



Continuing Education for Electricians

CETC CONNECTICUT
ELECTRICAL
Training Center, LLC

2026 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>

2026 Continuing Education for Electricians

(For **All Electrical License Holders**)

Part 1 - Connecticut General Statutes

The following is a link to Public Act 22-104

<https://www.cga.ct.gov/2022/act/Pa/pdf/2022PA-00104-R00HB-05330-PA.PDF>

Sec. 37. (NEW) (Effective July 1, 2022) Any contractor who is licensed under chapter 393 of the general statutes and engaged to perform work on a private residence, and any person who owns or controls a business that is engaged to perform work on, or render services concerning, a private residence through persons licensed under chapter 393 of the general statutes to perform such work or render such services, shall include in the invoice or work order for such work or services, provided such invoice or work order is not signed by the consumer and therefore may constitute a contract, when complete: (1) The full legal name and license number of such licensed contractor or the licensed contractor of record for such business for such work or services, which licensed contractor or licensed contractor of record is liable for the work of any individual who performs work on such contractor's behalf related to the invoiced work or services; (2) such licensed contractor's address or, in the case of a business, the business's address and phone number; (3) a description of such work or services; (4) the labor and material costs of such work or services; (5) the date or dates on which such work was performed or services were rendered; and (6) the complete name of each licensee who performed such work or rendered such services. For the purposes of this section, "private residence" has the same meaning as provided in section 20-419 of the general statutes.

Sec. 42. Section 20-334d of the general statutes is repealed and the following is substituted in lieu thereof (Effective from passage):

(a) As used in this section:

(1) "Accredited continuing professional education" means any education of an electrician or plumber that is (A) designed to maintain professional competence in the [pursuit,] practice, pursuit and standards of electrical work or plumbing and piping work, [and that is] (B) approved by the commissioner, and [is] (C) provided (i) by an agency, institution or organization [, institution or agency that is] that has been approved by the commissioner, and (ii) in-person or through an online technology platform that includes real-time video with audio, requires participants to periodically confirm their active engagement during the educational training session and enables participants to interact with instructors in real time during the entire educational training session;

(2) "Certificate of continuing education" means a document [issued to an electrician or plumber by an organization, institution or agency] that (A) an agency, institution or organization that has been approved by the commissioner [that] and offers accredited continuing professional education [, which (A)] issues to an electrician or plumber, (B) certifies that an electrician or plumber has satisfactorily completed a specified number of continuing education hours, and [(B)] (C) bears the (i) name of such agency, institution or organization, [institution or agency, the] (ii) title of the program, [the] (iii) dates during which the program was

conducted, [the] (iv) number of continuing education hours satisfactorily completed, and [the] (v) signature of the director of such [organization, institution or agency or the signature of the] agency, institution or organization or of such director's authorized agent; and (3) "Commissioner" means the Commissioner of Consumer Protection. (b) The commissioner, with the advice and assistance of the Electrical Work Board established pursuant to subsection (b) of section 20-331, shall adopt regulations, in accordance with chapter 54, to: (1) [establish] Establish additional requirements for accredited continuing professional education for electricians licensed pursuant to sections 20- 330 to 20-341, inclusive; (2) establish qualifying criteria for accredited continuing professional education programs and establish qualifying criteria for acceptable certificates of continuing education; and (3) provide for the waiver of required accredited continuing professional education for electricians for good cause. Such regulations shall require not less than four hours per year of accredited continuing professional education for such electricians, except upon request of the Electrical Work Board, the commissioner may increase such hours to a maximum of seven hours. (c) The commissioner, with the advice and assistance of the Plumbing and Piping Work Board established pursuant to subsection (d) of section 20-331, shall adopt regulations, in accordance with chapter 54, to: (1) [establish] Establish additional requirements for accredited continuing professional education for plumbers licensed pursuant to sections 20-330 to 20-341, inclusive, which regulations shall require not more than a total of seven hours of accredited continuing professional education every two years, except in the event of significant changes to the building code, as approved by the International Code Council, that relate to plumbing, the commissioner, at such commissioner's discretion, may require more than a total of seven hours of accredited continuing professional education every two years; (2) establish qualifying criteria for accredited continuing professional education programs and establish qualifying criteria for acceptable certificates of continuing education; and (3) provide for the waiver of required accredited continuing professional education for plumbers for good cause. (d) Notwithstanding the provisions of subsection (c) of this section, any person who has been issued a P-6, P-7, W-8 or W-9 license pursuant to section 20-334a and the regulations of Connecticut state

