side of a service or within a service equipment enclosure(s), or for a separately derived system, that ensures the required electrical conductivity between metal parts required to be electrically connected. (CMP-5)

23

## Article 100: Definitions – Dormitory Unit

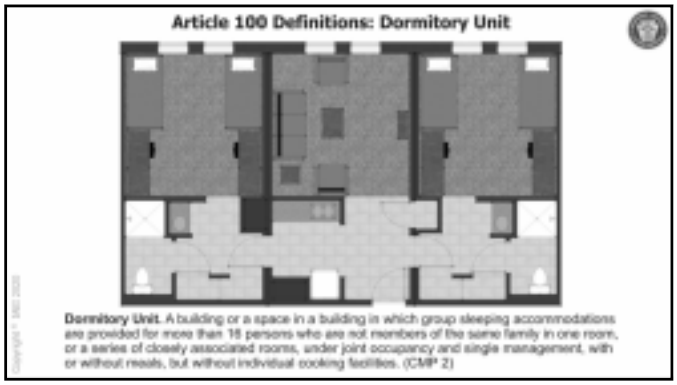
- **Dormitory Unit.** A building or a space in a building in which group sleeping accommodations are provided for more than 16 persons who are not members of the same family in one room, or a series of closely associated rooms, under joint occupancy and single management, with or without meals, but without individual cooking facilities. (CMP 2)
- New definition for a “Dormitory Unit” was introduced at Article 100
- Used in (4) different articles but was not defined in the *NEC*
- Without an *NEC* definition, installers and inspectors alike experience a **wide variety of interpretation** as to what constitutes a dormitory unit
- While a dormitory unit can certainly be found at a typical college campus, a dormitory unit is not limited to a learning institution



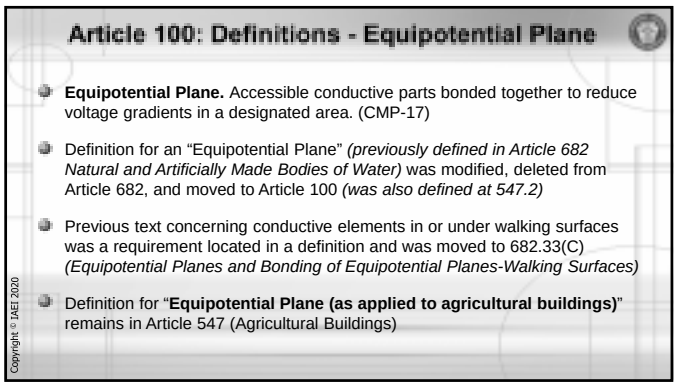
24


Article 100 Definitions
Dormitory Unit

25


Article 100 Definitions: Dormitory Unit
Dormitory Unit. A building or a space in a building in which group sleeping accommodations are provided for more than 16 persons who are not members of the same family in one room, or a series of closely associated rooms, under joint occupancy and single management, with or without meals, but without individual cooking facilities. (CMP 2)

26


Article 100: Definitions - Equipotential Plane
Equipotential Plane. Accessible conductive parts bonded together to reduce voltage gradients in a designated area. (CMP-17)
Definition for an "Equipotential Plane" (previously defined in Article 682 Natural and Artificially Made Bodies of Water) was modified, deleted from Article 682, and moved to Article 100 (was also defined at 547.2)
Previous text concerning conductive elements in or under walking surfaces was a requirement located in a definition and was moved to 682.33(C) (Equipotential Planes and Bonding of Equipotential Planes-Walking Surfaces)
Definition for "Equipotential Plane (as applied to agricultural buildings)" remains in Article 547 (Agricultural Buildings)
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## Article 100: Fault Current and Fault Current, Available

- New definitions of the terms **"fault current"** and **"fault current, available"** have been added to Article 100
- A **new informational note** and associated figure have been added to enhance clarity and usability
- This revision aligns with similar recent revisions in other standards that use the terms, such as NFPA 70E
- Different terms were used to describe large amount of current capable of being delivered at a point on the system during a short-circuit condition:
  - Maximum available fault current and Maximum available short-circuit current, Short circuit, fault current, available fault current, short-circuit current rating, interrupting rating, available short-circuit current, short-circuit current, available fault current



29

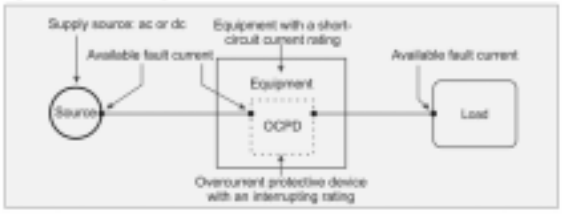
## Article 100: Definitions

**Fault Current.** The current delivered at a point on the system during a short-circuit condition. (CMP-10)

**Available Fault Current.** The largest amount of current capable of being delivered at a point on the system during a short-circuit condition. (CMP-10)

**Informational Note:** A short-circuit can occur during abnormal conditions such as a fault between circuit conductors or a ground fault. See Informational Note Figure 100.1.

**Figure Informational Note Figure 100.1 Available Fault Current.**




30

## Article 100: Definitions – Free Air

- **Free Air (as applied to conductors)**. Open or ventilated environment that allows for heat dissipation and air flow around an installed conductor. (CMP-6)
- New definition for “Free Air (as applied to conductors)” added to Article 100
- The term “free air” is used throughout the *NEC*, yet to this point, this term has not been defined in the *NEC*
- Contact or close proximity with additional conductors or other materials that could impede the flow of heat away from the conductor would not allow the use of free air ampacity ratings of the conductor ampacity tables in Article 310



31

## Article 100 Definitions: Free Air (as Applied to Conductors)

**Free Air (as applied to conductors).** Open or ventilated environment that allows for heat dissipation and air flow around an installed conductor. (CMP-6)

New definition should clarify that contact or close proximity with additional conductors or other materials that could impede the flow of heat away from the conductor would not allow the use of free air ampacity ratings of the conductor ampacity tables in Article 310

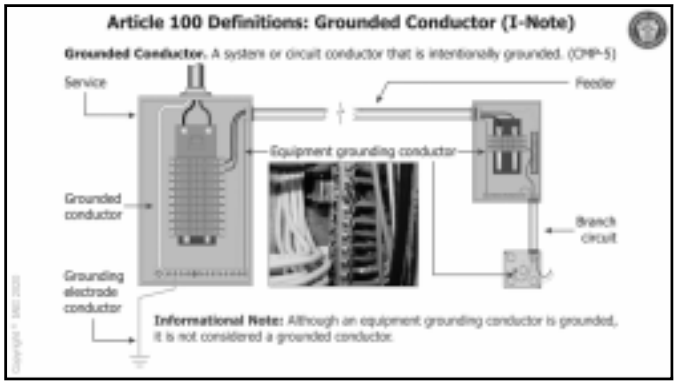
32

## Article 100: Definitions – Grounded Conductor, Informational Note

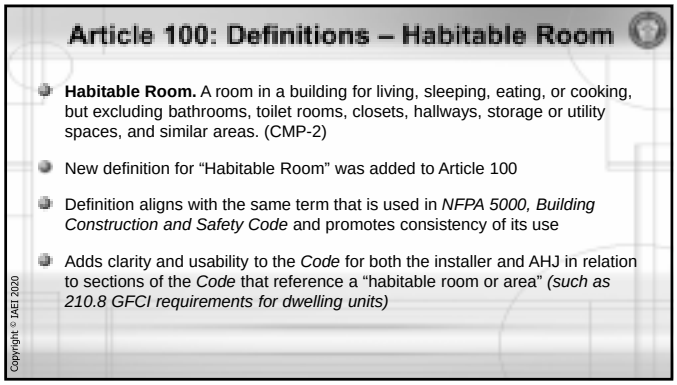
- A new Informational note was added to the definition of a “Grounded Conductor” to clarify that an **equipment grounding conductor** is **not subject to** the identification and connection rules of a grounded conductor
- I-Note states that although an equipment grounding conductor is grounded, it is **not considered a grounded conductor**
- Some would argue that an EGC is an “intentionally grounded” conductor while others would say an EGC is not by definition an “intentionally grounded” conductor as it is not a “system or circuit” conductor



33


Article 100 Definitions: Grounded Conductor (I-Note)
Grounded Conductor. A system or circuit conductor that is intentionally grounded. (CMP-5)
Service
Feeder
Equipment grounding conductor
Grounded conductor
Branch circuit
Grounding electrode conductor
Informational Note: Although an equipment grounding conductor is grounded, it is not considered a grounded conductor.

34


Article 100: Definitions – Habitable Room
Habitable Room. A room in a building for living, sleeping, eating, or cooking, but excluding bathrooms, toilet rooms, closets, hallways, storage or utility spaces, and similar areas. (CMP-2)
New definition for "Habitable Room" was added to Article 100
Definition aligns with the same term that is used in NFPA 5000, Building Construction and Safety Code and promotes consistency of its use
Adds clarity and usability to the Code for both the installer and AHJ in relation to sections of the Code that reference a "habitable room or area" (such as 210.8 GFCI requirements for dwelling units)
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Article 100 Definitions
Habitable Room

36

## Article 100: Definitions – Island Mode

- **Island Mode.** The operational mode for stand-alone power production equipment or an isolated microgrid, or for a multimode inverter or an interconnected microgrid that is disconnected from an electric power production and distribution network or other primary power source. (CMP-4)
- **Informational Note:** Isolated microgrids are distinguished from interconnected microgrids, which are addressed in Article 705.
- New definition for "Island Mode" primarily related to microgrid systems and stand-alone systems was added to Article 100
- A stand-alone (or islanded mode) microgrid never connects to the utility grid but instead operate in an island mode at all times
- Using terms like "stand-alone mode" and "islanded mode" necessitated the need to define these terms as they are used often in in the Chapter 7 articles



37

## Article 100: Definitions – Island Mode *(cont.)*

- Name was changed to simply "Island Mode"
- Changes were made to the definition to better clarify the use of the term and how it applies to various applications that operate in island mode
- Name was changed from "Stand-Alone (Islanded) Mode" to "Island Mode" as the changes made to the definition of "Stand-Alone System" in Article 100 and the proposed definition of "Stand-Alone (Islanded) Mode" originally slated for 710.2 caused confusion with the definition of "Microgrid System" in Article 705
- Definitions consistent with IEEE 1547-2018 - IEEE *Standard for Interconnection and Interoperability of Distributed Energy Resources with Associated Electric Power Systems Interfaces*



38

39

## Article 100 Labeled

- New Informational Note added explaining that even though a section of the *NEC* may require a product to be labeled, it is common practice to have the label, symbol, or other identifying mark applied to the **smallest unit container** in which the product is packaged
- Several types of electrical equipment addressed in the *NEC* that are required to not only be "**Listed**," but also required to be "**Labeled**"
- A typical pressure wire connector (wire nut) for splicing conductors together is required to be listed and labeled, but it is one of those products that are too small to affix a label to each individual pressure wire connector



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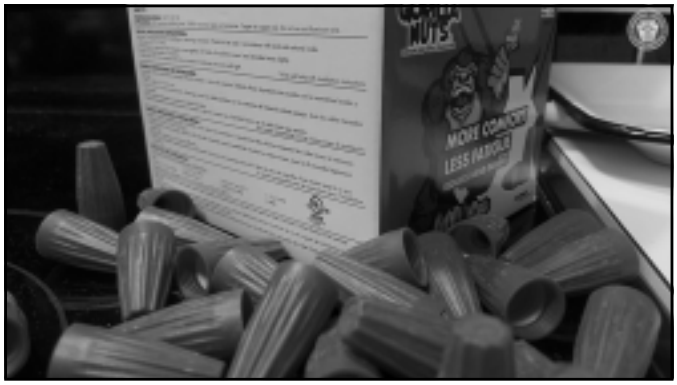


41

## Article 100: Definitions – Reconditioned

- A new definition for "**Reconditioned**" was added to Article 100 and an **informational note** added to indicate that the term reconditioned is frequently referred to as **rebuilt**, **refurbished**, or **remanufactured**
- Several requirements added throughout the *Code* added to indicate if specific equipment **can or cannot be reconditioned** *(see receptacles, switches, panelboards, circuit breakers, etc.)*
- Definition based on a National Electrical Manufacturers Association (NEMA) document titled, "*NEMA Policy on Reconditioned Electrical Equipment*"
- Marking requirements for reconditioned, refurbished or remanufactured electrical equipment added to 110.21(A)(2) for 2017 *NEC*



42

## Article 100 Definitions: Reconditioned

**Reconditioned.** Electromechanical systems, equipment, apparatus, or components that are restored to operating conditions. This process differs from normal servicing of equipment that remains within a facility, or replacement of listed equipment on a one-to-one basis. (CMP-10)


*See also 110.21(A)(2)

**Informational Note:** The term reconditioned is frequently referred to as rebuilt, refurbished, or remanufactured.

43

## 110.3(B) Installation and Use of Listed Equipment

- Equipment that is listed, labeled, **or both** shall be installed and used in accordance with any instructions included in the listing or labeling
- Listing requirements were **modified** for clarity and usability to address equipment that is listed, labeled, **or both**
- The words “listed” and “labeled” are often looked upon as interchangeable by installers and inspectors alike even though both of these terms are defined in Article 100
- Electrical equipment can easily be both listed and labeled
- Marking on the product is the manufacturer’s substantiation that the product is in compliance with the appropriate product standard
- Only true way AHJ can determine whether the inspected product is compliant with the applicable product standard is the third-party label on the product



44

## 110.3(B) Installation and Use of Listed Equipment


Equipment that is listed, labeled, or both shall be installed and used in accordance with any instructions included in the listing or labeling

45

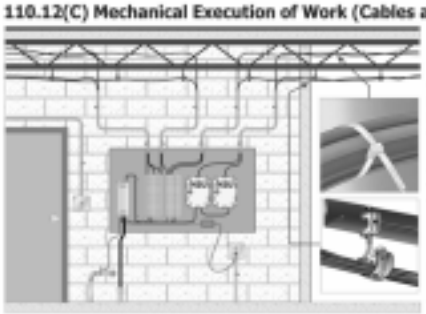
## 110.12(C) Cables and Conductors

- Redundant requirements for "**Mechanical Execution of Work"** for communication cables and conductors in Chapter 7 and 8 were relocated to Article 110
- A new subdivision (C) titled "**Cables and Conductors**" has been added to 110.12 which is titled "**Mechanical Execution of Work**"
- Includes relocated requirements from the **.24 sections** from the communications articles in Chapters 7 and 8
- Conductor and cable support and concerns about damage are addressed in both 110.12(C) and in 800.24



46

## 110.12(C) Mechanical Execution of Work (Cables and Conductors)



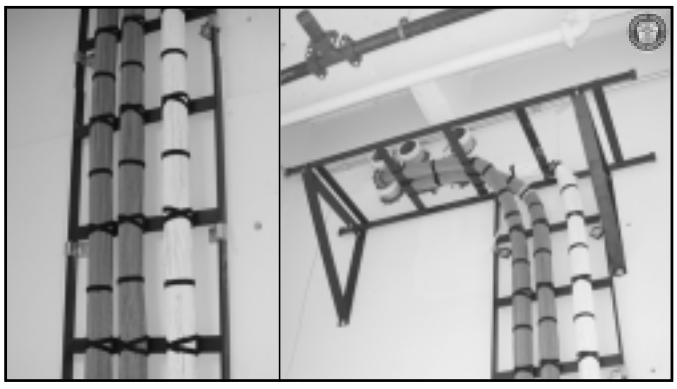
Exposed cables and conductors to be supported by building structure to prevent damaged by normal building use

Cables and conductors to be secured by hardware (straps, staples, cable ties, hangers, etc.) designed and installed to not damage the cable

Installation to comply with 300.4 and 300.11

Nonmetallic cable ties and other nonmetallic cable accessories used to secure and support cables in environmental air spaces (plenums) must be listed as having low smoke and heat release properties

47



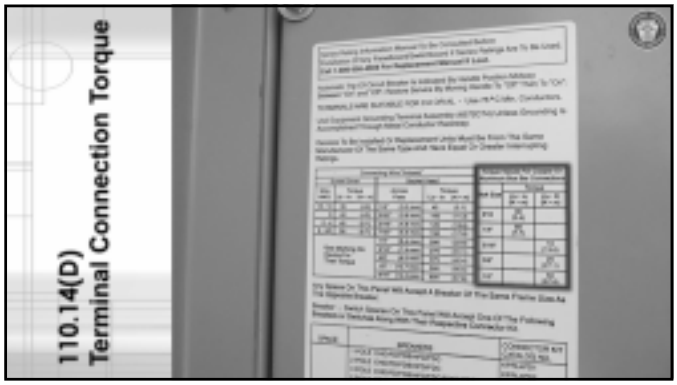
48

## 110.14(D) Terminal Connection Torque

- The title of subdivision (D) has been changed from "Installation" to "**Terminal Connection Torque**"
- The term "**calibrated**" has been deleted from this section *(replaced with "approved means shall be used to achieve the indicated torque value")*
- Three new informational notes provide practical guidance for installers and inspectors
- Proper emphasis needs to be on achieving the required torqueing values rather than the tool used to achieve such values



49




50

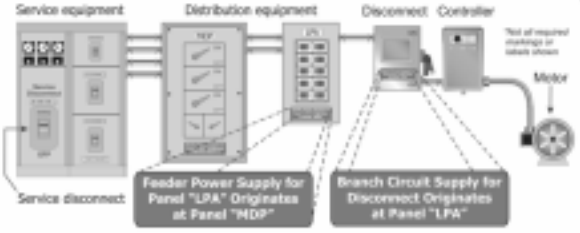
## 110.22(A) Identification of Disconnecting Means

- Disconnects are now required to **identify of the source** of the branch circuit or feeder for the disconnect at the disconnecting means enclosure *(other than one- or two-family dwellings)*
- Disconnecting means is required to be marked with a label to identify exactly what the disconnect is for
- Also required to provide identification of the circuit source that supplies the disconnecting means
- Same identification requirement for switchboards, switchgear, and panelboards *[see 408.4(B)]*
- Power supply identification practice will enhance the safety for the electrical personnel who service these disconnects



51

## 110.22(A) Identification of Disconnecting Means




Each disconnecting means shall be legibly marked to indicate its purpose unless located and arranged so the purpose is evident

In other than one- or two-family dwellings, the marking shall include the identification of the circuit source that supplies the disconnecting means

The marking shall be of sufficient durability to withstand the environment involved

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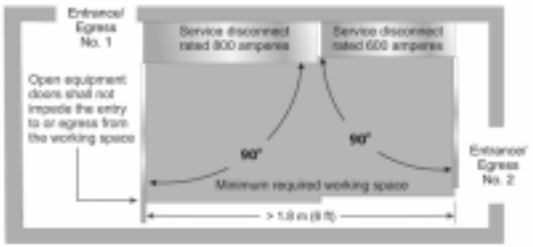
## 110.26(C)(2) Large Equipment

- Revisions to "**Large Equipment**" working space to address the hazards presented by two or more service disconnects with combined ratings of **1200 amps or more**
- For service disconnecting means where **two or more service disconnect enclosures** are installed with combined ampere rating is 1200 amperes or more and over 1.8 m (6 ft) wide, the **"Large Equipment" rules will now apply**
- Requirements also added to prevent **open equipment doors** from impeding the entry to or egress from the working space of large equipment



53

## 110.26(C)(2) Large Equipment




Large equipment is generally required to have an entrance/egress at each end of the working space for equipment rated 1200 amperes or more and over 1.8 m (6 ft) wide or for service disconnecting means installed in accordance with 230.71 where the combined ampere rating is 1200 amperes or more and over 1.8 m (6 ft) wide

54

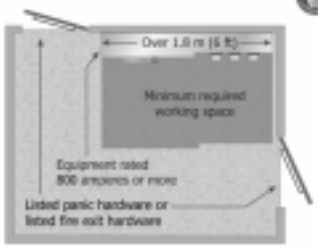
## 110.26(C)(3) Personnel Doors

- Revision added to clarity appropriate hardware *(equipped with listed panic hardware **or listed fire exit hardware**)* for personnel doors within 7.6 m (25 ft) from working space around electrical equipment rated 800 amperes or more
- The words **"or listed fire exit hardware"** have been added to 110.26(C)(3)
- An informational note has been added that references two UL standards that apply to the door hardware referred to in this rule
- Both panic hardware and fire exit hardware are listed to **UL 305** *(Standard for Safety for Panic Hardware)*, while fire exit hardware is tested to **UL 10C** *(Standard for Safety for Positive Pressure Fire Tests of Door Assemblies)*
- The revision differentiates **listed panic hardware** from **listed fire exit hardware**



55

## 110.26(C)(3) Personnel Doors

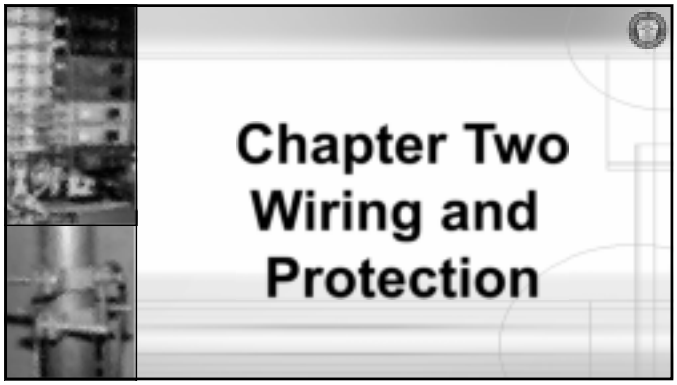



Where equipment rated 800 amperes or more that contains overcurrent devices, switching devices, or control devices is installed and there is a personnel door(s) intended for entrance to and egress from the working space less than 7.6 m (25 ft) from the nearest edge of the working space, the door(s) shall open in the direction of egress and be equipped with **listed panic hardware** or listed fire exit hardware.