agencies shall not be required to meet the continuing education requirements established pursuant to subsection (c) of this section. (e) Notwithstanding the provisions of subsections (a) to (d), inclusive, of this section, all accredited continuing professional education offered under the provisions of this section shall: (1) Limit class size to (A) fifty attendees if such accredited continuing professional education is offered in-person, or (B) twenty-five attendees if such accredited continuing professional education is offered through an online technology platform; (2) not be offered or held at the place of business of a licensed plumbing contractor if such accredited continuing professional education is for plumbers and offered in-person; and (3) not be offered or held at the place of business of a licensed electrical contractor if such accredited continuing professional education is for electricians and offered in-person. A provider of an accredited continuing professional education course shall retain an audio-visual recording of such course for a period of not less than thirty days after completion of such course. Recordings shall be made available to the department upon the department's request for such recordings.

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. 20-332-15a. 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
Sec. 20-332 page 21 (2-08)
Department of Consumer Protection § 20-332-18a
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 more 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. 20-332b. 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

Sec. 20-332c. Apprentice, journeymen and contractor working group established.

Membership. Report. (a) There is established a working group to discuss hiring ratios for apprentices, journeymen and contractors and study the hiring ratio relief process. The working group shall meet at least three times annually and shall study and make recommendations related to apprentices, journeymen and contractors.

(b) The working group shall consist of ten members, and shall be evenly divided between members of the following union and nonunion industry trade groups: The International Brotherhood of Electrical Workers, the Independent Electrical Contractors of New England, the Associated Builders and Contractors of Connecticut, Sheet Metal Local 40, Sprinkler Fitters Local 669, the Connecticut Chapter of American Fire Sprinkler Association, the United Association of Plumbers and Pipefitters Local 777, the Plumbing Heating and Cooling Contractors of Connecticut, the Connecticut Heating and Cooling Contractors and the Connecticut State Building and Construction Trades Council. Each union industry trade group member shall be either the business manager of such group or such business manager's designee

from such group. Each nonunion industry trade group member shall be either the president of such group or such president's designee from such group.

(c) Such members shall be selected as follows:

(1) Two union members appointed by the speaker of the House of Representatives;

(2) Two union members appointed by the president pro tempore of the Senate;

(3) One nonunion member appointed by the majority leader of the House of Representatives;

(4) One union member appointed by the majority leader of the Senate;

(5) Two nonunion members appointed by the minority leader of the House of Representatives;
and

(6) Two nonunion members appointed by the minority leader of the Senate.

(d) All appointing authorities shall consult with the chairpersons and ranking members of the joint standing committee of the General Assembly having cognizance of matters relating to the Department of Consumer Protection prior to making any appointments pursuant to this section.

(e) All appointments to the working group shall be made not later than thirty days after the effective date of this section. Any vacancy shall be filled by the appointing authority.

(f) The members of the working group shall select the chairpersons of the working group from among the members of the group. One chairperson shall be a union member and one chairperson shall be a nonunion member. Such chairpersons shall schedule the first meeting of the working group.

(g) The administrative staff of the joint standing committee of the General Assembly having cognizance of matters relating to the Department of Consumer Protection shall serve as administrative staff of the working group.

(h) Not later than December 1, 2017, and annually thereafter, the working group shall submit a report on its recommendations to the joint standing committee of the General Assembly having cognizance of matters relating to the Department of Consumer Protection, in accordance with the provisions of section 11-4a.

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.

2026 Connecticut State Building Code

(Include in all course handouts to attendees for their future use and review with class.)

Building and Fire Code Adoption Process

State Building, Fire Safety and Fire Prevention Codes Update

The **Department of Administrative Services, Office of the State Building Inspector** and **Office of the State Fire Marshal**, in conjunction with the **Codes & Standards Committee** and the **Fire Prevention Code Advisory Committee**. Planned adoption of the following codes for Spring 2026.

- 2026 Connecticut State Building Code (CSBC)
- 2026 Connecticut State Fire Safety Code (CSFSC)
- 2026 Connecticut State Fire Prevention Code (CSFPC)
- 2024 International Building Code (IBC) by the ICC
- 2024 International Existing Building Code (IEBC) by the ICC
- 2024 International Energy Conservation Code (IECC) by the ICC
- 2024 International Mechanical Code (IMC) by the ICC
- 2024 International Plumbing Code (IPC) by the ICC
- 2024 International Residential Code (IRC) by the ICC
- 2024 International Swimming Pool & Spa Code (ISPSC) by the ICC
- 2023 NFPA 70 National Electrical Code (NEC) by NFPA
- 2017 ICC A117.1 Accessible and Usable Buildings and Facilities by the ICC
- 2024 International Fire Code (IFC) by the ICC
- 2024 NFPA 101 - Life Safety Code by the NFPA
- 2024 NFPA 1- Fire Code by the NFPA
- 2025 NFPA 72 - National Fire Alarm Code by the NFPA

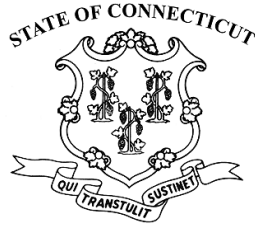
The model codes are viewable on their publisher's web sites:

- **[International Code Council \(ICC\) Codes](#)**
- **[National Fire Protection Association \(NFPA\) Codes](#)**

[https://portal.ct.gov/DAS/Office-of-State-Building-Inspector/Building-and-Fire-Code-Adoption- Process/Documents](https://portal.ct.gov/DAS/Office-of-State-Building-Inspector/Building-and-Fire-Code-Adoption-Process/Documents)

[NOTE: Always refer to the State Building Officials website indicated above for all of the most currently adopted codes and "AMENDMENTS" to the codes.](#)

- **Discuss the CT Amendments to the 2023 NEC and other adopted codes containing amendments with reference to electrical.**



Senate Bill No. 1465

Public Act No. 25-47

AN ACT AUTHORIZING THE COMMISSIONER OF CONSUMER PROTECTION TO ALLOW CERTAIN SKILLED TRADE LICENSEES TO DEVIATE FROM CERTAIN SKILLED TRADE HIRING RATIOS.

Be it enacted by the Senate and House of Representatives in General Assembly convened:

Section 1. Section 20-332b of the general statutes is repealed and the following is substituted in lieu thereof (*Effective October 1, 2025*):

(a) 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] shall apply to apprentices, [~~journeymen~~] journeypersons and contractors for the following trades:

TRADE

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

Apprentices

Licensees

(~~[Journeyman]~~ Journeypersons or
Contractors)

1
2
3
4

1
2
3
6

Senate Bill No. 1465

5	9
6	12
7	15
8	18
9	21
10	24

Ratio continues at 3 Journeypersons
To 1 Apprentice

(b) (1) Notwithstanding the provisions of subsection (a) of this section, a licensed contractor may hire one or more additional apprentices even if the licensed contractor does not employ a sufficient number of licensees to satisfy the applicable allowable hiring ratio established in subsection (a) of this section, provided:

(A) The licensed contractor submits a ratio relief application to the Department of Consumer Protection, in a form and manner prescribed by the Commissioner of Consumer Protection, for such additional apprentice or apprentices, which application shall include, at a minimum:

(i) The name and contact information of the licensed contractor;

(ii) The name and contact information of the licensed and registered apprentices currently employed by the licensed contractor;

(iii) The name and contact information of each such additional apprentice, if known by the licensed contractor;

(iv) Information demonstrating that the criteria established in subparagraph (A) of subdivision (2) of this subsection or pursuant to subsection (a) of section 2 of this act have been satisfied;

(v) A statement disclosing whether the Department of Consumer Protection has taken any disciplinary action against the licensed

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contractor during the three-year period immediately preceding the date of such application, and, if so, a description of such disciplinary action;

(vi) A statement disclosing whether the Labor Department has taken any enforcement action against the licensed contractor pursuant to chapter 558 during the three-year period immediately preceding the date of such application, and, if so, a description of such enforcement action;

(vii) A copy of each notice of termination of an apprenticeship agreement that the licensed contractor submitted to the Labor Department during the three-year period immediately preceding the date of such application;