56

57




58

## 200.3 Connection to Grounded System

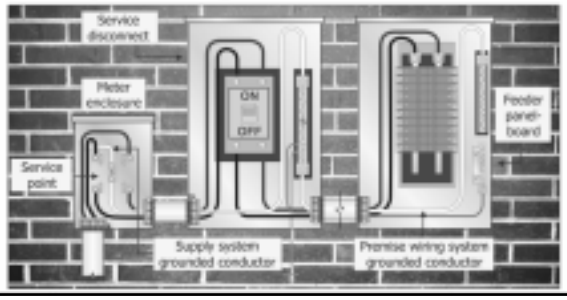
- Grounded conductors of premises wiring systems are required to be electrically connected to the supply system grounded conductor
- This applied to **all premises wiring** *(not just interior wiring)*
- Previous word "**interior**" implied that a grounded conductor is only required in the supply system if the premises wiring is located inside a building or structure
- Replacing "**interior**" with "**premises wiring**" makes the language easier to understand and correlates with 250.24(C) *(Grounded Conductor Brought to Service Equipment)*



59

## 200.3 Connection to Grounded System

Grounded conductors of premises wiring systems shall be electrically connected to the supply system grounded conductor to ensure a common, continuous grounded system *(applies to all premises wiring, not just interior wiring)*




60

## 200.10(B) Identification of Terminals

- Means of identification of the **grounded conductor terminals or screws** for such things as receptacles can be achieved by a metal or metal coating that is not only substantially white in color, but "**substantially silver**" in color as well
- The words "**or silver**" have been added to second level subdivision (1)
- Receptacles, polarized attachment plugs, and cord connectors for plugs and polarized plugs typically include a terminal that is **silver or chrome** in color, as compared to **brass or gold** color
- The revision reflects the **common identification means** employed by product manufacturers



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## 200.10(B) Identification of Terminals for Receptacles, Plugs, and Connectors

Identification of the grounded conductor terminals or screws for receptacles, polarized attachment plugs, and cord connectors for plugs and polarized plugs required to be achieved by a metal or metal coating that is substantially "white *or silver*" in color or by the word "white" or the letter "W" located adjacent to the identified terminal

If terminal is not visible, conductor entrance hole for the grounded conductor connection required to be colored "white" or marked with the word "white" or the letter "W"

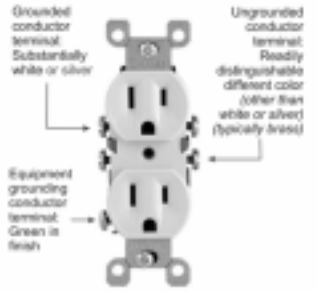


Photo courtesy of Leviton

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## 210.8 Measurements for GFCI Protection

- When determining if GFCI protection is required and a measurement is involved, the distance from a receptacle is required to be measured as the "shortest path" the supply cord of an appliance connected to the receptacle would follow without piercing a floor, wall, ceiling, or fixed barrier, or the shortest path without passing through a ~~**door, doorway, or**~~ window
- Revision removed "**door**" and "**doorway**" from the list of obstacles that should not be measured through for this *Code* cycle
- A receptacle under the kitchen sink behind cabinet door for the garbage disposer will once again require GFCI protection
- All 125-volt through 250-volt receptacles installed within 1.8 m (6 ft) from the top inside edge of the bowl of a sink requires GFCI protection *(including bedroom receptacles, etc.)*



63

## 210.8 Measurements for GFCI Protection


When determining if GFCI protection for personnel is required and a measurement is involved, the distance from a receptacle is required to be measured as the shortest path the supply cord of an appliance connected to the receptacle would follow without piercing a floor, wall, ceiling, or fixed barrier, or the shortest path without passing through a ~~door, doorway, or window~~. (210.8)

64

## 210.8(A) GFCI Protection for Personnel

- Dwelling unit GFCI protection has been expanded to all **125-volt through 250-volt receptacles** supplied by single-phase branch circuits rated 150 volts or less to ground installed in the specified areas of 210.8(A)
  - *Previously was all **125-volt, single-phase, 15- and 20-ampere receptacles** installed in (10) specific locations (bathrooms, kitchens, laundry areas, etc.)*
- Addition of up to 250-volt receptacles and removing the amperage limitations of **15- and 20-amperes** will provide GFCI protection to most receptacles commonly used in the specified areas of 210.8(A) *(Dryer receptacle, etc.)*
- 250-volt rated receptacles present **similar shock hazards** and substantiation submitted for this change demonstrated the need for GFCI protection for greater the 125-volt rated receptacles
- Similar to 2017 *NEC* changes at 210.8(B)



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## 210.8(A)(5) GFCI in Dwelling Unit Basements

- GFCI protection now required for ***ALL*** dwelling unit basements *(not just unfinished portions of basements)*
- GFCI now required for all 125-volt through 250-volt receptacles in both an **unfinished basement** and a **finished basement** intended as a habitable space
- Includes basements that are finished out to be a habitable room or space such as a bedroom, exercise room, game room, etc.
- Conductive floor surfaces may exist in finished and unfinished basements and basements *(whether finished or unfinished)* are prone to moisture including flooding
- A prevalent moisture hazard exists with a person being in contact with a damp floor, independent of flooring type, and then interacting with the electrical system



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## 210.8(A)(5) GFCI Protection for Basements

All 125-volt through 250-volt receptacles supplied by a single-phase branch circuit rated 150 volts or less to ground installed in any and all dwelling unit basements will require ground-fault circuit-interrupter (GFCI) protection for personnel

Unfinished Basement



Finished Basement

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## 210.8(A)(11) GFCI for Indoor Damp and Wet Locations

- GFCI protection is now required at **indoor damp and wet locations** of dwelling units
- Covers areas considered a damp or wet location not within 1.8 m (6 ft) of a sink, bathtub, or shower area
- Change will require GFCI protection for all **125-volt through 250-volt receptacles** supplied by a single-phase branch circuit rated 150 volts or less to ground installed in indoor damp or wet locations regardless of the room or areas of the dwelling unit
- Includes areas such as **mud room with no sink** or an indoor area where animals like dogs are washed down



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## 210.8(A)(11) GFCI Protection for Indoor Damp or Wet Locations


All 125-volt through 250-volt receptacles supplied by a single-phase branch circuit rated 150 volts or less to ground installed in indoor damp or wet locations require ground-fault circuit-interrupter (GFCI) protection for personnel



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## 210.8(B) Other Than Dwelling Units

- New GFCI requirements at non-dwelling unit locations were added for:
  - Damp locations
  - Accessory buildings
  - Laundry areas
  - Areas around bathtubs and shower stalls
- **210.8(B)(6):** Indoor "**damp**" location was added to the existing GFCI requirement for indoor wet non-dwelling unit locations for clarity and consistency as shock hazard in a damp location is similar to a wet location
- **210.8(B)(8):** Non-dwelling unit **accessory buildings** added to existing GFCI provisions for garages, service bays, and similar areas *(other than vehicle exhibition halls and showrooms)*



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## 210.8(B) Other Than Dwelling Units *(cont.)*

- **210.8(B)(8) *(cont.)*:** Accessory buildings can have same degree of shock hazard as garages and vehicle service bays and deserved the same level of GFCI protection
- **210.8(B)(11):** GFCI protection added for receptacles installed in **non-dwelling unit laundry areas**
  - Laundry areas at non-dwelling units are similar to laundry areas of a dwelling unit and deserve the same GFCI protection
- **210.8(B)(12):** GFCI protection added for receptacles installed within 1.8 m (6 ft) of the outside edge of **non-dwelling unit bathtubs or shower stalls**
  - Shower stalls and bathtubs can exist in commercial and industrial locations outside of a locker room or bathroom for a variety of purposes such as decontamination, and safety applications



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## 210.8(B) GFCI Protection for Other Than Dwelling Units

New provisions for GFCI protection were added for non-dwelling unit locations for receptacles:

Indoor Damp and Wet Locations

Garages, accessory buildings, and service bays

Laundry areas

Bathtubs and shower stalls



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## 210.8(B)(2) GFCI for Kitchens and More

- Additional language was added to clarify that **areas not defined as a kitchen** with a sink and permanent provisions for either food preparation ***or*** cooking have the same potential for shock hazards as a kitchen
- This would include areas such as:
  - Ice cream parlors
  - Coffee shops
  - Smoothie stores
- These areas typically have stainless steel countertop and/or stainless-steel appliances but no “permanent provisions for cooking”
- These facilities have at least the same potential for shock hazards as a kitchen



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## 210.8(B)(2) GFCI Protection for Kitchens and More

GFCI protection required for all 125-volt through 250-volt receptacles supplied by single-phase branch circuits rated 150 volts or less to ground, 50 amperes or less and all receptacles supplied by three-phase branch circuits rated 150 volts or less to ground, 100 amperes or less installed in areas defined as a “kitchen” and areas with a sink and permanent provisions for either food preparation or cooking

Coffee Shop
*(no permanent provisions for cooking)*

Ice Cream Parlor
*(no permanent provisions for cooking)*



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## 210.8(D) GFCI Protection for Specific Appliances

- New List Item (D) correlates the requirements found in **422.5(B)** *(Type of GFCI protection for appliances)* and refers to the list of GFCI requirements for appliances in **422.5(A)**
- Provides continued consistency as the list of appliances requiring GFCI protection is modified in future *Code* editions
- Previous GFCI requirements for dwelling unit **dishwashers** were moved from 210.8(D) to 422.5(A)(7) *(which now covers all dishwashers)*
- New 210.8(D) attempts to build a bridge for GFCI requirements from 210.8 to 422.5
- Where the appliance is a **vending machine** and GFCI protection is not provided as an integral part of the attachment plug or located within the supply cord not more than 300 mm (12 in.) from the attachment plug, the branch circuit(s) supplying vending machines is required to have GFCI protection



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## 210.8(D) GFCI Protection for Specific Appliances

New text at new 210.8(D) titled, "Specific Appliances" and the move of the GFCI requirement for dishwashers correlates the requirements found in 422.5(B) (Type and Location for GFCI protection for appliances) and refers to the list of appliances requiring GFCI protection in 422.5(A)

Dishwashers GFCI protection was moved from 210.8(D) to 422.5(A)(7)

Vending machine GFCI protection cannot be factory installed within the appliance

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## 210.8(E) GFCI for Equipment Requiring Servicing

- GFCI protection now required for all **receptacles required by 210.63** for:
  - 210.63(A): HVAC equipment
  - 210.63(B)(1): Indoor service equipment
  - 210.63(B)(2): Indoor equipment requiring dedicated equipment space
- 210.63 expanded for this *Code* cycle
- These receptacles can be located up to 7.5 m (25 ft) away from equipment, use of extension cord is not uncommon *(increasing the likelihood of a shock hazard)*



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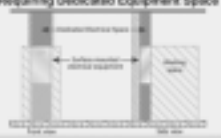
## 210.8(E) GFCI for Equipment Requiring Servicing

210.63(A) HVAC and Refrigeration Equipment

210.63(B)(1) Indoor Service Equipment

210.63(B)(2) Indoor Equipment Requiring Dedicated Equipment Space



GFCI protection shall be provided for the receptacles required by 210.63

A 125-volt, single-phase, 15- or 20-ampere-rated receptacle outlet shall be installed at an accessible location within 7.5 m (25 ft) of the equipment as specified in 210.63(A) and (B)

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## 210.8(F) GFCI for Outdoor Outlets

- GFCI protection is now required on **dwelling unit outdoor outlets** supplied by single-phase branch circuit rated 150 volts or less to ground, and 50 amperes or less
- This would include 240-volt HVAC unit "outlets"
- **Exemption** provided for branch circuit dedicated to **deicing and snow-melting equipment** and **outdoor lighting outlets** other than those covered in 210.8(C) *(crawl space lighting outlets)*
- Outdoor dwelling unit outlets typically serve loads that are comprised of 240-volt motor driven pumps or compressors that are in operation for many years without maintenance



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## 210.8(F) GFCI Protection For Outdoor Outlets

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## 210.11(C)(3) Bathroom Branch Circuit(s)

- Additional text added clarifies that only **bathroom receptacles** required to be supplied by **20-ampere rated bathroom receptacle outlet branch circuits** are receptacle outlet(s) required by **210.52(D)** and any other receptacles installed in the bathroom that **serve a countertop or work surface**
- 210.52(D) requires at least one receptacle outlet installed within 900 mm (3 ft) of the outside edge of each basin in dwelling unit bathroom
- Previous provisions were being interpreted to mandate any receptacle(s) installed in a dwelling unit bathroom to be supplied by dedicated 20-ampere bathroom receptacle branch circuit *only [even receptacles not required by 210.52(D)]*



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## 210.11(C)(3) Bathroom Branch Circuit(s)


One or more 120-volt, 20-ampere branch circuit required to supply the bathroom(s) receptacle outlet(s) required by 210.52(D) and any countertop and similar work surface receptacle outlets

210.52(D): Receptacle outlet must be located within 900 mm (3 ft) of the outside edge of the basin (sink)

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## 210.11(C)(4) Garage Branch Circuit(s)

- Garage receptacle outlet 120-volt, 20-ampere branch circuits are only required for the receptacles required by **210.52(G)(1)** for attached garages and in detached garages with electric power
- Section **210.52(G)(1)** requires at least one receptacle outlet to be installed in **each vehicle bay** of an attached garage and in each detached garage with electric power, with these required receptacle outlet(s) located not more than 1.7 m (5½ ft) above the floor
- Garage receptacle outlets *NOT* required by 210.52(G)(1) do not have to be supplied by this dedicated 120-volt, 20-ampere branch circuit(s) or even be supplied by a 20-ampere rated branch circuit *(could be a 15-ampere rated branch circuit)*



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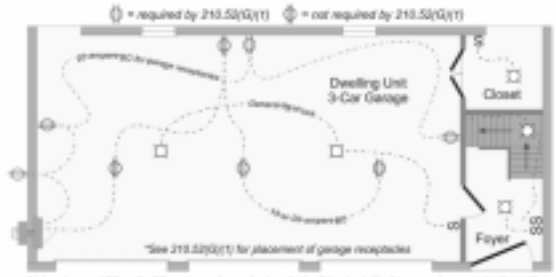
## 210.11(C)(4) Garage Branch Circuit(s)




At least one 120-volt, 20-ampere branch circuit shall be installed to supply receptacle outlets required by 210.52(G)(1) in dwelling unit garages (no other outlets)

Exception permits supply of readily accessible outdoor receptacle outlets



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## 210.12(C) AFCI for Patient Sleeping Rooms in Nursing Homes and Limited-Care Facilities

- AFCI protection has been expanded to patient sleeping rooms in **nursing homes** and **limited-care facilities**
- AFCI protection was expanded to include **guest rooms and guest suites of hotels and motels** during the 2017 *NEC* revision cycle as these areas are similar to dwelling units
- Similar rooms with comparable uses exist at patient sleeping rooms in nursing homes and limited-care facilities
- AFCI technology will provide same protection from arcing faults to the occupants of these rooms that is afforded occupants of conventional dwelling units and guest rooms and guest suites of hotels and motels



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## 210.12(C) AFCI Protection for Nursing Homes and Limited-Care Facilities

All 120-volt, single-phase, 15- and 20-ampere branch circuits supplying outlets and devices installed in guest rooms and guest suites of hotels and motels and patient sleeping rooms in nursing homes and limited-care facilities are required to AFCI protected



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## 210.12(D) AFCI for Extensions or Modifications at Guest Rooms and Guest Suites

- **Guest rooms and guest suites of hotels and motels** have been added to the areas requiring AFCI protection for **extensions and modifications** of existing occupancies
- AFCI protection is now required at dwelling units, dormitory units, and guest rooms and guest suites of hotels and motels where branch-circuit wiring is **modified, replaced, or extended**
- All these areas are typically used and treated much like a dwelling unit
- By exception, AFCI protection not required for existing branch circuit conductors where extended **not more than 1.8 m (6 ft)** and does not include any additional outlets or devices *(other than splicing devices)*
- This measurement **does not include** the conductors inside an enclosure, cabinet, or junction box



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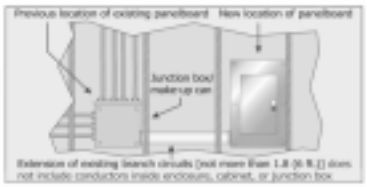
## 210.12(D) AFCI Protection for Extensions/Modifications of Guest Rooms and Guest Suites of Hotels and Motels


Extension of existing branch circuits [not more than 1.8 m (6 ft.)] does not include conductors inside enclosures, cabinet, or junction box

AFCI protection required at dwelling units, dormitory units, and guest rooms and guest suites of hotels and motels where branch-circuit wiring is modified, replaced, or extended

AFCI protection not required where extension of existing branch circuit conductors is not more than 1.8 m (6 ft) in length and does not include any additional outlets or devices (other than splicing devices)



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## 210.15 Reconditioned Equipment

- New section added prohibiting GFCI devices, AFCI devices, and ground-fault protection equipment from being reconditioned
- Several new sections were added throughout the *Code* with permission **for or against** equipment being reconditioned
- Marking requirements for reconditioned, refurbished or remanufactured electrical equipment located at 110.21(A)(2)
- Provisions of new 210.15 is the first of these new statements throughout the *Code* in reference to reconditioned equipment



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## 210.15 Reconditioned Equipment

GFCI | GFCI/AFCI | GFPE

The following shall not be reconditioned:

(1) Equipment that provides ground-fault circuit-interrupter (GFCI) protection for personnel