(viii) If during the three-year period immediately preceding the date of such application a state agency authorized the licensed contractor to hire one or more apprentices in excess of the applicable allowable hiring ratio established in subsection (a) of this section, an attestation from the licensed contractor that (I) the state agency authorized the licensed contractor to hire such apprentice or apprentices during such three-year period, (II) the licensed contractor continues to employ such apprentice or apprentices or offered to rehire such apprentice or apprentices prior to the date of such application, and (III) the licensed contractor did not terminate the employment of such apprentice or apprentices for any reason other than that a position with the licensed contractor was unavailable; and

(ix) Any other information the Commissioner of Consumer Protection, in the commissioner's discretion, deems relevant for the purposes of this subsection; and

(B) The ratio relief application submitted to the department pursuant to subparagraph (A) of this subdivision is approved in the manner set forth in subparagraph (A) of subdivision (2) of this subsection or

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subdivision (1) of subsection (b) of section 2 of this act.

(2) (A) If the commissioner or the commissioner's designee determines that the licensed contractor employs a combination of not more than eight journeypersons and contractors including such licensed contractor, and the applicant attests that the Labor Department has not taken any enforcement action against the licensed contractor pursuant to chapter 558 during the three-year period immediately preceding the date of such application, the commissioner or such designee shall render a decision approving such application, provided the licensed contractor:

(i) Seeks to hire one or more additional apprentices at a ratio that does not exceed one apprentice to one journeyperson or contractor;

(ii) Attests that at least one such apprentice is enrolled in a qualified apprenticeship training program that is offered by a school in the Technical Education and Career System established under section 10-95, unless the licensed contractor made a good faith effort to seek out an apprentice enrolled in such a program and such effort was unsuccessful; and

(iii) Attests that the licensed contractor is suffering from an undue operational hardship due to the applicable allowable hiring ratio established in subsection (a) of this section.

(B) The commissioner or the commissioner's designee shall send notice of the decision rendered under subparagraph (A) of this subdivision to the licensed contractor in a form and manner prescribed by the commissioner not later than ten business days after the department received such application.

(C) Each decision rendered under subparagraph (A) of this subdivision shall be a final decision for the purposes of section 4-183.

(3) If the commissioner or the commissioner's designee determines,

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after reviewing the application submitted pursuant to subparagraph (A) of subdivision (1) of this subsection, that the licensed contractor employs a combination of more than eight journeypersons and contractors including such licensed contractor, that the Labor Department has taken any enforcement action against the licensed contractor pursuant to chapter 558 during the three-year period immediately preceding the date of such application or that the licensed contractor otherwise does not satisfy the criteria set forth in subdivision (2) of this subsection, the commissioner or such designee shall refer such application to the appropriate examining board established under section 20-331.

(4) The Commissioner of Consumer Protection may, in accordance with the provisions of chapter 54, amend any regulations adopted pursuant to section 20-332 to effectuate the provisions of this subsection.

Sec. 2. (NEW) (*Effective October 1, 2025*) (a) (1) Not later than February 1, 2026, each examining board established under section 20-331 of the general statutes shall establish a set of criteria for the purpose of determining whether good cause exists for such board to approve the ratio relief applications referred to such board pursuant to subdivision (3) of subsection (b) of section 20-332b of the general statutes, as amended by this act. Such criteria shall include, but need not be limited to, criteria for the review of any such application submitted by a licensed contractor against whom the Labor Department has taken enforcement action pursuant to chapter 558 of the general statutes.

(2) Each examining board may amend the criteria established pursuant to subdivision (1) of this subsection not more frequently than once per calendar year.

(3) The Commissioner of Consumer Protection shall post all criteria established pursuant to subdivision (1) of this subsection, as such criteria may be amended pursuant to subdivision (2) of this subsection,

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on the Department of Consumer Protection's Internet web site.

(b) (1) Not later than ninety days after the Commissioner of Consumer Protection refers a ratio relief application to the appropriate examining board pursuant to subdivision (3) of subsection (b) of section 20-332b of the general statutes, as amended by this act, such board shall (A) determine, on the basis of the criteria posted on the Department of Consumer Protection's Internet web site pursuant to subdivision (3) of subsection (a) of this section, whether good cause exists to approve such application, (B) based on such determination, render a decision approving or rejecting such application, and (C) send notice to the applicant disclosing such board's decision and the basis for such board's determination regarding the existence or nonexistence of good cause.

(2) Each decision rendered under subdivision (1) of this subsection shall be (A) a final decision for the purposes of section 4-183 of the general statutes, and (B) exempt from the provisions of subsection (b) of section 21a-7 of the general statutes and subsection (d) of section 21a-9 of the general statutes.

Governor's Action:

Approved June 10, 2025

2026 Continuing Education for Electricians

(For **All Electrical License Holders**)

Part 2 - Safety



Occupational Safety and Health Administration



OSHA Trade Release

U.S. Department of Labor
Occupational Safety and Health Administration
Office of Communications
Washington, D.C.
www.osha.gov
For Immediate Release

December 11, 2023

Contact: Office of Communications
Phone: 202-693-1999

OSHA announces switch from traditional hard hats to safety helmets to protect agency employees from head injuries better

WASHINGTON – The U.S. Department of Labor's Occupational Safety and Health Administration announced that the agency is replacing traditional hard hats used by its employees with more modern safety helmets to protect them better when they are on inspection sites.

In 2020, the Bureau of Labor Statistics reports head injuries accounted for nearly 6 percent of non-fatal occupational injuries involving days away from work. Almost half of those injuries occurred when workers came in contact with an object or equipment while about 20 percent were caused by slips, trips and falls.

Dating back to the 1960s, traditional hard hats protect the top of a worker's head but have minimal side impact protection and also lack chin straps. Without the straps, traditional hard hats can fall off a worker's head if they slip or trip, leaving them unprotected. In addition, traditional hard hats lacked vents and trapped heat inside.

On Nov. 22, 2023, OSHA published a [Safety and Health Information Bulletin](#) detailing key differences between traditional hard hats and more modern safety helmets and the advancements in design, materials and other features that help protect workers' entire heads better. Today's safety helmets may also offer face shields or goggles to protect against projectiles, dust and chemical splashes. Others offer built-in hearing protection and/or communication systems to enable clear communication in noisy environments.

The agency recommends safety helmets be used by people working at construction industry and the oil and gas industry; in high-temperature, specialized work and low-risk environments; performing tasks involving electrical work and working from heights; and when required by regulations or industry standards.

OSHA wants employers to make safety and health a core value in their workplaces and is committed to doing the same by leading by example and embracing the evolution of head protection.

[Learn more about OSHA.](#)



U.S. Department of Labor
Occupational Safety and Health Administration
Directorate of Technical Support and Emergency Management

Head Protection: Safety Helmets in the Workplace

Safety and Health Information Bulletin

SHIB 3-6-2024

Introduction

OSHA regulates head protection for general industry, construction, and maritime and requires employers to ensure affected workers wear appropriate head protection. This Safety and Health Information Bulletin (SHIB) provides information for employers and employees when selecting PPE for head protection. This SHIB also provides instructions for properly inspecting and storing head protection. With a thorough understanding of the benefits and capabilities of head protection options, employers and workers can make informed decisions on selection and use.

Background

Proper head protection is crucial in work environments with falling objects, struck-by, overhead electrical hazards, and risks from slips, trips, and falls. Both scientific understanding of head injuries and head protection technology continues to advance. Modern head protection, whether it's a safety helmet or a hard hat, varies in styles and levels of protection, allowing employers and workers to choose head protection appropriate for the job. OSHA's head protection standards state that there can be compliance through ANSI Z89.1-2009, 2003, and 1997: published by the International Safety Equipment Association (ISEA). The range of products available today allows employers and employees to select the right type of head protection for the job, comply with the requirements of all OSHA standards (general industry, construction, maritime), and obtain optimum head protection.



Figure 1- Example of a safety helmet.

Two Types (impact) and three Classes (electrical) of head protection are recognized.

Type I head protection offers protection from blows to the top of the head.

Type II head protection offers protection from blows to the top and sides of the head.

Class G (General) head protection is designed to reduce exposure to low voltage conductors and are proof tested at 2,200 volts (phase to ground).

Class E (Electrical) head protection is designed to reduce exposure to higher voltage conductors and are proof tested at 20,000 volts (phase to ground).