(2) Equipment that provides arc-fault circuit-interrupter (AFCI) protection

(3) Equipment that provides ground-fault protection (GFP) of equipment

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## Reconditioned Equipment Sections for the 2020 *NEC*

| Code Section | CMP | Equipment | Yes/No | SR/PC |
|---|---|---|---|---|
| 230.15 | CMP-2 | GFCI devices, AFCI devices, and GFP equipment | No | SR 7857 |
| 240.62 | CMP-10 | Low-voltage fuseholders and low-voltage nonrenewable fuses | No | SR 7974, PC 981 |
| 240.88(A)(1) | CMP-10 | Molded-case circuit breakers | No | DSR 8011, PC 980 |
| 240.88(A)(2) | CMP-10 | Low- and medium-voltage power circuit breakers | Yes | DSR 8011, PC 980 |
| 240.88(A)(3) | CMP-10 | High-voltage circuit breakers | Yes | DSR 8011, PC 980 |
| 240.88(B)(1) | CMP-10 | Low-voltage power circuit breaker electronic trip units | No | DSR 8011, PC 980 |
| 240.88(B)(2) | CMP-10 | Electromechanical protective relays and current transformers | Yes | DSR 8011, PC 980 |
| 240.102 | CMP-10 | Medium-voltage fuseholders and medium-voltage nonrenewable fuses | No | SR 8048, PC 982 |
| 406.3(A) | CMP-18 | Receptacles | No | SR 8187 |
| 406.7 | CMP-18 | Attachment plugs, cord connectors, and flanged surface devices | No | SR 8189 |

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## Reconditioned Equipment Sections for the 2020 *NEC*

| Code Section | CMP | Equipment | Yes/No | SR/PC |
|---|---|---|---|---|
| 408.80(A) | CMP-9 | Panelboards | No | SR 8172, PC 987 |
| 408.80(B) | CMP-9 | Switchboards and switchgear, or sections of switchboards or switchgear | Yes | SR 8172, PC 987 |
| 410.7 | CMP-18 | Luminaires, lampholders, and retrofit kits | No | SR 8162 |
| 411.4 | CMP-18 | Listed low-voltage lighting systems or a lighting system assembled from listed parts | No | SR 8164 |
| 490.48 | CMP-9 | Switchgear, or sections of switchgear | Yes | SR 8212 |
| 695.10 | CMP-13 | Fire pump controllers and transfer switches | No | SR 7522, PC 983 |
| 700.3(C) | CMP-13 | Automatic transfer switches (Emergency Systems) | No | SR7584, PC 984 |
| 701.5(C) | CMP-13 | Automatic transfer switches (Legally Required Standby Systems) | No | SR 7586, PC 985 |
| 702.5 | CMP-13 | Transfer switches (Optional Standby Systems) | No | SR 7588, PC 986 |
| 708.24 | CMP-13 | Transfer equipment (Critical Operations Power Systems) | No | Sr 7517 |
| 800.3(G) | CMP-16 | Communication equipment [*must comply with 110.21(A)(2)] | Yes* | SR 7509 |

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## 210.52(C) Receptacles at Countertops and Work Surfaces

- Revision clarifies that the receptacle outlets installed for countertop or work surfaces [210.52(C)] are **not permitted** to satisfy the requirement for receptacle outlet placement ***(wall spacing)*** as provided in 210.52(A)
- Section 210.52(A) pertains to the "no point measured horizontally along the floor line of any wall space is more than 1.8 m (6 ft) from a receptacle outlet" wall spacing rule
- Receptacle outlets installed to serve the countertops and work surfaces in kitchens, pantries, breakfast rooms, dining rooms, and similar areas cannot be considered as the receptacle outlets required by 210.52(A)



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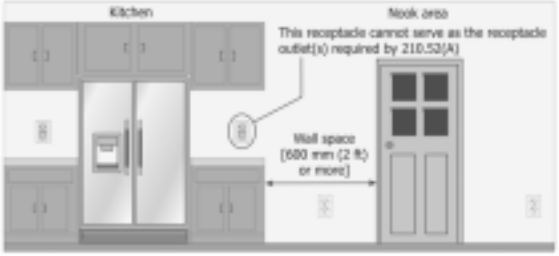
## 210.52(C) Countertops and Work Surfaces




In kitchens, pantries, breakfast rooms, dining rooms, and similar areas of dwelling units, receptacle outlets for countertop and work surfaces [300 mm (12 in.) or wider] shall be installed in accordance with 210.52(C)(1) through (C)(3)

Countertop receptacles shall not be considered as the receptacle outlets required by 210.52(A)

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## 210.52(C)(2) Receptacles at Island and Peninsular Countertops

- For island and peninsular countertop and work surfaces, the horizontal measurement was replaced with a **square foot calculation** to determine the number of receptacles required
- Previously, a measurement was required across the countertop with at least one receptacle required to be installed at each island countertop space or peninsular countertop space with a long dimension of **600 mm (24 in.)** or greater and a short dimension of **300 mm (12 in.)** or greater
- Historically, **only one receptacle outlet** has been required at an island and peninsular countertops regardless of the size of that island or peninsular
- Changes to this section will required **more than one receptacle outlet** at larger kitchen islands and peninsulas



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## 210.52(C)(2) Receptacles at Island and Peninsular Countertops *(cont.)*

- At least one receptacle is required to be provided for the **first 0.84 m² (9 ft²)**, **or fraction thereof**, of the countertop or work surface
- An additional receptacle outlet is required for every **additional 1.7 m² (18 ft²)**, **or fraction thereof**, of the countertop or work surface
- At least one receptacle outlet must be located **within 600 mm (2 ft)** of the outer end of a peninsular countertop or work surface
- A peninsular countertop measurements are taken from the **connected perpendicular wall** *(see TIA Log No. 1442)*



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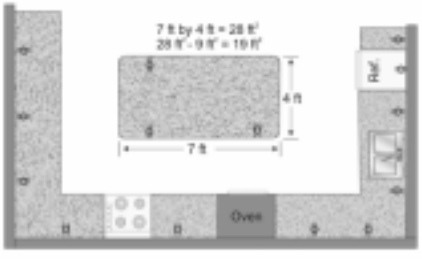
## 210.52(C)(2) Island and Peninsulars

At least one receptacle outlet shall be provided for the first 0.84 m² (9 ft²), or fraction thereof, of the countertop or work surface

A receptacle outlet shall be provided for every additional 1.7 m² (18 ft²), or fraction thereof, of the countertop or work surface

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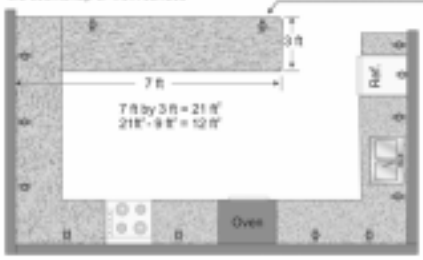
## 210.52(C)(2) Island and Peninsulars

At least one receptacle outlet shall be provided for the first 0.84 m² (9 ft²), or fraction thereof, of the countertop or work surface

A receptacle outlet shall be provided for every additional 1.7 m² (18 ft²), or fraction thereof, of the countertop or work surface




At least one receptacle outlet shall be located within 600 mm (2 ft) of the outer end of a peninsular countertop or work surface

A peninsular countertop is to be measured from the connected perpendicular wall

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## 210.52(C)(2) Island and Peninsulas

**Examples of Minimum Number of Receptacle Outlets Required**

| Total Square Footage of Countertop | Minimum No. of Receptacle Outlets |
|---|---|
| 8 sq. ft. | 1 |
| 9 sq. ft. | 1 |
| More than 9 sq. ft. up to 27 sq. ft. [9 sq. ft. + 18 sq. ft. = 27 sq. ft.] | 2 |
| 28 sq. ft. [first 9 sq. ft. (one), additional 18 sq. ft. (one) and addition fraction there of (1 sq. ft.) (one)] | 3 |
| 48 sq. ft. [48 sq. ft. - 9 sq. ft. = 39 sq. ft.] [39 sq. ft. ÷ 18 sq. ft. = 2.17 sq. ft.] | 4 |

**210.52(C)(2)(a) Island and Peninsular Countertops and Work Surfaces**

At least one receptacle outlet shall be provided for the first 0.84 m² (9 ft²), or fraction thereof, of the countertop or work surface.

A receptacle outlet shall be provided for every additional 1.7 m² (18 ft²), or fraction thereof, of the countertop or work surface.

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## 210.52(E)(3) Receptacles at Balconies, Decks, and Porches

- The required receptacle outlet for balconies, decks, and porches is also required at decks that are installed in a **freestanding manner** where connection to the actual dwelling is not made at any point
- At least one 125-volt, 15- or 20-ampere receptacle outlet is required to be installed at every dwelling unit balcony, deck, or porch
- Many decks are installed in a cantilevered manor where connection to the actual dwelling unit building is not made at any point *(leaving an air gap to promote drainage and prevent wood decay)*
- Previous text would suggest that a receptacle is not required at this type of deck as it is technically "unattached"
- At least one receptacle outlet *(accessible from the balcony, deck, or porch)* on any balcony, deck, or porch is now required for decks that are **within 102 mm (4 in.) horizontally** of the dwelling unit



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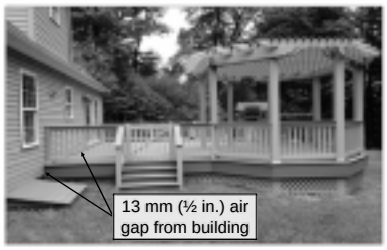
## 210.52(E)(3) Balconies, Decks, and Porches




At least one 125-volt, 15- or 20-ampere receptacle outlet required to be provide for all balconies, decks, and porches that are constructed within 102 mm (4 in.) horizontally of the dwelling unit

Receptacle must be located in an accessible location from the balcony, deck, or porch and not more than 2.0 m (6½ ft) above the balcony, deck, or porch walking surface



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## 210.65 Receptacles for Meeting Rooms

- Meeting room receptacle outlet rules received revisions and a new home at **210.65** rather than its original location at 210.71
- 210.65 provides a **better location** with other requirements for receptacle outlets for usability and uniform numbering
- Previous language at 210.71(B)(2) for floor receptacle outlets could have been interpreted to only apply to a **square or rectangle-shaped meeting rooms**
- What about a **round-shaped meeting room**?
- Revisions to 210.65(B)(2) clarifies length versus width concerns while addressing **non-rectangular meeting rooms**, such as those that are round
- Floor outlets now applies to a meeting room "**with any floor dimension**" that is 3.7 m (12 ft) or greater "**in any direction**"



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## 210.65 Receptacles for Meeting Rooms *(cont.)*

- These revisions also allow a floor receptacle outlet *(as previously required)* or a **floor outlet to serve receptacle(s)** to accommodate hardwired desk or furniture that could have **built-in receptacle outlets**
- Requirement for at least one floor receptacle outlet, or floor outlet to serve receptacle(s), located at a distance **not less than 1.8 m (6 ft)** from any fixed wall allows for **emergency entrance/egress** to and from these meeting rooms without having to maneuver around and over extension cords and flexible powers cords for laptop computers and the like



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## 215.9 GFCI Protection for Feeders

- Revision provides correlation with GFCI protection requirements in **210.8** by **removing** the existing limitations of a feeder to provide GFCI protection to only **15 and 20-ampere receptacle branch circuits**
- Feeders are now permitted to be protected by a ground-fault circuit interrupter (GFCI) installed in a readily accessible location which will also provide the necessary GFCI protection to any branch circuit in lieu of the provisions for such interrupters as specified in 210.8 *(GFCI protection for personnel)* and 590.6(A) *(GFCI protection for personnel for temporary wiring installations)*
- GFCI requirement at **210.8(A)** now include receptacle outlets rated **125-volt through 250-volt**
- **210.8(B)** include all 125-volt through 250-volt receptacles supplied by single-phase branch circuits rated 150 volts or less to ground, 50 amperes or less, and all receptacles supplied by three-phase branch circuits rated 150 volts or less to ground, 100 amperes or less



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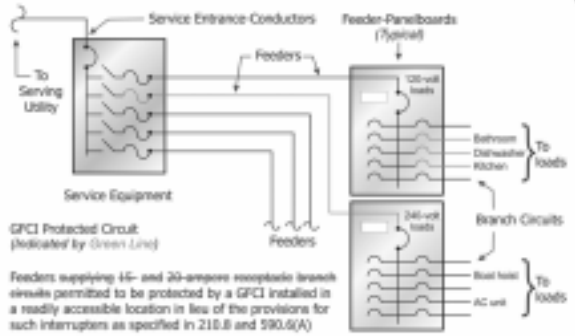
## 215.9 GFCI Protection for Feeders

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## 215.10, Ex. No. 3 GFP for Feeders

- New exception added to permit **temporary feeders** to be used during repair, maintenance or emergencies **without GFP of equipment**
- Time period permitted for these temporary feeders **not to exceed 90 days**
- GFP of equipment is required for each feeder disconnect rated 1000 amperes or more and installed on solidly grounded wye electrical systems of more than 150 volts to ground *(not exceeding 600 volts phase-to-phase)*
- Without this exception, the use of temporary feeders during repair, maintenance, or emergencies may present difficulties in achieving the required GFP protection
- **Example:** Portable generator connected to a facility electrical system during a loss of power due to power failure or maintenance activity



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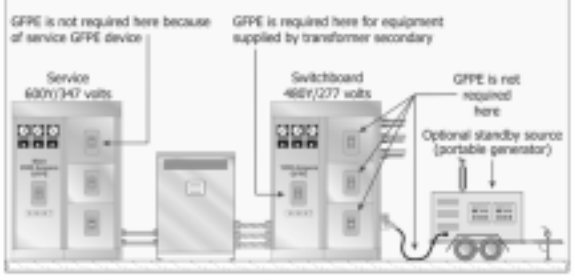
## 215.10 Ex. No. 3 GFP for Feeders

Ground-fault protection (GFP) for equipment not required for temporary feeder conductors that are used to connect a generator to a facility for repair, maintenance, or emergencies

Temporary feeders only permitted for the time period necessary but cannot exceed 90 days




110

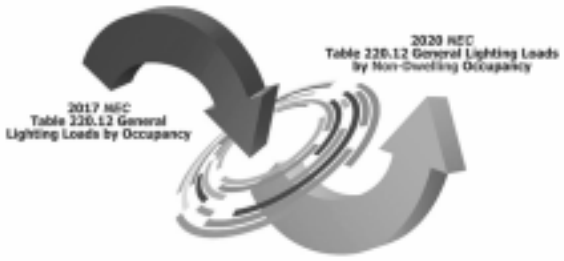
## 220.12 Lighting Load for Specified Non-Dwelling Occupancies

- Section 220.12 and Table 220.12 has been **extensively revised**
- General lighting load values for specific occupancies at Table 220.12 have received very **minimal revisions since the 1971 edition of the *NEC***
- **Reduced lighting loads** in most occupancies was achieved
- Aligns Table 220.12 with those occupancies found in **ASHRAE 90.1-2016** *(Energy Standard for Buildings Except Low-Rise Residential Buildings)* and the International Energy Conservation Code
- Dwelling and multi-family dwelling units were moved out of Table 220.12 and referenced in revised **220.14(J)**



111

## Table 220.12 General Lighting Loads by Non-Dwelling Occupancy




Section 220.12 and Table 220.12 has been extensively revised - Reduced lighting loads in most occupancies was achieved - Dwelling and multi-family dwelling units were moved out of Table 220.12 and referenced in revised 220.14(I)

112

## Table 220.12 General Lighting Loads by Non-Dwelling Occupancy (Part 1)

| Type of Occupancy | Unit Load Volt-amperes/m² | Unit Load Volt-amperes/ft² |
|---|---|---|
| Automotive facility | 16 | 1.5 |
| Convention Center | 15 | 1.4 |
| Courthouse *(see Courtrooms)* | 15 22 | 1.4 2.0 |
| Dormitory | 16 | 1.5 |
| Exercise center | 15 | 1.4 |
| Fire station | 14 | 1.3 |
| Gymnasium[a] *(see Armories and auditoriums)* | 18 11 | 1.7 1.0 |
| Health care clinic *(see Hospitals)* | 17 22 | 1.6 2.0 |
| Hospital | 17 | 1.6 |
| Hotels and motels, including apartment houses without provisions for cooking by tenants[a] | 18 22 | 1.7 2.0 |
| Library | 16 | 1.5 |
| Manufacturing facility[a] *(see Industrial commercial (loft) bldg)* | 24 22 | 2.2 2.0 |
| Motion picture theater | 17 | 1.6 |
| Museum | 17 | 1.6 |
| Office[a] *(see Office buildings)* | 14 39 | 1.3 3.5 |

113

## Table 220.12 General Lighting Loads by Non-Dwelling Occupancy (Part 2)

| Type of Occupancy | Unit Load Volt-amperes/m² | Unit Load Volt-amperes/ft² |
|---|---|---|
| Parking garage[a] *(see Garages-commercial (storage))* | 3 6 | 0.3 0.5 |
| Penitentiary | 13 | 1.2 |
| Performing arts theater | 16 | 1.5 |
| Police station | 14 | 1.3 |
| Post office | 17 | 1.6 |
| Religious facility *(see Churches)* | 24 11 | 2.2 1.0 |
| Restaurant[a] *(see Restaurants and Clubs)* | 16 22 | 1.5 2.0 |
| Retail[a,b] *(see Barber shops and beauty parlors and Stores)* | 28 33 | 1.9 3.0 |
| School/university *(see Schools)* | 33 | 3.0 |
| Sports arena | 33 | 3.0 |
| Town hall | 15 | 1.4 |
| Transportation | 13 | 1.2 |
| Warehouse | 13 3 | 1.2 0.25 |
| Workshop | 18 | 1.7 |

114

**Table 220.12 General Lighting Loads by Non-Dwelling Occupancy (Part 3)**

| Type of Occupancy | Unit Load | |
|---|---|---|
| | Volt-amperes/m² | Volt-amperes/ft² |
| | *(Note at bottom of table)* | |

Note: The 125 percent multiplier for a continuous load as specified in 210.20(A) is included when using the unit loads in this table for calculating the minimum lighting load for a specified occupancy.

'Armories and auditoriums are considered gymnasium-type occupancies.

'Lodge rooms are similar to hotels and motels.

'Industrial commercial loft buildings are considered manufacturing-type occupancies.

'Banks are office-type occupancies.

'Garages — commercial (storage) are considered parking garage occupancies.

'Clubs are considered restaurant occupancies.

'Barber shops and beauty parlors are considered retail occupancies.

'Stores are considered retail occupancies.



115

## 220.14(J) and 220.11 Lighting Loads for Dwelling Units

- *NEC* calculation of **3.0 watts per square foot** for dwelling units was moved from Table 220.12 to **220.14(J)** and reference to Table 220.12 was removed from 220.14(J)
- Table 220.12 revised to only addresses non-dwelling unit *occupancies*
- New sentence added to address **motors rated less than 1/8 HP** and connected to a lighting circuit *(small motor loads will now be included in the general lighting load)*
- References to "**guest rooms or guest suites of hotels and motels**" removed and relocated to new **220.14(M)**
- Long-standing requirement for calculating the floor area of a dwelling unit to not include **open porches, garages, or unused or unfinished spaces** not adaptable for future use has been relocated from 220.12 to a **new 220.11**



116

## 220.14(J) and 220.11 Lighting Loads for Dwellings

***Green shaded area included in lighting load calculation***


Calculation of general-purpose branch circuits is determined by using a unit load of 3 volt-amperes (watts) per square foot for dwelling units *[Moved from Table 220.12 to 220.14(J)]*

For dwelling units, the calculated floor area shall not include open porches, garages, or unused or unfinished spaces not adaptable for future use *[Relocated from 220.12 to new 220.11]*



117

## 220.14(J) and 220.11 Lighting Loads for Dwellings

$$\frac{\text{Floor Area x 3 VA}}{\text{120 Volts}} = \text{Amperes (General Purpose Lighting)}$$

$$\frac{\text{Amperes, Gen. Purpose Lighting}}{\text{15 or 20 Amp Circuits}} = \text{Min. Number of Circuits}$$

$$\frac{\text{2800 sq. ft. x 3 VA (8400 VA)}}{\text{120 Volts}} = \text{70.0 Amperes}$$

$$\frac{\text{70.0 Amperes}}{\text{15 or 20 Ampere Circuits}} = \begin{matrix}\text{(4.66) } \underline{5} \text{ – 15 Ampere Circuits or}\\ \text{(3.50) } \underline{4} \text{ – 20 Ampere Circuits}\end{matrix}$$

Calculation of general-purpose branch circuits is determined by using a unit load of 3 volt-amperes (watts) per square foot for dwelling units *(Moved from Table 220.12 to 220.14(J))*

For dwelling units, the calculated floor area shall not include open porches, garages, or unused or unfinished spaces not adaptable for future use *(Relocated from 220.12 to new 220.11)*



118

## 220.42 General Lighting

- Demand factors for derating feeder and service conductors in **hospitals** were deleted
  - Now required to include **100% of total VA** of the calculated lighting load
- Demand factors for feeder and service conductors in **hotels, motels and apartment houses** without provision for cooking, were increased to correlate with revisions in Table 220.12
- **Table 220.42** still applies a demand factor to lighting loads at dwelling units, hotels and motels, and warehouses with all other occupancies required to include **100% of the total volt-amperes (VA)** of the lighting load



119

## Table 220.42 Lighting Load Demand Factors

| Type of Occupancy | Portion of Lighting Load to Which Demand Factor Applies (Volt-Amperes) | Demand Factor (%) |
|---|---|---|
| Dwelling Units | First 3000 at<br>From 3001 to 120,000 at<br>Remainder over 120,000 at | 100<br>35<br>25 |
| Hospitals | First 50,000 at<br>Remainder over 50,000 at | 40<br>20 |
| Hotels and Motels, (including apartment houses without provisions for cooking by tenants)* | First 20,000 at<br>From 20,001 to 100,000 at<br>Remainder over 100,000 at | 60 50<br>50 40<br>35 30 |
| Warehouses (storage) | First 12,500 or less at<br>Remainder over 12,500 at | 100<br>50 |
| All Others | Total volt-amperes | 100 |

*The demand factors of this table shall not apply to the calculated load of feeders or services supplying areas in hospitals, hotels and motels where the entire lighting is likely to be used at one time, as in operating rooms, ballrooms or dining rooms.



120

## 220.53 Appliance Load - Dwelling Unit(s)

- **All fastened in place household electric cooking equipment** *(not just an electric range)* added to the list of appliances that cannot be included in the **four or more appliances** eligible for **75% derating demand factor**
- Previously permitted to apply demand factor of **75%** to nameplate rating load of **four or more appliances fastened in place** *(other than electric ranges, clothes dryers, space-heating equipment or air-conditioning equipment)*
- Appliances rated **¼ hp or greater**, or **500 watts or greater**, that are fastened in place is now the benchmark for appliances that can be included in this 75% derating rule
- This will eliminate typical bathroom exhaust fan from this derating



121

## 220.53 Appliance Load - Dwelling Unit(s)

**STANDARD LOAD CALCULATION**

| Appliances | Quantity | VA Ungrnd | VA Neutral |
|---|---|---|---|
| Dishwasher | 1 | 1,500 | 1,500 |
| Disposal (¼ hp motor) | 1 | 1,176 | 1,176 |
| Compactor | 1 | 600 | 600 |
| Exhaust Fans (120 VA each) | 2 | 240 | 240 |
| Water Heaters (4,500 VA each) | 2 | 9,000 | |
| **Totals** | **5** | **12,276** | **3,276** |
| 4 or more Appliances Total at 75% | | **9,207** | **2,457** |

A demand factor of 75 percent can be applied to the nameplate rating load of four or more appliances rated ¼ hp or greater, or 500 watts or greater, that are fastened in place, and that are served by the same feeder or service in a one-family, two-family, or multifamily dwelling.

This demand factor cannot be apply to:

(1) Household electric cooking equipment that are fastened in place (was electric ranges)
(2) Clothes dryers
(3) Space heating equipment
(4) Air-conditioning equipment



122

## 225.30(B) Number of Supplies (Feeders)
## Common Supply Equipment

- New text added permitting **more than one feeder** *(up to six feeders)* under very limited circumstances
- Building or other structure served by an outside feeder **previously** permitted to be supplied by **only one feeder** *[unless another feeder (or branch circuit) was permitted by "special conditions" of previous 225.30(A) through (E)]*
- 225.30 "**special conditions**" can include such equipment as fire pumps, emergency systems, legally required standby systems, optional standby systems, parallel power production system
- AHJ can grant "**special permission**" for additional feeders or branch circuits for multiple-occupancy buildings where there is no space available for supply equipment accessible to all occupants or a single building or other structure "**sufficiently large**" enough to make two or more supplies essential
- "**Special conditions**" can also exist where different voltages, frequencies, or phases are involved



123

## 225.30(B) Number of Supplies (Feeders) Common Supply Equipment *(cont.)*

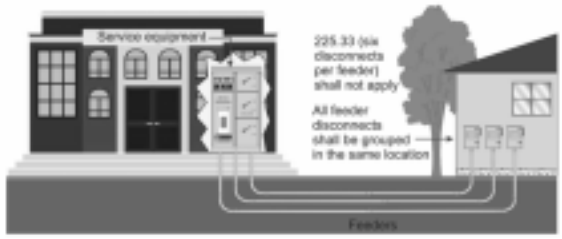
- New text added permitting **more than one feeder** *(up to six feeders)* under very limited circumstances *(cont.)*
- New 225.30(B) will permit **up to six feeders** to supply a building or structure under the following conditions:
  - (1) Each feeder must **originate in the same panelboard, switchboard or other distribution equipment**
  - (2) Each feeder must **terminate in a single disconnecting means**
  - (3) Where more than one feeder is installed, all feeder disconnects supplied are required to be **grouped in the same location**
  - (4) Each disconnect must be **marked to indicate the load served**
- Feeders have the added benefit of overcurrent and short circuit protection and should not be afforded the same requirements as service conductors



124

## 225.30(B) Common Supply Equipment (Feeders)

Feeders are generally limited to one feeder on the load side of the service equipment per building or structure [see permissive conditions at 225.30(A) through (F)]




New provisions added to allow up to six feeders originating in the same panelboard, switchboard, or other distribution equipment, with each feeder terminating in a single disconnecting means

Each disconnect to be marked to indicate the load served

125

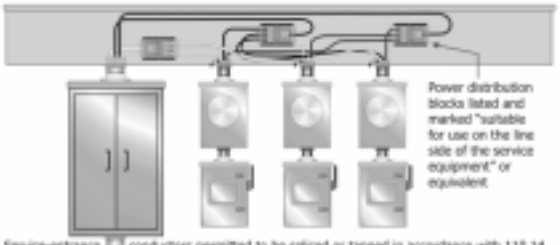
## 230.46 Splices and Tapped Conductors

- The requirement for **marking power distribution blocks** used on service conductors required to be marked "**suitable for use on the line side of the service equipment**" or equivalent was moved from 314.28(E)(1) to 230.46
- All power distribution blocks, pressure connectors, and devices for splices and taps of service conductors must be listed
- Effective **January 1, 2023**, pressure connectors and devices for splices and taps on service conductors must be marked as **suitable for use on the line side of service equipment**



126

## 230.46 Spliced and Tapped Conductors



Power distribution blocks listed and marked "suitable for use on the line side of the service equipment" or equivalent

Service-entrance conductors permitted to be spliced or tapped in accordance with 110.14, 300.5(E), 300.13, and 300.15 with power distribution blocks (PDB), pressure connectors, and devices for splices and taps required to be listed

PDBs installed on service conductors required to be marked "suitable for use on the line side of the service equipment" or equivalent with all devices used to splice service conductors required to be marked in this manner effective January 1, 2023

127

## 230.62(C) Barriers

- Previous provision for **barriers** at service panelboards, switchboards, and switchgear has been moved to Article 230 to apply to all service equipment
- Previous barrier requirements of **408.3(A)(2)** were relocated and expanded in new **230.62(C)**
- **All service equipment** is now required to be provided with **barriers** to prevent line side inadvertent contact
- This includes but is not limited to panelboards, switchboards, switchgear, motor control centers, individual circuit breaker enclosures, SUSE rated transfer switches and fused disconnects



128

## 230.62(C) Service Equipment - Barriers

Barriers required to be placed in all service equipment such that no uninsulated, ungrounded service busbar or service terminal is exposed to inadvertent contact by persons or maintenance equipment while servicing load terminations

Service Panelboard

Transfer switches marked suitable for use as service equipment

Motor control center marked suitable for use as service equipment

129

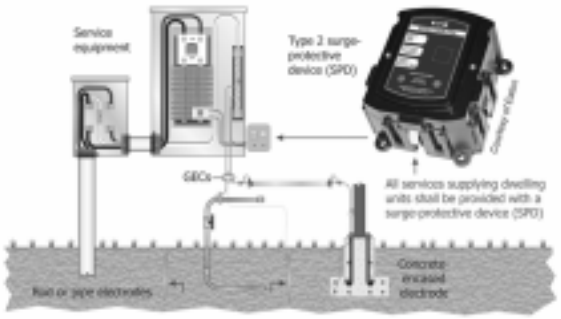
## 230.67 Surge Protection

- New requirement added for **surge protection** on all **services at dwelling units**
- The surge protection device (SPD) must be an **integral part of the service equipment** or **located immediately adjacent to the service equipment**
- Exception permits alternate location provided an SPD is located at **each next level distribution equipment** downstream toward the load
- This SPD required to be either a **Type 1** or **Type 2** SPD
- Applies to **replacement** of residential service equipment as well



130

## 230.67 Surge Protection for Dwelling Units




131

## 230.71 Maximum Number of Disconnects

- Revision **eliminates** more than one service disconnecting means in the **same panelboard or other enclosure**
- Continues to retain the **six service disconnect rule** for services with the up to six service disconnects required to be installed in **separate enclosures only**
- Previous provisions permitted service disconnecting mean(s) to consist of **not more than six** switches or sets of circuit breakers mounted in a **single enclosure** or in a group of **separate enclosures**
- Revision takes into consideration the challenges created for electrical workers when encountering a panelboard with more than one service disconnecting means in the same enclosure



132

## 230.71 Maximum Number of Disconnects *(cont.)*

- A **single service disconnect** within service equipment provides additional protection from electric shock hazards where **barriers are in place** over the exposed energized conductors/terminals to **eliminate any live exposed parts**
- Barriers required to be provided to eliminate live exposed parts for switchboards, switchgear and panelboards in accordance with **230.62(C)** *[was 408.3(A)(2)]*



133

## 230.71(A) and (B) Maximum Number of Disconnects

Service disconnecting means can be any of the following:

- A single "main" or...
- ~~Up to six grouped in a single enclosure~~ or...
- Up to six separate enclosures grouped in the same location or...
- In or on a switchboard or in switchgear *(see conditions)*

134

## 230.85 Emergency Disconnects

- New requirement added requiring an **emergency disconnect** at a **readily accessible <u>outdoor</u> location** for dwelling units
- New outdoor emergency disconnecting requirement primarily based upon providing **first responders** an outdoor accessible emergency or service disconnecting means during an **emergency situation** such as a fire, gas leak, structural damage, flooding, etc.
- Access service disconnecting means for first responders is very challenging when the service disconnect is installed in an indoor location of a dwelling unit area such as a basement
- Requiring first responders to enter a potentially hazardous environment *(such as a burning building)* to find and then activate the service disconnect(s) is not a safe practice

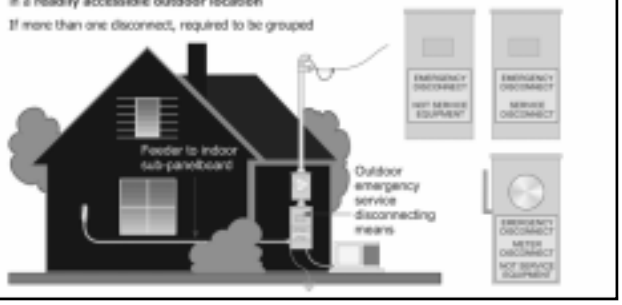


135

## 230.85 Exterior Emergency Disconnect(s) for Dwelling Units

All one- and two-family dwelling unit service conductors shall terminate in disconnecting means having a short-circuit current rating equal to or greater than the available fault current, installed in a **readily accessible outdoor location**

If more than one disconnect, required to be grouped




136

## 230.85 Exterior Emergency Disconnect(s) for Dwelling Units

All one- and two-family dwelling unit service conductors shall terminate in disconnecting means installed in a **readily accessible outdoor location** *(grouped if more than one disconnect)*


Each disconnect shall be one of the following:

1. Service disconnects marked as follows: EMERGENCY DISCONNECT, SERVICE DISCONNECT
2. Meter disconnects installed per 230.82(3) and marked as follows: EMERGENCY DISCONNECT, METER DISCONNECT, NOT SERVICE EQUIPMENT
3. Other listed disconnect switches or circuit breakers on the supply side of each service disconnect that are suitable for use as service equipment and marked as follows: EMERGENCY DISCONNECT, NOT SERVICE EQUIPMENT

137

## 240.6(C) Restricted Access Adjustable-Trip Circuit Breakers

- New provision added to recognize **modern electronic trip units** provided with a **password** to keep unauthorized users from changing the settings on a restricted access adjustable-trip circuit breaker(s)
- Adjustable settings on an adjustable-trip circuit breaker needs to be protected from **inadvertent settings** out of the desired operational settings, such as **restricted access** to the adjusting means
- Previously, restricted access could be achieved by locating an adjustable-trip circuit breaker behind one of three methods:
  - Behind removable and sealable covers
  - Behind bolted equipment enclosure doors
  - Behind locked doors accessible only to qualified persons



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## 240.6(C) Restricted Access Adjustable-Trip Circuit Breakers *(cont.)*

- New provision added to recognize **modern electronic trip units** provided with a **password** to keep unauthorized users from changing the settings on a restricted access adjustable-trip circuit breaker(s) *(cont.)*
- Forth option added pertaining to **password protected** adjustable-trip circuit breaker, with password **accessible only to qualified personnel**
- Fully programmable models offered that enable ultimate customization and flexibility
- Equipped with the latest microprocessor technology with advanced algorithms that notify maintenance personnel when the power distribution system needs to be maintained or replaced
- Has the ability to accurately measure energy consumption with no additional meters or equipment



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## 240.6(C) Restricted Access Adjustable-Trip Circuit Breakers



Courtesy of Eaton

Restricted access shall be achieved by one of the following methods:

(1) Located behind removable and sealable covers over the adjusting means

(2) Located behind bolted equipment enclosure doors

(3) Located behind locked doors accessible only to qualified personnel

(4) Password protected, with password accessible only to qualified personnel



140

## 240.87 Arc Energy Reduction

- An instantaneous trip setting that is less than the available arcing current is one of seven methods recognized to achieve **arc energy reduction**
- Revision to **240.87(B)(5)** clarifies that **temporary adjustment** of the instantaneous trip setting to achieve arc energy reduction **shall not be permitted**
- Arc energy reduction is designed to limit the arc-flash energy to which electrical workers or maintenance personnel could be exposed when working on the load side of an overcurrent devices that is rated or can be adjusted to **1200 amperes or higher**
- The incident energy in an arcing event is directly proportional to the time frame a fault will be permitted to persist on the electrical system



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## 240.87 Arc Energy Reduction *(cont.)*

- The **final setting** of the instantaneous trip is what determines whether or not additional arc energy reduction techniques are required
- Not the intention of this requirement that the **minimum setting** of the instantaneous trip *(as is typically shipped from the factory)* be the determining factor on whether or not additional arc energy reduction is necessary
- **Final setting** as determined by the electrical system requirements such as **inrush characteristics** or **selective coordination** is determining factor
- Arc energy reduction is **not achieved** with an instantaneous trip being **adjusted to a lower setting** while a worker is working on the equipment, and then adjusted back to the desired setting after the work is complete



142

## 240.87 Arc Energy Reduction

An instantaneous trip setting that is less than the available arcing current is one of seven methods recognized to achieve arc energy reduction

Courtesy of Eaton Corporation

Temporary adjustment of the instantaneous trip setting to achieve arc energy reduction does not satisfy this requirement

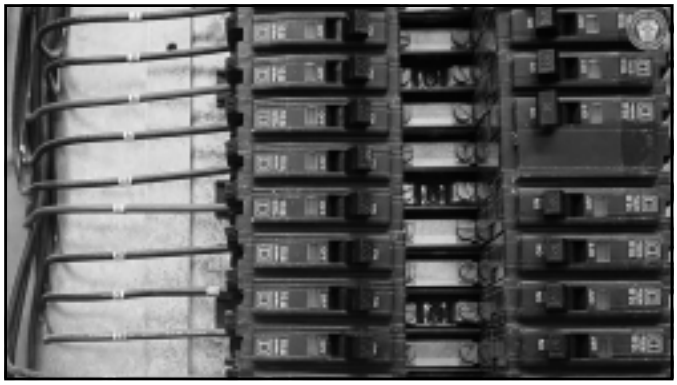
143

## 240.88 Reconditioned Equipment

- New section added dealing with reconditioned equipment to indicate that **molded-case circuit breakers** shall not be permitted to be reconditioned
- Each Code Making Panel (CMP) was asked to review the equipment they have purview over and determine what equipment could be reconditioned and what equipment could not be reconditioned but rather replaced when necessary
- Molded-case circuit breakers and low-voltage power circuit breaker electronic trip units cannot be reconditioned
- Low- and medium-voltage power circuit breakers, high-voltage circuit breakers, electromechanical protective relays, and current transformers **can be reconditioned**
- Marking requirement for reconditioned equipment located at **110.21(A)(2)**



144



145

## Article 242 Overvoltage Protection (New)

- New article added to provide the general, installation, and connection requirements for **overvoltage protection** and **overvoltage protective devices** for clarity and usability
- Relocates previous **Articles 280** (Surge Arresters, Over 1000 Volts) and **285** (Surge-Protective Devices, 1000 Volts or Less) into a new Article 242
- More appropriately located immediately following Article 240 for overcurrent protection
- Combining previous Articles 280 and 285 in a style similar to that of Article 240 significantly improve clarity and usability

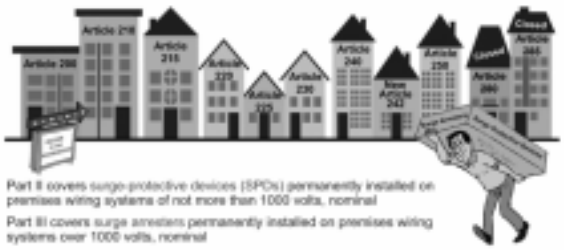


146

## Article 242 Overvoltage Protection

New Article 242 added to provide the general, installation, and connection requirements for overvoltage protection and overvoltage protective devices

Relocates previous Articles 280 and 285 into a new Article 242




Part II covers surge-protective devices (SPDs) permanently installed on premises wiring systems of not more than 1000 volts, nominal

Part III covers surge arresters permanently installed on premises wiring systems over 1000 volts, nominal

147

## 250.25 Grounding Systems Permitted to Be Connected on the Supply Side Service Disconnect

- **New section** created to cover the requirements for grounding of supply-side disconnects permitted to be connected on the supply-side of a service
- Points user of the Code to **250.24** *(Grounding Service-Supplied Alternating-Current Systems)* for the grounding and bonding requirements for these supply-side disconnects
- **230.82** lists eleven specific items that the *Code* permits to be installed ahead of or on the line side of a service disconnecting means
- Grounding of systems such as solar, wind, fuel cells, and interconnected power production systems were not covered in detail when connected on the line side of a service disconnect