Class C (Conductive) head protection is not intended to provide protection against contact with electrical hazards.

ANSI/ISEA Z89.1-compliant head protection, including safety helmets and hard hats, are manufactured using a wide range of materials from high density polyethylene to glass reinforced nylon. Some hard hats and safety helmets incorporate advanced energy re-distribution solutions that reduce rotational forces of certain impacts and distribute impact energy throughout the headwear to help reduce brain trauma. Chin straps are recognized as an effective way to keep head protection on when working in awkward positions or when experiencing a slip or fall and should be considered for use with all head protection.

Manufacturers offer an array of product-specific approved optional features designed to address specific workplace hazards. Accessories can include add-on face shields or goggles, to protect against projectiles, dust, and chemical splashes, and hearing protection and communication systems. In addition, impact indicator technology can be mounted on protective headwear for concussion awareness. However, head protection with integrated technology may not be suitable for some workplaces.

Choosing the right head protection

Employers must conduct a hazard assessment at their job site and based on the workplace hazards determine whether head protection is necessary and if so, the most appropriate type.

Safety Helmets for OSHA

After a general Job Hazard Analysis of its work and a thorough evaluation of head protection options, OSHA determined Type II, Class G safety helmets were the most appropriate form of head protection for its employees. The Agency recognizes that based on their own Job Hazard Analysis, employers and workers may decide that another form of head protection is for them.

Considerations when selecting head protection.

Construction Sites. For construction sites, especially those with high risks of falling objects and debris, impacts from equipment, awkward working positions, and/or slip, trip, and fall hazards: consider Type II head protection with chin straps.

Oil and Gas Industry. For oil and gas industry worksites where workers face multiple hazards, including potential exposure to chemicals and severe impacts: consider Type II head protection with integrated eye and face protection, like face shields and goggles.

Working from Heights. For tasks or jobs that involve working from heights: consider head protection with chin straps to prevent the head protection from falling off.

Electrical Work. For tasks involving electrical work or proximity to electrical hazards, head protection with non-conductive materials (Class G and Class E) provide protection to prevent electrical shocks. NOTE – Vented hard hats or safety helmets cannot be used for electrical work.

High and Low-Temperature Environments. In high temperatures or where there is exposure to molten materials, employers should select head protection with advanced heat resistant properties, which can provide appropriate protection to workers. These are marked “HT” on the label.

For cold environments, employers should select head protection that has been preconditioned in low temperatures prior to testing. These are marked “LT” on the label.

High visibility. High visibility head protection is marked “HV” on the label. HV head protection helps workers be seen on jobsites like construction and road work.

Specialized Work Environments. For jobs that require integrated face shields, hearing protection or communication devices, employers should consider protective headwear that allows for these manufacturer compatible safety features.

Properly storing and evaluating head protection

Always refer to the manufacturer’s specific guidelines for head protection care, use, and storage. As a general rule:

1. Inspect the outer shell for cracks, dents, or other signs of damage. Run your fingers over the surface to check for any irregularities.
2. Examine the suspension system (headband and chin strap) for wear and tear, ensuring it is securely attached to the shell and free from damage, and inspect interior cushioning for wear or compression, if applicable. If there are any signs of deterioration, contact the manufacturer for replacement options.
3. Check for labels and certification marks. Look for labels and certification marks inside the head protection. These indicate that the head protection meets the necessary safety standards and requirements. Check that the labels are legible and not tampered with. Note: only head protection having a reverse-wearing label or mark can be worn in reverse.
4. Examine accessories and attachments. If head protection has manufacturer approved accessories or attachments (face shields, goggles, earmuffs, etc.), inspect them for damage or signs of wear. Make sure they are securely fastened to the head protection and are functioning correctly.
5. Check for proper fit. Before using head protection, ensure it fits comfortably and securely. Adjust the suspension system to achieve a snug fit without excessive pressure points. Head protection should not be too loose or too tight.
6. Refer to the manufacturer's guidelines for recommended lifespan or guidance on when to take head protection out of service. The service-life of head protection depends on many factors including storage, handling, use, and exposure to harsh environments including UV Rays. Any hard hat or helmet should be discarded when it is impacted or if there are any signs of damage or degradation.
7. Clean and dry head protection before storing. After each use, clean the exterior of head protection with mild soap and water. Ensure no dirt, debris, or chemicals are present that could compromise the

head protection's structural integrity. Once cleaned, allow the head protection to air-dry. Avoid exposing head protection to direct sunlight, extreme temperatures, or chemicals during storage. Do not store your head protection in your car or where it may be exposed to direct sunlight or extreme temperatures.