148

## 250.25 Grounding Systems Permitted to Be Connected on the Supply Side Service Disconnect

- As more and more renewable and interconnected power production sources are connected to the serving utility directly, the need for prescriptive grounding and bonding requirements for these alternative sources is even more critical
- When this equipment is installed in another enclosure and identified as not being "service equipment," requirements need to be provided on how to properly accomplish the grounding and bonding of these installations
- Since the idea is to generally treat the installation like a service *(but not call it a service)*, pointing both the installer and enforcer to the same requirements as used for the service equipment, provides the direction and a consistent installation needed



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150

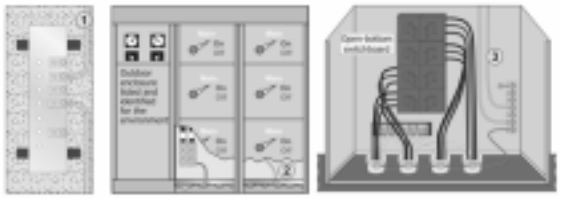
## 250.64(A) Aluminum or Copper-Clad Aluminum GECs

- 250.64(A) formatted into a **list format** for improved clarity and usability
- Clarifies that terminations for **aluminum or copper-clad aluminum** grounding electrode conductors (GEC) located in the **interior of equipment "listed and identified for the environment"** are separated from the earth and **can be terminated** within 450 mm (18 in.) of the earth
- Section was divided into **three distinctive parts** to better distinguish what type of bare, covered, or insulated aluminum or copper-clad aluminum GECs can or cannot be terminated **within 450 mm (18 in.) of the earth**, or be installed **where subject to corrosive conditions**, or be installed **in direct contact with concrete**
- Similar changes occurred at **250.120(B)** for terminating aluminum or copper-clad aluminum EGCs within 450 mm (18 in.) of the earth



151

## 250.64(A) Aluminum or Copper-Clad Aluminum GECs



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

1. Bare or covered GECs ***not permitted*** to be installed where subject to corrosive conditions or be installed in direct contact with concrete *(without an extruded polymeric covering)*
2. Terminations made within outdoor enclosures that are listed and identified for the environment are ***permitted*** within 450 mm (18 in.) of bottom of the enclosure
3. Aluminum or copper-clad aluminum GECs installed external to buildings or equipment enclosures ***not permitted*** to be terminated within 450 mm (18 in.) of the earth



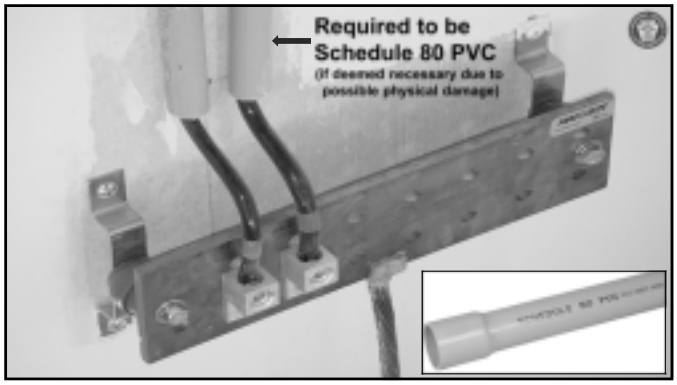
152

## 250.64(B)(2) and (B)(3) GEC Installations Exposed to Physical Damage

- Revision clarifies that **Schedule 80 PVC** is required when PVC conduit is used for **protection from physical damage** for a grounding electrode conductor (GEC)
- This is **consistent with other sections of the *Code***, such as 230.50(B)(1) where Schedule 80 PVC is an option to provide protection from physical damage for service-entrance conductors
- Schedule 40 PVC does not provide the **impact and crush resistant characteristics** required for providing the protection anticipated by the *Code* and cannot be used in any location where protection from physical damage is required



153




154

## 250.68(C)(3) GEC Connections to Rebar-Type Concrete-Encased Electrodes

- New provisions added to clarify that the rebar system in a footing or foundation is not suitable as the conductor to interconnect other grounding electrodes
- 250.68(C)(3), which gives the permission to use a rebar extension for connection of GECs and bonding jumpers was reformatted into a **list format**
- **Installation requirements** for the use of a rebar "stub-up" as an extension connected to a concrete-encased electrode was added
- Rebar extension must be continuous with the concrete-encased electrode rebar or it needs to be connected to the concrete-encased electrode rebar by the usual steel tie wires, exothermic welding, welding, or other effective means



155

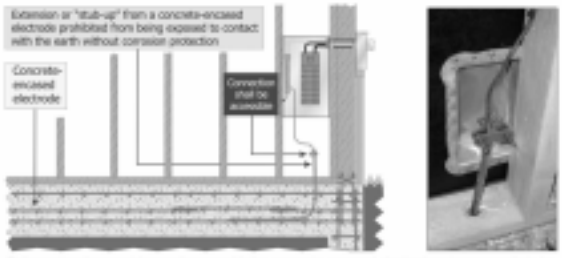
## 250.68(C)(3) GEC Connections to Rebar-Type Concrete-Encased Electrodes *(cont.)*

- Additional language **prohibits** the rebar *(both the concrete-encased electrode rebar and the rebar extension)* from being used as a conductor to **interconnect the individual electrodes** of grounding electrode systems
- The rebar extension:
  - Must be **connected to the rebar** in the foundation or footing
  - Shall not be exposed to earth contact without **corrosion protection**
  - Shall not be used to **interconnect electrodes** of the grounding electrode system
- Same change added at **250.53(C)** for bonding jumper(s) used to connect the grounding electrodes together to form the grounding electrode system



156

## 250.68(C)(3) Concrete-Encased Electrode Extension




Rebar extension must be continuous with the concrete-encased electrode rebar or needs to be connected to the concrete-encased electrode rebar by the usual steel tie wires, exothermic welding, welding, or other effective means

Rebar *(both the concrete-encased electrode rebar and the rebar extension)* not permitted to be used as a conductor to interconnect the individual electrodes of grounding electrode systems

157

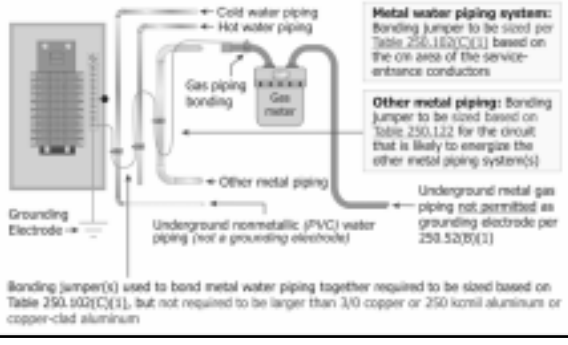
## 250.104(A)(1) Bonding of Metal Water Piping Systems

- Revision clarifies that **bonding jumper(s)** used to bond metal water piping system(s) together are not required to be larger than **3/0 copper** or **250 kcmil aluminum or copper-clad aluminum**
- Bonding jumper(s) used to bond metal water piping together still required to be sized based on **Table 250.102(C)(1)** but not required to be larger than 3/0 copper or 250 kcmil aluminum or copper-clad aluminum
- Changes made as a result of changing sizing reference from Table 250.66 to Table 250.102(C)(1) in the 2017 *NEC*, which resulted in an **inadvertent increase in the sizing** of bonding jumper(s) for metal water piping systems
- Same basic change occurred at **250.104(C)** for bonding of **structural metal**



158

## 250.104(A)(1) Bonding of Metal Water Piping Systems




Bonding jumper(s) used to bond metal water piping together required to be sized based on Table 250.102(C)(1), but not required to be larger than 3/0 copper or 250 kcmil aluminum or copper-clad aluminum

159

## 250.104(A)(3) Buildings or Structures Supplied by Feeder(s) or Branch Circuit(s)

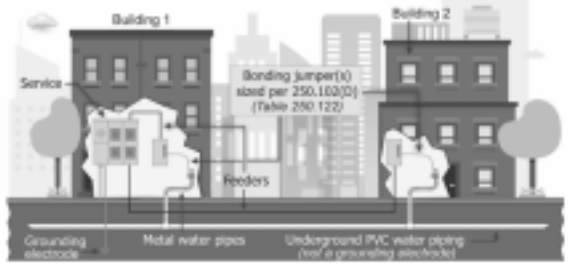
- Revision clarifies the **sizing requirements for bonding jumper(s)** used for bonding metal water piping systems when a building or structure is supplied by a feeder or branch circuit
- Reference changed from Table 250.102(C)(1) to **250.102(D)** *(and **Table 250.122**)* based on the largest overcurrent device supplying circuits the building or structure
- This bonding jumper sizing was changed in 2017 *NEC* to required sizing in accordance with Table 250.102(C)(1), based on the size of the feeder or branch-circuit conductors that supply the building or structure
- Feeders and branch circuits are protected by overcurrent protective devices and the size of these bonding jumpers should be based on 250.122



160

## 250.104(A)(3) Buildings or Structures Supplied by Feeder or BC

Bonding jumper(s) used for bonding metal water piping system(s) at multiple buildings or structures supplied by a feeder(s) or branch circuit(s) required to be sized based on 250.102(D) (Table 250.122) based on the largest overcurrent device supplying circuits to the buildings or structures




161

## 250.109 Metal Enclosures

- New section added indicating **metal enclosures** can be used to connect bonding jumpers or equipment grounding conductors, or both, together to become a part of an **effective ground-fault current path**
- Metal covers and metal fittings attached to these metal enclosures are also considered to be connected to the enclosed bonding jumpers or equipment grounding conductors, or both
- If circuit conductors are spliced within a box or terminated on equipment within or supported by a box, all EGCs associated with any of those circuit conductors are **required to be connected within the box or to the box** [250.148]
- Exposed, normally non-current-carrying metal parts of fixed equipment supplied by or enclosing conductors or components that are likely to become energized are **required to be connected to an EGC** [250.110]



162

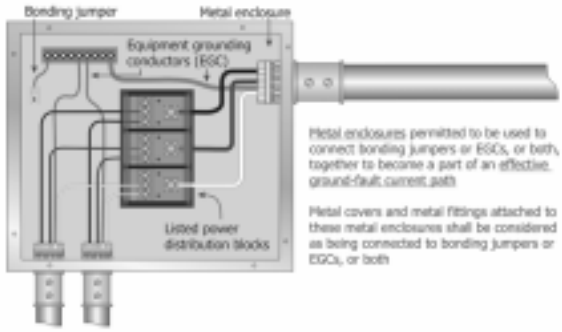
## 250.109 Metal Enclosures *(cont.)*

- New section added indicating **metal enclosures** can be used to connect bonding jumpers or equipment grounding conductors, or both, together to become a part of an **effective ground-fault current path** *(cont.)*
- These and other *Code* requirements call for a connection of EGCs to metal box or metal enclosure, yet there was **no *Code* allowances** for these metal enclosures to serve as any part of an effective ground-fault current path
- Needed change to clarify that metal boxes, cabinets and other metal enclosures are **permitted to be used for grounding and bonding** of metal raceways, metal cables, and other metal equipment that is connected to the metal box, cabinet or enclosure



163

## 250.109 Metal Enclosures as an Effective Ground-Fault Path




164

## 250.121(B) Restricted Use of Metal Frame of Building or Structure as EGC

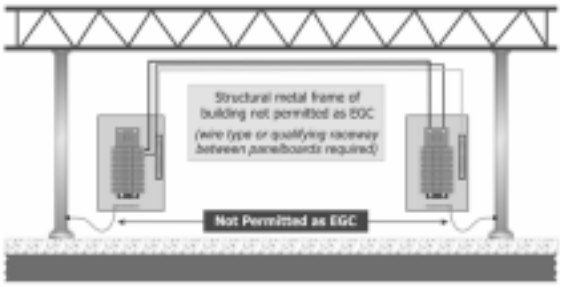
- New sub-section added to prohibit the **structural metal frame of a building or structure** from being used as an **equipment grounding conductor** (EGC)
- These prohibitive EGC rules were previously found at 250.134(A) and only applied to electrical equipment secured to and in electrical contact with a metal rack or structure provided for the electrical equipment's support
- New rules apply to **all types** of equipment *(not just electrical equipment supported by a metal rack or structure)* and structural metal frames of a building or structure
- The structural metal frame of a building or structure need not serve as an EGC due to the uncertain path that ground-fault current must take in an effort to clear a fault



165

## 250.121(B) Restricted Use of Metal Frame of Building or Structure

The structural metal frame of a building or structure shall not be used as an equipment grounding conductor




166

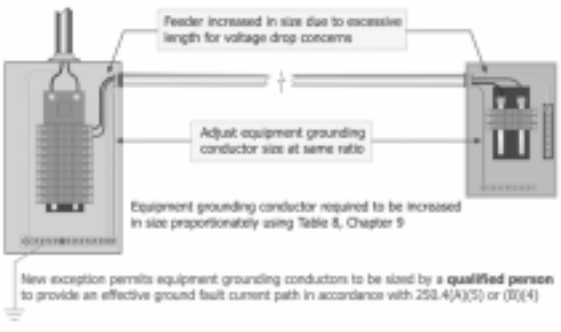
## 250.122(B) Adjustment of EGC Sizing

- Revisions clarify that **adjustment and/or correction factors** do not require an increase in the size of the equipment grounding conductor (EGC)
- If ungrounded conductors are increased in size for any reason **other than** as required in **310.15(B)** *(temperature adjustment factors)* or **310.15(C)** *(number of current-carrying conductors adjustment factors)*, wire-type EGCs, if installed, are required to be increased in size proportionately *(same ratio)* to the increase in circular mil area of the ungrounded conductors
- **New exception** added to allow the EGC to be sized by a **qualified person**, provided an effective ground fault current path can be established
- New exception will allow equipment grounding conductors to be sized by a "**qualified person**" to provide an effective ground fault current path rather than the **"ratio" method**



167

## 250.122(B) Adjusting Equipment Grounding Conductor Size




168

## 250.148 Continuity of EGCs and Attachment in Boxes

- Revision clarifies that all wire-type equipment grounding conductors (EGC) associated with any spliced circuit conductors must be connected ***within*** the box or to the box
- Revision improve readability and clarify when EGCs within a box are intended to be connected together and bonded to a metal box or device
- Title was changed from "Continuity and Attachment of Equipment Grounding Conductors to Boxes" to "**Continuity of Equipment Grounding Conductors and Attachment in Boxes"**
- Emphasis was placed on the fact that only the EGCs associated with the spliced conductors are to be connected within the box or to the box
- Connecting all EGCs together, especially if of considerably different sizes, is impractical and unnecessary



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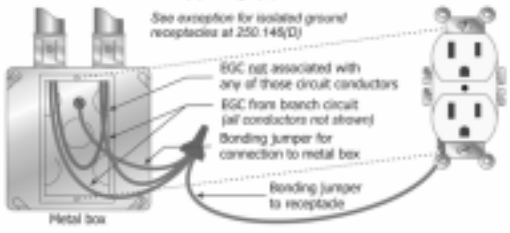
## 250.148 Continuity of EGCs and Attachment in Boxes

If circuit conductors are spliced within a box or terminated on equipment within or supported by a box, all wire-type equipment grounding conductor(s) associated with any of those circuit conductors shall be connected within the box or to the box with devices suitable for the use in accordance with 250.8 and 250.148(A) through (D)




A connection used for no other purpose shall be made between the metal box and the equipment grounding conductor(s) in accordance with 250.8



170

## 250.184(C), Exception – Multigrounded Neutral Systems

- **New exception** added to relieve bonding the neutral conductor to a grounding electrode in an **uninterrupted conductor exceeding 400 m (1300 ft)** if the only purpose for removing the cable jacket is for bonding the neutral conductor to a grounding electrode in a multigrounded neutral system
- 250.184(C)(3) requires at least one grounding electrode to be installed and connected to the multigrounded neutral conductor every 400 m (1300 ft)
- National Electrical Safety Code (NESC) allows long cable runs such as those for wind farms and solar farms to still be considered multi-point grounded but not held to distances like the 400 m (1300 ft) maximum length between bonding of the neutral conductor to a grounding electrode



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## 250.184(C), Exception – Multigrounded Neutral Systems *(cont.)*

- **New exception** added to relieve bonding the neutral conductor to a grounding electrode in an **uninterrupted conductor exceeding 400 m (1300 ft)** if the only purpose for removing the cable jacket is for bonding the neutral conductor to a grounding electrode in a multigrounded neutral system *(cont.)*
- Removing the cable jacket only to create a point for connecting the multigrounded neutral conductor to a grounding electrode creates a **less desirable condition** than allowing further space between these connection points
- Removing the outer sheathing of the multigrounded neutral conductor cable creates a "**weak link**" in the cable that could lead to premature cable failure
- New exception in the *NEC* will align the NESC and *NEC* to avoid questions as to which standard has authority and brings consistency on this issue



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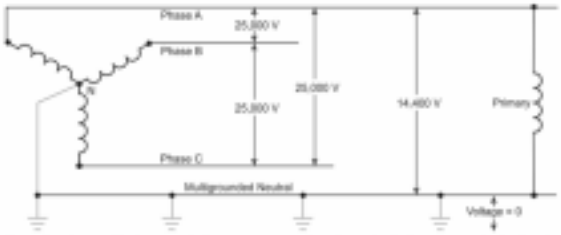
## 250.184(C) Multigrounded Neutral Systems

Where a multigrounded neutral system is used, at least one grounding electrode shall be installed and connected to the multigrounded neutral conductor every 400 m (1300 ft)




*Exception: In a multipoint grounded system, a grounding electrode shall not be required to bond the neutral conductor in an uninterrupted conductor exceeding 400 m (1300 ft) if the only purpose for removing the cable jacket is for bonding the neutral conductor to a grounding electrode*



173

## 250.187 Impedance Grounded Neutral Systems

- Revisions clarify that the conductor from the neutral point of a transformer to the grounding impedance device **does not meet the definition of neutral conductor** in Article 100 since it is not intended to carry current during normal operation
- The conductor from the neutral point of a transformer in this system to the grounding impedance device is now identified as a **grounded conductor**
- Title of **250.187(B)** was changed from "Identified and Insulated" to simply "**Insulated**" as a grounded conductor is already required to be identified or marked as a grounded conductor at **200.6**



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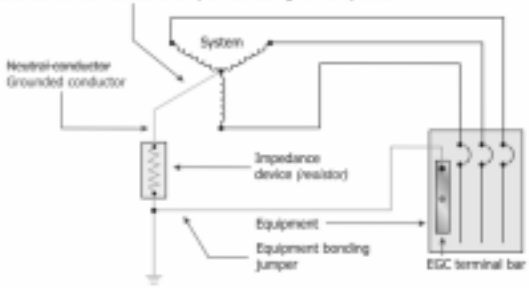
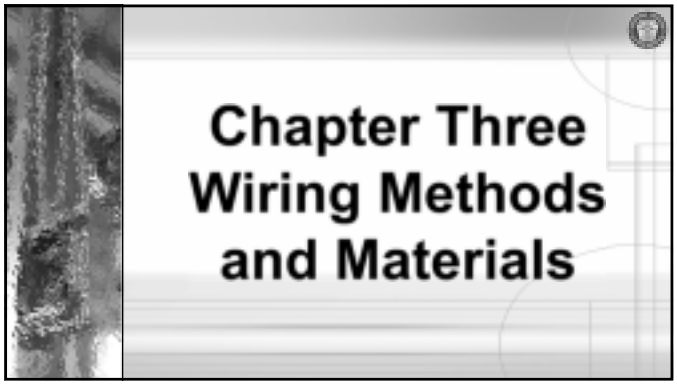
## 250.187 Impedance Grounded Neutral Systems

The conductor from the neutral point of a transformer of an impedance grounded system to the grounding impedance device does not meet the definition of neutral conductor in Article 100 since it is not intended to carry current during normal operation




175




176

## 300.4(G) Protection Against Physical Damage - Insulated Fittings

- Previous *Code* text required conductors to be protected by an **identified fitting providing a smoothly rounded insulating surface** where insulated circuit conductors of **4 AWG or larger** enter a raceway in a cabinet, pull box, junction box, or auxiliary gutter
- Title of 300.4(G) was revised to remove the word "**Insulated**" to cover **alternative metal fittings** *(such as a metal grounding bushing/locknut)*
- Revised into a **list format** and text added to cover **listed metal fittings** that have **smoothly rounded edges** that will not damage the 4 AWG and larger conductors
- Previous exception for **threaded hubs or bosses** was rewritten into positive *Code* text



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## 300.4(G) Protection Against Physical Damage - Insulated Fittings

Where raceways contain 4 AWG or larger insulated circuit conductors, and conductors enter a cabinet, a box, an enclosure, or a raceway, conductors shall be protected by any of the following:

(1) Identified fitting providing a smoothly rounded insulating surface

(2) A listed metal fitting that has smoothly rounded edges

(3) Separation from the fitting or raceway by using an identified insulating material that is securely fastened in place

(4) Threaded hubs or bosses (integral part of cabinet, box, enclosure, or raceway) with smoothly rounded or flared entry



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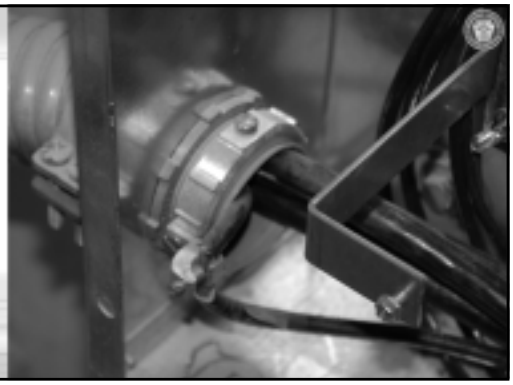
## 300.4(G) Protection Against Physical Damage - Fittings



179

## 300.7(A) Raceways Exposed to Different Temperatures - Sealing

- Where raceways or sleeves are known to be subjected to different temperatures, and where condensation is known to be a problem, required to be **sealed with a sealant identified for use with cable insulation, conductor insulation** *(rather than filled with an approved material)*
- Previously required the raceway or sleeve to be filled with an "**approved material**"
- Revision brings consistency and **similar language** to 300.7(A) as other raceway sealing requirements such as **225.27** for sealing an outdoor raceway entering a building



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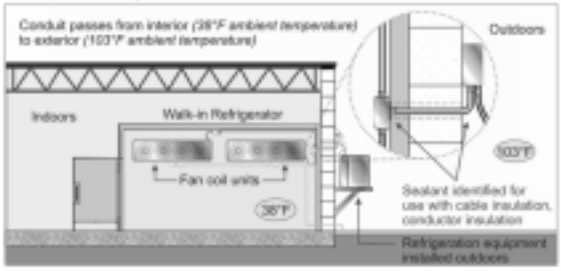
## 300.7(A) Raceways Exposed to Different Temperatures - Sealing

Where a raceway or sleeve are known to be subjected to different temperatures, and where condensation is known to be a problem, the raceway or sleeve is now required to be sealed with a sealant "identified for use with cable insulation, conductor insulation, a bare conductor, a shield, or other components"




181

## 300.15(F) Boxes, Conduit Bodies, or Fittings - Where Required: Fitting

- Revisions occurred to make it clear **that listed transition fittings** and **listed interconnector devices** are permitted to be installed in **concealed locations** behind drywall and similar locations
- At each conductor splice point, outlet point, switch point, junction point, etc., a fitting **identified for the use** is permitted in lieu of a box or conduit body where conductors are not spliced or terminated within the fitting and the fitting is accessible after installation, **unless the fitting is listed for concealed installation**
- Transition fitting *(Type AC cable to EMT, etc.)* not required to be accessible after installation as they are **designed to be installed concealed**
- No different than a coupling used to join consecutive pieces of the same raceway which are not required to be accessible



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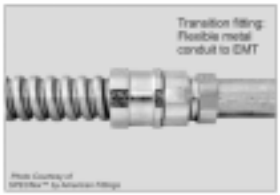
## 300.15(F) Boxes, Conduit Bodies, or Fittings - Where Required: Fittings

At each conductor splice point, outlet point, junction point, etc., a fitting identified for the use is permitted in lieu of a box or conduit body where conductors are not spliced or terminated within the fitting and the fitting is accessible after installation ...





*unless the fitting is listed for concealed installation*

183

## 300.22(D) Wiring in Air-Handling Areas Under Raised Floors (ITE Rooms)

- Revision occurred to reference **645.5(E)** *(Supply Circuits and Interconnecting Cables – Under Raised Floors)* **rather than the entire Article 645** for electrical wiring in air-handling areas beneath raised floors for information technology equipment
- Installation must first meet the requirements of **645.4** *(Special Requirements for Information Technology Equipment Rooms)* so that 645.5(E) can permit the different requirements that normally would be required in 300.22(C) for wiring under raised floors



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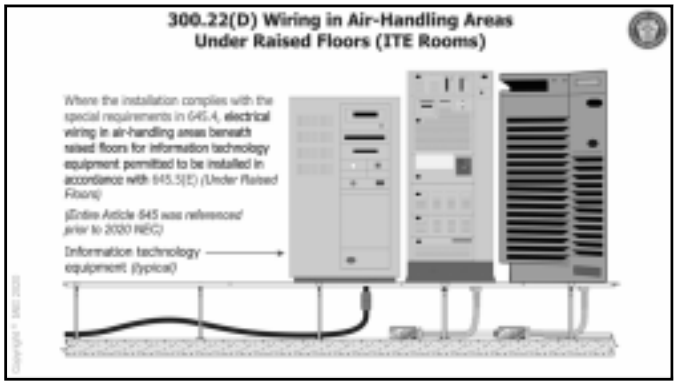
## 300.22(D) Wiring in Air-Handling Areas Under Raised Floors (ITE Rooms)

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186

## 300.25 Exit Enclosures (Stair Towers)

- New section added pertaining to the **allowable electrical wiring methods** serving electrical equipment in **exit enclosures** *(stairways)*
- Where an exit enclosure is required to be **separated from the building**, only electrical wiring methods serving **equipment permitted by the authority having jurisdiction in the exit enclosure** shall be installed within the exit enclosure
- Equipment deemed necessary to be contained in a stair tower could be such things as **fire sprinkler equipment**, **security systems**, **public address systems**, and **fire department emergency communications devices**
- Consistent with information found in NFPA 101 *(Life Safety Code-2018 edition)*



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## 300.45 Warning Danger Signs

- **Editorial revisions** for signs required to be posted at points of access to conductors for raceway and cable systems of over 1000 volts replacing the word "~~Warning~~" with the word "**Danger**"
- Sign or label required to convey the following wording: **DANGER—HIGH VOLTAGE—KEEP OUT** !
- Previous title and *Code* requirement were inconsistent
- This sign is actually ANSI Z535 danger signs rather than warning signs
- Reference to **110.21(B)** *(Equipment Markings- Field-Applied Hazard Markings)* was also added to 300.45 triggering other important **marking requirements** for these signs



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## 300.45 Warning Danger Signs

For systems of over 1000 volts, nominal, danger signs are required to be conspicuously posted at points of access to conductors in all raceway systems and cable systems

Sign(s) are required to comply with 110.21(B), be readily visible, and state the following:


DANGER—HIGH VOLTAGE—KEEP OUT



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## 300.45 Warning Danger Signs


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## Article 310 Reorganized

- Article 310 was **extensively reorganized** to increase the usability of the article
- The ampacity tables in Article 310 will simply be titled as **Table 310.16** through Table 310.21
- The scope of Article 310 is limited to **not more than 2000 volts**
- Requirements and ampacity tables for conductors **over 2000 volts** have been incorporated into **new Article 311**
- Copper-clad aluminum conductors must meet the material requirements of Section 310.3(B)



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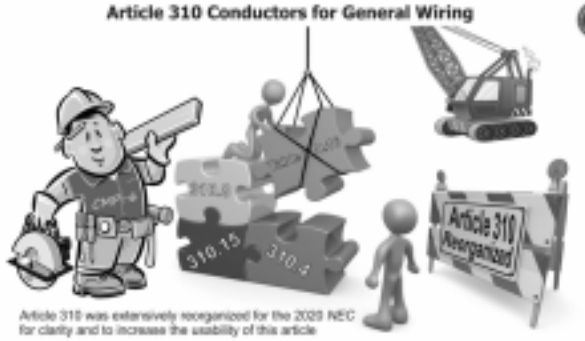
## Article 310 Conductors for General Wiring




Article 310 was extensively reorganized for the 2020 NEC for clarity and to increase the usability of this article

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## Article 310 Conductors for General Wiring
### Comparison Chart (2017 NEC to 2020 NEC)

| 2020 NEC | Topic | 2017 NEC |
|---|---|---|
| Part I | General | Part I |
| 310.1 | Scope | 310.1 |
| ~~310.2~~ | ~~Definitions~~ | 310.2 |
| 310.3 | Conductors | 310.106 |
| 310.3(A) | Minimum Size of Conductors | 310.106(A) |
| 310.3(B) | Conductor Material | 310.106(B) |
| 310.3(C) | Stranded Conductors | 310.106(C) |
| 310.3(D) | Insulated | 310.106(D) |
| Part II | Construction Specifications | Part III |
| 310.4 | Conductor Constructions and Applications | 310.104 |
| Table 310.4(A) | Conductor Applications and Insulations Rated 600 Volts | Table 310.104(A) |
| Table 310.4(B) | Thickness of Insulation for Nonshielded Types RHH and RHW Solid Dielectric Insulated Conductors Rated 2000 Volts | Table 310.104(B) |
| 310.6 | Conductor Identification | 310.110 |
| 310.6(A) | Grounded Conductors | 310.110(A) |
| 310.6(B) | Equipment Grounding Conductors | 310.110(B) |
| 310.6(C) | Ungrounded Conductors | 310.110(C) |

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## Article 310 Conductors for General Wiring
### Comparison Chart (2017 NEC to 2020 NEC)

| 2020 NEC | Topic | 2017 NEC |
|---|---|---|
| 310.8 | Marking | 310.120 |
| 310.8(A) | Required Information | 310.120(A) |
| 310.8(B) | Method of Marking | 310.120(B) |
| 310.8(B)(1) | Surface Marking | 310.120(B)(1) |
| 310.8(B)(2) | Marker Tape | 310.120(B)(2) |
| 310.8(B)(3) | Tag Marking | 310.120(B)(3) |
| 310.8(B)(4) | Optional Marking of Wire Size | 310.120(B)(4) |
| 310.8(C) | Suffixes to Designate Number of Conductors | 310.120(C) |
| 310.8(D) | Optional Markings | 310.120(D) |
| Part III | Installation | Part II |
| 310.10 | Uses Permitted | 310.10 |
| 310.10(A) | Dry Locations | 310.10(A) |
| 310.10(B) | Dry and Damp Locations | 310.10(B) |
| 310.10(C) | Wet Locations | 310.10(C) |
| 310.10(D) | Locations Exposed to Direct Sunlight | 310.10(D) |
| ~~310.10(E)~~ | ~~Shielding~~ | 310.10(E) |
| 310.10(F) | Direct-Burial Conductors | 310.10(F) |

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**Article 310 Conductors for General Wiring**
**Comparison Chart (2017 NEC to 2020 NEC)**

| 2020 NEC | Topic | 2017 NEC |
|---|---|---|
| 310.10(F) | Corrosive Conditions | 310.3(B) |
| 310.10(G) | Conductors in Parallel | 310.3(C) |
| 310.10(G)(1) | General | 310.3(C)(1) |
| 310.10(G)(2) | Conductor and Installation Characteristics | 310.3(C)(2) |
| 310.10(G)(3) | Separate Cables or Raceways | 310.3(C)(3) |
| 310.10(G)(4) | Ampacity Adjustment | 310.3(C)(4) |
| 310.10(G)(5) | Equipment Grounding Conductors | 310.3(C)(5) |
| 310.10(G)(6) | Bonding Jumpers | 310.3(C)(6) |
| 310.12 | Single-Phase Dwelling Services and Feeders | 310.15(B)(7) |
| 310.12(A) | Services | 310.15(B)(7)(1) |
| 310.12(B) | Feeders | 310.15(B)(7)(2) |
| 310.12(C) | Feeder Ampacities | 310.15(B)(7)(3) |
| 310.12(D) | Grounded Conductors | 310.15(B)(7)(4) |
| Table 310.12 | Single-Phase Dwelling Services and Feeders | Table 310.15(B)(7) (2017 NEC) |
| 310.14 | Ampacities for Conductors Rated 0-2000 Volts | 310.15 |
| 310.14(M) | General | 310.15(N) |

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**Article 310 Conductors for General Wiring**
**Comparison Chart (2017 NEC to 2020 NEC)**

| 2020 NEC | Topic | 2017 NEC |
|---|---|---|
| 310.14(A)(1) | Tables or Engineering Supervision | 310.15(A)(1) |
| 310.14(A)(2) | Selection of Ampacity | 310.15(A)(2) |
| 310.14(A)(3) | Temperature Limitation of Conductors | 310.15(A)(3) |
| 310.14(B) | Engineering Supervision | NEW |
| 310.15 | Ampacity Tables | 310.15(B) |
| 310.15(A) | General | 310.15(B)(1) |
| 310.15(B) | Ambient Temperature Correction Factors | 310.15(B)(2) |
| 310.15(B)(1) | General | 310.15(B)(2) |
| 310.15(B)(2) | Rooftop | 310.15(B)(2)(c) |
| Table 310.15(B)(1) | Ambient Temperature Correction Factors Based on 30°C (86°F) | Table 310.15(B)(2)(a) |
| Table 310.15(B)(2) | Ambient Temperature Correction Factors Based on 40°C (104°F) | Table 310.15(B)(2)(b) |
| 310.15(C) | Adjustment Factors | 310.15(B)(3) |
| 310.15(C)(1) | More than Three Current-Carrying Conductors | 310.15(B)(3)(a) |
| Table 310.15(C)(1) | Adjustment Factors for More Than Three Current-Carrying Conductors | Table 310.15(B)(3)(a) |

197

**Article 310 Conductors for General Wiring**
**Comparison Chart (2017 NEC to 2020 NEC)**

| 2020 NEC | Topic | 2017 NEC |
|---|---|---|
| 310.15(C)(2) | Raceway Spacing | 310.15(B)(3)(b) |
| 310.15(D) | Bare or Covered Conductors | 310.15(B)(4) |
| 310.15(E) | Neutral Conductor | 310.15(B)(5) |
| 310.15(F) | Grounding or Bonding Conductor | 310.15(B)(6) |
| 310.16 | Ampacities of Insulated Conductors in Raceway, Cable, or Earth (Directly Buried) (86°F) | NEW |
| 310.17 | Ampacities of Single-Insulated Conductors in Free Air (86°F) | NEW |
| 310.18 | Ampacities of Insulated Conductors in Raceway or Cable (104°F) | NEW |
| 310.19 | Ampacities of Single-Insulated Conductors in Free Air (104°F) | NEW |
| 310.20 | Ampacities of Conductors Supported on a Messenger (104°F) | NEW |
| 310.21 | Ampacities of Bare or Covered Conductors in Free Air (104°F) | NEW |
| Table 310.16 | Ampacities of Insulated Conductors Not More Than Three Current-Carrying Conductors in Raceway, Cable, or Earth (Directly Buried) (86°F) | Table 310.15(B)(16) |
| Table 310.17 | Ampacities of Single-Insulated Conductors in Free Air (86°F) | Table 310.15(B)(17) |
| Table 310.18 | Ampacities of Insulated Conductors Not More Than Three Current-Carrying Conductors in Raceway or Cable (104°F) | Table 310.15(B)(18) |

198

**Article 310 Conductors for General Wiring**
**Comparison Chart (2017 NEC to 2020 NEC)**

| 2020 NEC | Topic | 2017 NEC |
|---|---|---|
| Table 310.19 | Ampacities of Single-Insulated Conductors in Free Air (104°F) | Table 310.15(B)(19) |
| Table 310.20 | Ampacities of Conductors Supported on a Messenger (104°F) | Table 310.15(B)(20) |
| Table 310.21 | Ampacities of Bare or Covered Conductors in Free Air (104°F) | Table 310.15(B)(21) |
| ~~310.60~~ | ~~Conductors Rated 2001 to 35,000 Volts~~ | Moved to new Article 311 |

199

## Article 310 Ampacity Tables

- The ampacity tables will simply be titled as Table 310.16 through Table 310.21 *(Example: **Table 310.15(B)(16)** will now be simply **Table 310.16**)*
- New sections were added at 310.16 through 310.21 that now refer to the ampacity tables and contain conditions of use previously found in the table headings
- The ampacity table headings were shortened and a note referring to the section language was added to each table
- All of the notes to the tables were retained at the bottom of the ampacity tables



200

**Table 310.16 ~~310.15(B)(16)~~** *(in part)*

201

## Article 310 Allowable Ampacity for Conductors

- Revision occurred throughout Article 310 removing the term "**allowable**" from **~~allowable~~ ampacities for conductors**
- "Allowable" removed from Article 310 **thirteen** times throughout the article
- "**Ampacity**" is defined in Article 100 as "the maximum current, in amperes, that a conductor can carry continuously under the conditions of use without exceeding its temperature rating"
- Proper term used throughout Article 310 should be "**ampacity**" and not "**allowable ampacity**" as it is the intent for this section to determine the ampacity of the conductor based upon its **condition of use**
- The use of the word "allowable" did not add any clarity and was deleted in several locations



202

## Article 310 Allowable Ampacity for Conductors

Revision occurred throughout Article 310 by removing the term "allowable" from ~~allowable~~ ampacities for conductors

**Ampacity**: The maximum current, in amperes, that a conductor can carry continuously under the conditions of use without exceeding its temperature rating.



203

## 310.10 and Ampacity Tables – Conductor Types Added

- Type **XHHN**, **XHWN**, and **XHWN-2** were added to the "**Uses Permitted**" locations and the ampacity tables based on appropriate temperature ratings
- These three types of conductor insulations were recognized by the 2017 *NEC* at Table 310.104(A) *[now Table 310.4(A)]*
- Inadvertently left out of the Article 310 ampacity tables for 2017 *NEC*
- Type XHHN, XHWN, and XHWN-2 insulated conductors were added to the insulated conductors and cables that can be used in **dry and damp locations** at 310.10(B)
- Types XHWN and XHWN-2 conductors were added to the list of acceptable types of conductors for a **wet location**

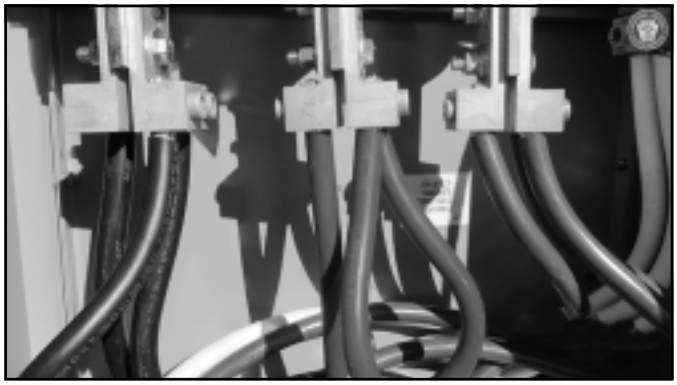


204

## 310.10 and Ampacity Tables - Conductor Types Added


Type XHHN, XHWN, and XHWN-2 were added to the 310.10 "Uses Permitted" locations and the ampacity tables based on appropriate temperature ratings

205



206

## 310.12 Single-Phase Dwelling Services and Feeders

- **New dwelling unit service ampacity table** from Informative Annex D, Example D7 added at **310.12** *[formerly Table 310.15(B)(7)]*
- Text added indicating Table 310.12 permitted to be used if there are **no temperature correction or adjustment factors needed**
- This dwelling unit table and/or information has been a part of the *Code* since the **1956 *NEC*** *(until the 2014 NEC)*
- These higher ampacity allowances permitted primarily due to the **diversity loads** associated with dwelling units
- Removed from the *Code* in the 2014 *NEC* and replaced with an ampacity reduction of not less than **83 percent** of the service or feeder rating of the ampacity values of then Table 310.15(B)(16)



207

## 310.12 Single-Phase Dwelling Services and Feeders *(cont.)*

- **New dwelling unit service ampacity table** from Informative Annex D, Example D7 added at **310.12** *[formerly Table 310.15(B)(7)] (cont.)*
- Reintroduced to the *Code* for the 2017 *NEC*, but it was located in **Informational Annex D**, following Example D7
- For ease of use, putting this sixty-three-year-old table back in Article 310 makes sense and compliments the reorganization of Article 310 for the 2020 *NEC* revision cycle



208

## 310.12 Permitted to be Used

310.12 - 120/240-Volt, 3-Wire, Single-Phase Dwelling Unit Service or Feeder or a 208Y/120-Volt, Single-Phase Dwelling Unit Feeder - If no adjustment or correction factors required, Table 310.12 permitted to be applied


83% reduction of service or feeder rating applies to service or feeder conductors supplying the entire load associated with the dwelling unit

209

## Table 310.12 Single-Phase Dwelling Services and Feeders

For one-family dwellings and the individual dwelling units of two-family and multifamily dwellings, service and feeder conductors supplied by a single-phase, 120/240-volt system shall be permitted to be sized in accordance with 310.12(A) through (D). [Single-phase feeder conductors consisting of two ungrounded conductors and the neutral conductor from a 208Y/120 volt system permitted to be sized in accordance with 310.12(A) through (C)]

| Service or Feeder Rating (Amperes) | Conductor (AWG or kcmil) | |
|---|---|---|
| | Copper | Aluminum or Copper-Clad Aluminum |
| 100 | 4 | 2 |
| 110 | 3 | 1 |
| 125 | 2 | 1/0 |
| 150 | 1 | 2/0 |
| 175 | 1/0 | 3/0 |
| 200 | 2/0 | 4/0 |
| 225 | 3/0 | 250 |
| 250 | 4/0 | 300 |
| 300 | 250 | 350 |
| 350 | 350 | 500 |
| 400 | 400 | 600 |

Note: If no adjustment or correction factors are required, this table shall be permitted to be applied.

210

## Article 311 Medium Voltage Cable (New)

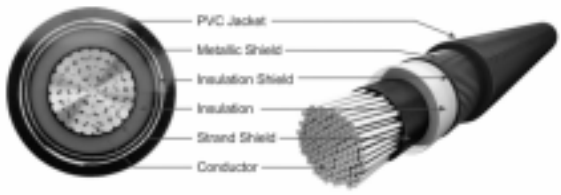
- In order to consolidate the **medium voltage requirements** previously found in **Articles 310** *(Conductors or General Use)* and **Article 328** *(Medium Voltage Cable)*, and to improve the usability of the *Code*, the requirements are combined into a **new Article 311**
- New article will cover the use, installation, construction specifications and ampacities for medium voltage conductors and cable (Type MV)
- Part of the **Article 310** reorganization included moving the Type MV cable requirements into new **Article 311** which also included moving the Type MV cable requirements out of **Article 328** and deleting that article entirely
- Prior to this new article, it was difficult to gather all necessary information pertaining to Type MV conductors and cables as they were scattered within the Article 310 ampacity tables for cables up to 2000 volts



211

## Article 311 Medium Voltage Cable

**Medium voltage cable:** A single or multiconductor solid dielectric insulated cable rated 2001 volts up to and including 35,000 volts, nominal.




Medium voltage requirements previously found in Articles 310 and Article 328 have be combined into new Article 311 to improve the usability of the Code



212

## 312.8(B) Power Monitoring or Energy Management Equipment

- The term "**Energy Management Equipment**" added to equipment permitted within the wiring space of enclosures for switches or overcurrent devices along with power monitoring equipment
- Wiring space within enclosures such as a panelboard cabinet for switches or overcurrent devices permitted to contain "**other wiring and equipment**" with limited percentage (40% and 75%) of the cross-sectional area of the space
- Listed energy management equipment's primary function is to monitor, measure and control circuits by automatic means within the wiring space of a cabinet, cutout box or a meter socket enclosure and is **similar in nature to that of power monitoring equipment**
- New list Item (3) was added for conductors used exclusively for control or instrumentation circuits



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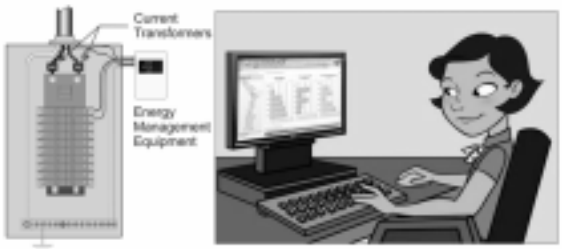
## 312.8(B) Power Monitoring or Energy Management Equipment




The term "Energy Management Equipment" added to equipment permitted within the wiring space of enclosures for switches or overcurrent devices along with power monitoring equipment

New list Item (3) was added for conductors used exclusively for control or instrumentation circuits



214

## 314.16(B)(5) EGC Box Fill Calculations

- Volume allowance for equipment grounding conductors (EGC) and equipment bonding jumpers was revised to add an **additional ¼ volume allowance** to the existing single volume allowance
- New ¼ volume allowance to be counted in installations with **more than four EGCs** or equipment bonding conductors
- All boxes (enclosures) must be large enough to provide for **sufficient free space** for all conductors and devices that will be enclosed within them to prevent overcrowding and possible physical damage when the devices or conductors are installed and completed
- Table 314.16(B) list the volume allowance as a function of conductor size



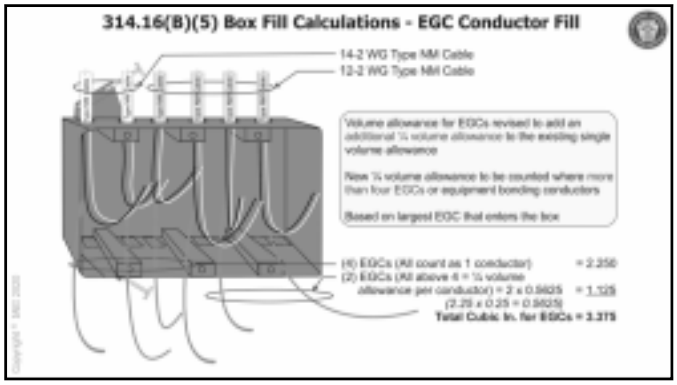
215

## 314.16(B)(5) EGC Box Fill Calculations *(cont.)*

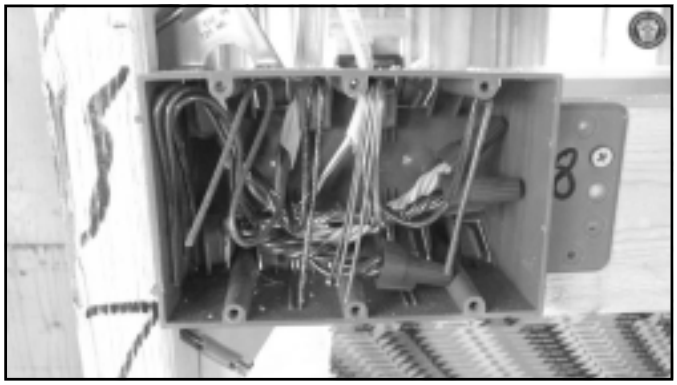
- A **single volume allowance** has been required for all equipment grounding conductors within a box since the 1971 *NEC*
- Single volume deduction based on the **largest equipment grounding conductor** or equipment bonding jumpers present in the box
- In multiple gang boxes, taking only one volume allowance based on the largest EGC is not always adequate resulting in **significant undue crowding** of conductors and not enough free space to allow heat to dissipate from the contained conductors
- Requiring all EGCs to meet **300.14** *[at least **150 mm (6 in.)** of free conductor for each conductor]* and applying only a single volume allowance was problematic in past editions of the *Code*



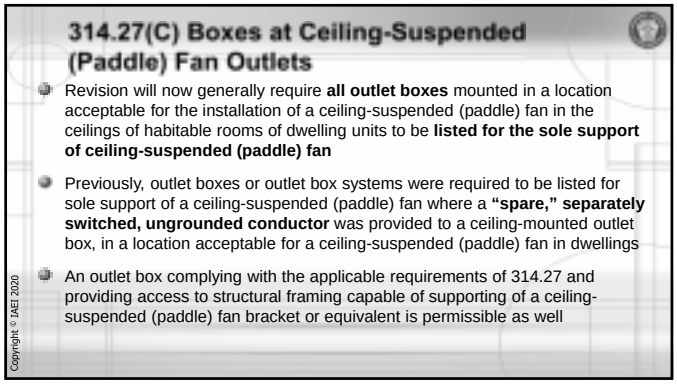
216


314.16(B)(5) Box Fill Calculations - EGC Conductor Fill
14-2 WG Type NM Cable
12-2 WG Type NM Cable
Volume allowance for EGCs revised to add an additional ¼ volume allowance to the existing single volume allowance
New ¼ volume allowance to be counted where more than four EGCs or equipment bonding conductors
Based on largest EGC that enters the box
(4) EGCs (All count as 1 conductor) = 2.250
(2) EGCs (All above 4 = ¼ volume allowance per conductor) = 2 x 0.5625 = 1.125
(2.25 x 0.25 = 0.5625)
Total Cubic In. for EGCs = 3.375

217



218


314.27(C) Boxes at Ceiling-Suspended (Paddle) Fan Outlets
Revision will now generally require **all outlet boxes** mounted in a location acceptable for the installation of a ceiling-suspended (paddle) fan in the ceilings of habitable rooms of dwelling units to be **listed for the sole support of ceiling-suspended (paddle) fan**
Previously, outlet boxes or outlet box systems were required to be listed for sole support of a ceiling-suspended (paddle) fan where a **"spare," separately switched, ungrounded conductor** was provided to a ceiling-mounted outlet box, in a location acceptable for a ceiling-suspended (paddle) fan in dwellings
An outlet box complying with the applicable requirements of 314.27 and providing access to structural framing capable of supporting of a ceiling-suspended (paddle) fan bracket or equivalent is permissible as well
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## 314.27(C) Boxes at Ceiling-Suspended (Paddle) Fan Outlets *(cont.)*

- Revision will now generally require **all outlet boxes** mounted in a location acceptable for the installation of a ceiling-suspended (paddle) fan in the ceilings of habitable rooms of dwelling units to be **listed for the sole support of ceiling-suspended (paddle) fan** *(cont.)*
- This new requirement will predicate the installation of an outlet box listed for the sole support of a ceiling-suspended (paddle) fan at most dwelling unit ceiling-mounted luminaire locations regardless of the existence of a "spare" separately switched ungrounded conductor or not
- Many ceiling-suspended (paddle) fans are now **remote-controlled** requiring only a two-wire installation



220

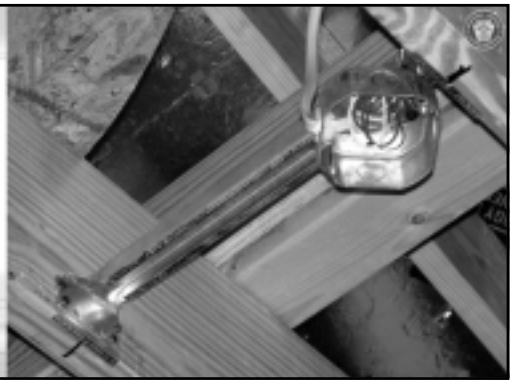
## 314.27(C) Boxes at Ceiling-Suspended (Paddle) Fan Outlets

All outlet boxes mounted in ceilings of habitable rooms of dwelling units required to be listed for the sole support of a ceiling-suspended (paddle) fan *(or outlet box providing access to structural framing capable of supporting of a ceiling-suspended (paddle) fan bracket or equivalent)*


Applicable only in locations acceptable for the installation of a ceiling-suspended (paddle) fan

221

## 314.27(C) Boxes at Ceiling-Suspended (Paddle) Fan Outlets



222

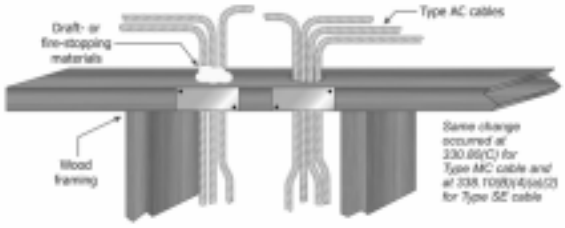
## 320.80(A) Type AC Cable Ampacity – Thermal Insulation

- Type AC cable is now required to comply with adjustment factors of **Table 310.15(C)(1)** *[previously T. 310.15(B)(3)(a) (More Than Three-Current-Carrying Conductors)]* when installed without maintaining spacing
- Similar to 334.80 for Type NM cable
- Where **more than two** Type AC, Type MC, Type NM, or Type SE cables containing **two or more current-carrying conductors** in each cable are installed in contact with thermal insulations, caulk, or sealing foam **without maintaining spacing** between cables, the ampacity of each conductor are required to be adjusted in accordance with Table 310.15(C)(1)
- Same cable installation restrictions implemented for metal-clad cable (**Type MC cable**) at **330.80(C)** and for service-entrance cable (**Type SE cable**) at **338.10(B)(4)(a)(2)**



223

## 320.80(A) Type AC Cable Ampacity-Thermal Insulation




Where more than two Type AC cables containing two or more current-carrying conductors in each cable are installed in contact with thermal insulation, caulk, or sealing foam without maintaining spacing between cables, the ampacity of each conductor shall be adjusted in accordance with Table 310.15(C)(1)

Note: Table 310.15(C)(1) is previous Table 310.15(B)(3)(a) *(Adjustment Factors for More Than Three Current-Carrying Conductors)*

224

## 330.130 Type MC-HL Cable in Hazardous (Classified) Locations

- New requirements added for Type MC cable with a designation of "**MC-HL**" installed in a hazardous (classified) location
- Type MC-HL cable shall be listed and shall have a gas/vapor tight continuous corrugated metallic sheath, an overall jacket of suitable polymeric material, and a separate equipment grounding conductor
- Prior to the 2020 *NEC*, there were no specific requirements for Type MC-HL cable in Article 330
- Type MC-HL cable with an interlocked metallic sheath provides a more flexible cable while still providing an overall jacket of suitable polymeric material
- Same change implemented for power and control tray cable (**Type TC cable**) with a designation of "TC-ER-HL" at **336.130**



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## 330.130 Type MC-HL in Hazardous (Classified) Locations

Type MC-HL cable required to be listed and have: (1) a gas/vapor tight continuous corrugated metallic sheath, (2) an overall jacket of suitable polymeric material, and (3) a separate EGC



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## 334.2 Nonmetallic-Sheathed Cable – Type NMS Deleted

- All references to **Type NMS** cable has been **deleted** from Article 334 as this cable construction is no longer manufactured
- Type NMS was defined as "insulated power or control conductors with signaling, data, and communications conductors within an overall nonmetallic jacket"
- This cable was intended to be used with "**smart house**" circuits back in the late 1980's and 90's
- Type NMS cable was manufactured specifically to accommodate this type of new technology by combining power conductors with signal conductors all in one cable
- The 1990's short-lived "smart home" concept should not be confused with today's successful home automation, the Internet of Things (IoT), and the connected home concepts



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## 334.2 Nonmetallic-Sheathed Cable - Type NMS Deleted

All references to Type NMS cable has been deleted from Article 334 as this cable construction is no longer manufactured




228

## 334.30 Securing and Supporting of Type NM Cable

- Revision will clarify how Type NM cable should be measured from the enclosure to the securing method with the **cable length** between the cable entry and the closest cable support not exceeding **450 mm (18 in.)**
- Previously, support method (staple) could be installed within 300 mm (12 in.) of a box and have a 4 ft, 6 ft, or even a 30 ft, loop of nonmetallic-sheathed cable between the staple and the box
- The "intent" was to limit the amount of cable between the securing method (staple) and the box to no more than 300 mm (12 in.)
- Other places in the *Code*, such as **314.17(C), Exception** indicate that this measurement should be "**measured along the sheath**" of the cable in question
- The extra length ***[450 mm (18 in.)]*** was provided in consideration of conductor length for repair *(if needed)*



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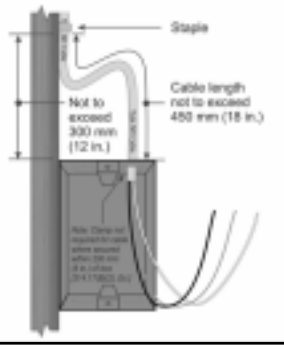
## 334.30 Securing and Supporting of Type NM Cable




Nonmetallic-sheathed cable required to be supported and secured at intervals not exceeding 1.4 m (4½ ft) and within 300 mm (12 in.) of every cable entry into enclosures such as outlet boxes, junction boxes, cabinets, or fittings

300 mm (12 in.) measurement is still measured from the box to the securing method (staples; cable ties, straps, hangers, etc.), but cable length between the cable entry and the closest cable support must not exceed 450 mm (18 in.)

230

## Article 337 Type P Cable (New)

- A new article was added covering the use, installation, and construction specifications for **Type P cable**
- Based on cable performance and requirements for some land-based operations (drilling rigs), Type P cable was originally **proposed** to be added to the 2020 *NEC* for **hazardous area applications only**
- Final 2020 *NEC* language **does not restrict** the use of Type P cable to hazardous (classified) locations
- Type P cable is a flexible and rugged and highly suitable for petrochemical applications resistant to various chemicals, abrasives, and petroleum-based additives
- Has the ability to resist damage from vibration, shaking, and movement that occurs in many processes



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## Article 337 - Type P Cable

A new article was added covering the use, installation, and construction specifications for Type P cable.

**Type P Cable:** A factory assembly of one or more insulated flexible tinned copper conductors, with associated equipment grounding conductor(s), with or without a braided metallic armor and with an overall nonmetallic jacket.

232

## 338.2 Definitions - Service-Entrance Cables

- New definition for "**Service-Entrance Conductor Assembly**" added to differentiate between service-entrance cables and assemblies of single-insulated USE conductors
- Existing definition for "**Service-Entrance Cable**" was revised to reflect added definition for "Service-Entrance Conductor Assembly"
- Type SE cables (SER and SEU) and Type USE cables all have an overall polymeric covering of some type
- Assemblies of single-conductor insulated Type USE conductors do not have an overall covering and treated like direct-burial conductors and are not subject to any ampacity limitations beyond the normal Article 310 and other *Code* rules



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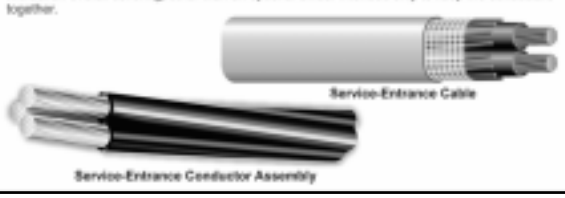
## 338.2 Definitions - Service-Entrance Cables

**Service-Entrance Cable.** A single conductor or multiconductor ~~assembly~~ cable provided with ~~or without~~ an overall covering, primarily used for services, and of the following types:

**Type SE.** Service-entrance cable having a flame-retardant, moisture-resistant covering.

**Type USE.** Service-entrance cable, identified for underground use, having a moisture-resistant covering, but not required to have a flame-retardant covering.

**Service-Entrance Conductor Assembly.** Multiple single-insulated conductors twisted together without an overall covering, other than an optional binder intended only to keep the conductors together.




234

## 338.100 Construction of Service-Entrance Cables

- All conductors of a cabled assemblies of multiple single-conductors of a **Type USE cable** are now required to be **insulated**
- Type SE or USE cable with an **overall covering** containing two or more conductors are permitted to have one conductor uninsulated
- To coincide with the revision to the definition of “Service-Entrance Cable” and the new definition of “Service-Entrance Conductor Assembly,” the phrase "**with an overall covering**" was added to **338.100(B)**
- Section divided into **two separate sub-sections** to aid the user of the *Code* in identifying the relevant requirements for each:
  - (A) Assemblies
  - (B) Uninsulated Conductors



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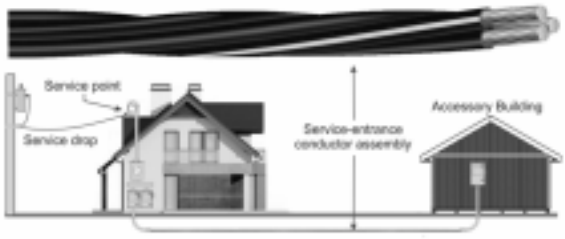
## 338.100 Construction of Service-Entrance Cables

All conductors of a cabled assemblies of multiple single-conductors of a direct buried Type USE cable are now required to be insulated




Type SE or USE cable with an overall covering containing two or more conductors permitted to have one conductor uninsulated

236

## 342.10(E) IMC Subject to Severe Physical Damage

- New sub-section (E) clarifies that intermediate metal conduit (**Type IMC**) is permitted to be installed where **subject to severe physical damage**
- “Physical damage” or “severe physical damage” are **not defined** in the *NEC (determined by AHJ)*
- Confusion exist amongst installers and inspectors pertaining to which wiring methods are acceptable for areas subject to severe physical damage
- **UL 1242** and **342.10(A)** permit IMC to be used in all atmospheric conditions *(including severe physical damage)*
- Same change occurred for rigid metal conduit (**Type RMC**) at **344.10(E)**
- Similar change occurred at **358.10(E)** for electrical metallic tubing (**EMT**) where language was added to allow **steel and stainless steel EMT** to be installed where subject to **physical damage** *(not severe physical damage, but physical damage)*



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## 342.10(E) IMC Subject to Severe Physical Damage

New 342.10(E) clarifies that intermediate metal conduit (Type IMC) is permitted to be installed where subject to severe physical damage

* Same change occurred at 344.10(E) for Rigid Metal Conduit (RMC)

Intermediate Metal Conduit




238

## 342.14 Dissimilar Metals – Type IMC

- Revision added to make it clear that **stainless steel fittings**, and enclosures can be used with **galvanized steel IMC** but **galvanized fittings** should not be used with **stainless steel IMC**
- Dissimilar metals and alloys have different electrode potentials
- To address dissimilar metals with conduit and raceway systems, the 2017 *NEC* was revised to clarify the acceptable fittings that can be used with these different types of conduits or raceways, based on galvanic compatibility
- Further revision occurred for the 2020 *NEC* to provide additional clarity on what fittings are acceptable for use with stainless steel IMC, RMC and EMT
- Same revisions occurred at **344.14** for **rigid metal conduit** and at **358.14** for electrical metallic tubing (**EMT**)



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## 342.14 Dissimilar Metals: Type IMC

Where practicable, dissimilar metals in contact anywhere in the system shall be avoided to eliminate the possibility of galvanic action

Stainless steel and aluminum fittings and enclosures shall be permitted to be used with galvanized steel IMC where not subject to severe corrosive influences.

Stainless steel IMC shall only be used with the following:

(1) Stainless steel fittings
(2) Stainless steel outlet boxes and enclosures
(3) Steel (galvanized, painted, powder or PVC coated, and so forth) boxes and enclosures when not subject to severe corrosive influences
(4) Stainless steel, nonmetallic, or approved accessories

**Note:** *Same requirements added at 344.14 for RMC and 358.14 for EMT*



240

## 344.10(A) Galvanized Steel, Stainless Steel, and Red Brass RMC

- Revision to clarify that **red brass RMC** is not restricted to just underground or swimming pool applications
- Previous **344.10(A)(2)** stating that red brass RMC is permitted to be installed for direct burial and swimming pool applications has been **deleted** *(not the only application for red brass RMC)*
- Red brass RMC is typically made up of approximately 85% copper, 5% tin, 5% lead, and 5% zinc
- Galvanized steel, stainless steel, and red brass RMC permitted under all atmospheric conditions and occupancies
- Red brass is one of four materials designated for rigid metal conduit at **344.100** and it meets all the requirements of RMC
- Red brass is **highly resistant to corrosion**, making it a viable wiring method for many applications, desired for visual appealing purposes in exposed applications



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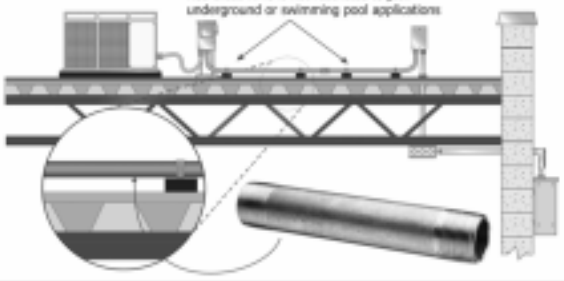
## 344.10(A) Galvanized Steel, Stainless Steel, and Red Brass RMC

Galvanized steel, stainless steel, and red brass RMC permitted under all atmospheric conditions and occupancies




242

## 350.10(4) Uses Permitted for Type LFMC

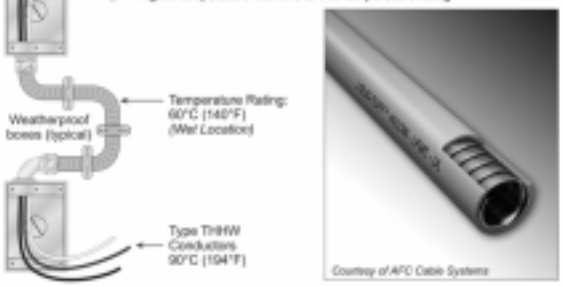
- Conductors or cables with **higher temperature ratings** permitted to be used in LFMC as long as the conductors or cables are **not operated at a higher temperature than the LFMC temperature rating**
- Same provisions allowed for PVC and ENT related to allowing conductors or cables with a rated temperature higher than the listed temperature rating of the raceway to be installed in these type raceways
- Numerous conductors and multiconductor cables with higher temperature ratings than the LFMC listed temperature rating
- Same change occurred for liquidtight flexible nonmetallic conduit (**LFNC**) at **356.10(8)**



243

## 350.10(4) Uses Permitted for LFMC

Conductors or cables with higher temperature ratings are permitted to be used in LFMC as long as the conductors or cables are not operated at a higher temperature than the LFMC temperature rating




244

## 370.20 Conductor Size and Termination (Cablebus)

- Two **new informational notes** were added to 370.20 related to conductor sizing and terminations for cablebus
- Two new informational notes point to **110.14(C)** for conductors operating **up to 2000 volts** and **110.40** for medium voltage conductors operating **above 2000 volts to 35,000 volts**
- New I-Notes designed to provide direction regarding termination information for the full range of voltages, which can be encountered with cablebus
- Termination temperatures are an important safety concern for electrical installations
- Location of these I-Notes follow 370.20(B), which deals directly with terminations
- Users of Article 370 may not be aware that 110.14(C) and 110.40 apply when the conductors terminate on equipment with a **termination temperature limitation**



245

## 370.20 I-Notes Added Cablebus Conductor Sizing and Terminations


246

## 374.6 Listing Requirements - (Cellular Metal Floor Raceways)

- New provision added to require **cellular metal floor raceways** shall be **listed**
- Cellular metal floor raceways consist of the hollow spaces in cellular metal floors and associated fittings that serve as enclosures for wires and cables
- This requirement follows a pattern in recent *Code* cycles requiring electrical equipment to be listed
- Many AHJs rely heavily on labeling of equipment under the program of a qualified electrical products testing laboratory
- One of the primary roles of the inspector is to ensure that listed products are installed in accordance with the manner the product has been tested or evaluated and to ensure proper installation and use



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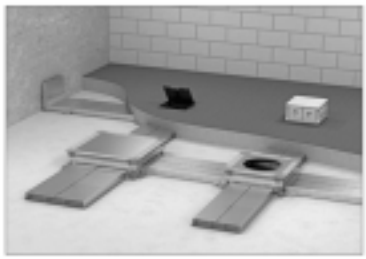
## 374.6 Listing Requirements for Cellular Metal Floor Raceways

A new 374.6 was added to Article 374 requiring all cellular metal floor raceways to be listed



Cellular Metal Floor Raceway

248

## 380.12(7) Uses Not Permitted – Multioutlet Assemblies

- New text added **prohibiting** a **multioutlet assembly** from being **cord and plug connected**
- Multioutlet assemblies intended for **permanent connection only** with a branch circuits *(prohibited from employing a cord and plug connection)*
- A multioutlet assembly is "a type of surface, flush, or freestanding raceway designed to hold conductors and receptacles, assembled in the field or at the factory" *(see Article 100)*
- "Multioutlet assemblies" provided with a cord-and-plug connection are readily available, but these devices are not listed as a multioutlet assembly
- This new prohibition is an attempt to make users of the *Code* aware of the product standard **"permanently installed" wiring method** and draw attention to a multioutlet assemblies **listing requirements**

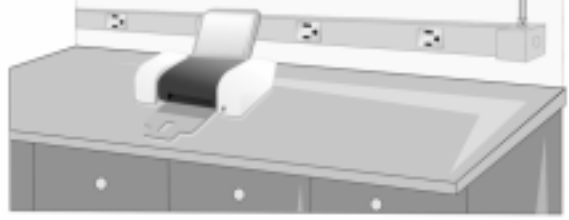


249

## 380.12(7) Multioutlet Assembly - Uses Not Permitted

A new List Item (7) was added to 380.12 prohibiting a multioutlet assembly from being utilized with a cord-and-plug connection

Intended for permanent connection only (*per its listing*)



250


251

## 382.104(C) Flat Conductor EGC for Nonmetallic Extensions

- Revision replaces "grounding conductor" with appropriate term "**equipment grounding conductor**" for concealable nonmetallic extensions
- For a nonmetallic extension, the "equipment grounding conductor" must consist of two overall sectioned conductors that enclose the grounded conductor and ungrounded conductor(s)
- The "EGC" layers have to be identified by one of four methods
- The road to proper interpretation and application of *Code* rules is using proper terminology
- "Grounding conductor" and its related definition was removed from the 2008 edition of the *NEC*



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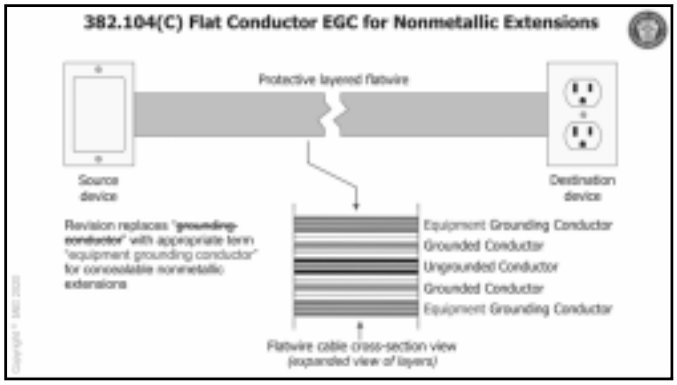
382.104(C) Flat Conductor EGC for Nonmetallic Extensions
Protective layered flatwire
Source device
Destination device
Revision replaces "~~grounding conductor~~" with appropriate term "equipment grounding conductor" for concealable nonmetallic extensions
Equipment Grounding Conductor
Grounded Conductor
Ungrounded Conductor
Grounded Conductor
Equipment Grounding Conductor
Flatwire cable cross-section view (expanded view of layers)

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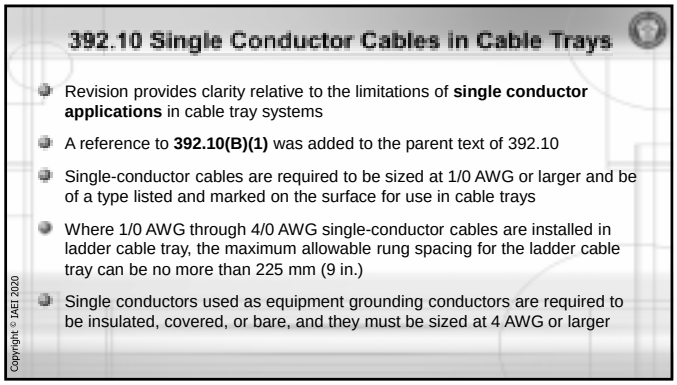
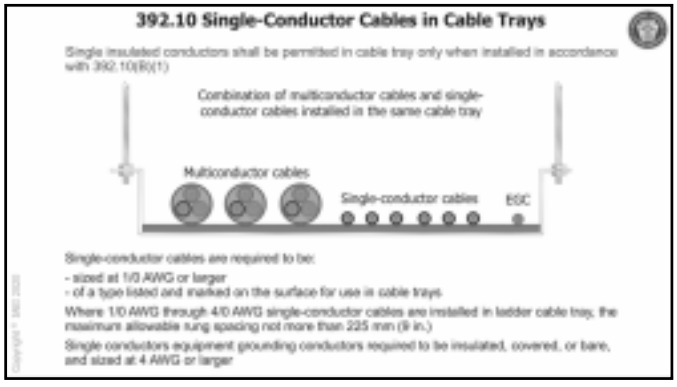

392.10 Single Conductor Cables in Cable Trays
Revision provides clarity relative to the limitations of **single conductor applications** in cable tray systems
A reference to **392.10(B)(1)** was added to the parent text of 392.10
Single-conductor cables are required to be sized at 1/0 AWG or larger and be of a type listed and marked on the surface for use in cable trays
Where 1/0 AWG through 4/0 AWG single-conductor cables are installed in ladder cable tray, the maximum allowable rung spacing for the ladder cable tray can be no more than 225 mm (9 in.)
Single conductors used as equipment grounding conductors are required to be insulated, covered, or bare, and they must be sized at 4 AWG or larger
Copyright © IAEI 2020

254


392.10 Single-Conductor Cables in Cable Trays
Single insulated conductors shall be permitted in cable tray only when installed in accordance with 392.10(B)(1)
Combination of multiconductor cables and single-conductor cables installed in the same cable tray
Multiconductor cables
Single-conductor cables
EGC
Single-conductor cables are required to be:
- sized at 1/0 AWG or larger
- of a type listed and marked on the surface for use in cable trays
Where 1/0 AWG through 4/0 AWG single-conductor cables are installed in ladder cable tray, the maximum allowable rung spacing not more than 225 mm (9 in.)
Single conductors equipment grounding conductors required to be insulated, covered, or bare, and sized at 4 AWG or larger

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## 392.30(B)(4) Cable Ties Used for Securement and Support in Cable Trays

- New provision added identifying **cable ties** used to secure and support conductors and cables in a cable tray as an **acceptable means of securement** when identified for securement and support in a cable tray
- Similar to existing requirements already in the *Code* for listing requirements for cable ties *[see 300.22(C)(1), 800.24]*
- If a cable tie is listed to **UL 1565** *(Positioning Devices)* under UL Product Spec category ZODZ, the cable tie has been identified for "**limited support**"
- If a cable tie is listed to **UL 62275** *(Cable management Systems-Cable Ties for Electrical Installations)*, cable tie retains 100% of its declared loop tensile strength (cable ties) or declared mechanical strength (fixing devices)



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## 392.30(B)(4) Cable Ties For Securement and Support in Cable Trays

Cable ties used to secure conductors and cables in cable trays required to "be listed and identified for the application and for securement and support"

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## 392.44 Expansion Splice Plates for Cable Trays

- New section added for **expansion splice plates** to address thermal expansion and contraction due to temperature variations for cable trays
- Important that cable tray installations incorporate features which provide adequate compensation for their **thermal contraction and expansion**
- The **length of a straight cable tray run** and the temperature differential will play a vital role in determining the number of expansion splice plates required
- Similar to existing requirements for **raceways** required to be provided with expansion, expansion-deflection, or deflection fittings where necessary to compensate for thermal expansion, deflection, and contraction *[see **300.7(B)**]*
- Expansion joint splice plates and bonding jumpers available from all major cable tray manufacturers



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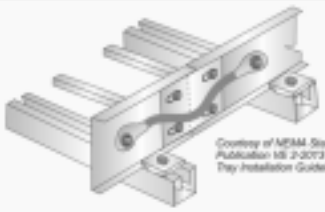
## 392.44 Expansion Splice Plates For Cable Trays

Expansion splice plates for cable trays required to be provided where necessary to compensate for thermal expansion and contraction



Courtesy of NEMA Standards Publication MS 2-2013 Cable Tray Installation Guidelines

**Reproduction of Figure 3-38 Expansion Splice Plate Attachment**

*(NOTE: In Figure 3-38, a bonding jumper is not required for fiberglass cable tray systems.)*



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## 392.46 Bushed Conduit and Tubing at Cable Trays

- New *Code* language added giving permission for individual conductors or multi-conductor cables to enter enclosures through **bushed nonflexible conduits or tubing or opening associated with a flange** that is connecting the cable tray system directly to equipment
- Bringing cables and individual conductors into equipment from a cable tray through bushed conduit and tubing is a common practice with installers
- Without new Code text, there was some confusion in the industry as to whether this practice was *Code* compliant
- A companion change occurred at new **312.5(C), Exception** to clarify where cabinets are involved, the 450 mm (18 in) minimum length for short sections of raceways (nipples) does not apply to 392.46



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## 392.46 Bushed Conduit and Tubing at Cable Trays *(cont.)*

- New *Code* language added giving permission for individual conductors or multi-conductor cables to enter enclosures through **bushed nonflexible conduits or tubing or opening associated with a flange** that is connecting the cable tray system directly to equipment *(cont.)*
- Limited to "**individual conductors or multiconductor cables with entirely nonmetallic sheaths**" as other wiring methods with metallic sheaths such as Type MC cable requires a listed connector to protect the internal conductors from abrasion where the cable is terminated or transitions to another wiring method
- **Sealing requirements** are involved with both 392.46(A) and (B), which calls for require sealing of the conduit or tubing or sealing or covering the opening



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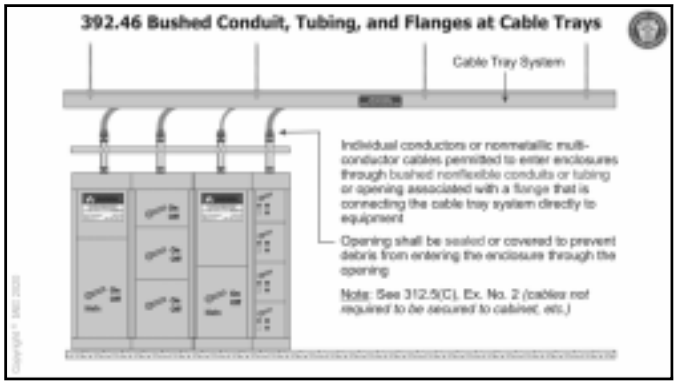
392.46 Bushed Conduit, Tubing, and Flanges at Cable Trays
Cable Tray System
Individual conductors or nonmetallic multi-conductor cables permitted to enter enclosures through bushed nonflexible conduits or tubing or opening associated with a flange that is connecting the cable tray system directly to equipment
Opening shall be sealed or covered to prevent debris from entering the enclosure through the opening
Note: See 312.5(C), Ex. No. 2 (cables not required to be secured to cabinet, etc.)

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392.46 Bushed Conduit and Tubing for Cable Trays
42-PP-3

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