8. Impact damage. If head protection has experienced an impact or has been subjected to a significant force, retire it immediately, even if there is no visible damage. Head protection is designed for single-use impact protection and may not retain its full effectiveness after an incident.
9. Keep Records: Maintain a record of each inspection, noting the date, any findings, and actions taken. Document the date of purchase and any relevant information about the head protection to track its lifespan. This is recommended for all personal protective equipment.

Resources

[OSHA's Website](#): The OSHA website provides extensive information on workplace safety, including head protection requirements. Workers can find OSHA standards related to personal protective equipment (PPE) and head protection.

General Industry. [29 CFR 1910.135 - Head Protection](#): The general requirements of this standard state that "The employer shall ensure that each affected employee wears a protective helmet when working in areas where there is a potential for injury to the head from falling objects," 29 CFR 1910.135(a)(1), and that "The employer shall ensure that a protective helmet designed to reduce electrical shock hazard is worn by each such affected employee when near exposed electrical conductors which could contact the head," 29 CFR. § 1910.135(a)(2).

Construction. [29 CFR 1926.100 – Head Protection](#): This standard generally requires that "Employees working in areas where there is a possible danger of head injury from impact, or from falling or flying objects, or from electrical shock and burns, shall be protected by protective helmets." 29 CFR 1926.100(a).

Maritime. [29 CFR 1915.155 - Head Protection\(Shipyard\)](#), [29 CFR 1917.93 – Head Protection \(Marine Terminals\)](#), and [29 CFR 1918.103 – Head Protection \(Longshoring\)](#): Each of the maritime standards generally require that "The employer shall ensure that each affected employee wears a protective helmet when working in areas where there is a potential for injury to the head from falling objects." 29 CFR 1915.155(a)(1); 1917.93(a), 1918.103(a).

[OSHA Regional and Area Offices](#). Employers and employees can contact their local OSHA regional or area offices for assistance and information on head protection requirements.

[ANSI/ISEA Z89.1 - Industrial Head Protection](#): This is the ANSI standard that specifies performance and testing requirements for industrial head protection, including safety helmets and hard hats.

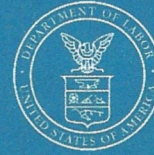
How to Contact OSHA

To discuss a health and safety issue at work, contact OSHA toll-free at 1-800-321-6742 (OSHA) or [by email](#), or [contact your nearest OSHA office](#).

This Safety and Health Information Bulletin is not a standard or regulation, and it creates no new legal obligations. The Bulletin is advisory in nature, informational in content, and is intended to assist employers in providing a safe and healthful workplace. Pursuant to the Occupational Safety and Health Act (OSH Act), employers must comply with hazard-specific safety and health standards and regulations promulgated by OSHA or by a state with an OSHA-approved State Plan. In addition, pursuant to Section 5(a)(1), the General Duty Clause of the Act, employers must provide their employees with a workplace free from recognized hazards likely to cause death or serious physical harm. Employers can be cited for violating the General Duty Clause if there is a recognized hazard and they do not take reasonable steps to prevent or abate the hazard. However, failure to implement any recommendations in this Safety and Health Information Bulletin is not, in itself, a violation of the General Duty Clause. Citations can only be based on standards, regulations, and the General Duty Clause.

There are 29 OSHA-approved occupational safety and health State Plans. State Plans are required to have standards and enforcement programs that are at least as effective as federal OSHA's and may have different or more stringent standards. More information about State Plans is available at: <https://www.osha.gov/stateplans>.

Workplace Mental Health



Mental health is an important component of overall well-being and is equally as vital as physical health for all employees. Mental health concerns due to work have the potential to adversely impact an employee's social interactions, productivity, performance, and absenteeism.

Stress affects people in a variety of ways such as muscle tension, headaches, stomach discomfort, high blood pressure, and heart disease. Ignoring workplace stress can have lasting harmful effects on individuals, families, co-workers, and communities.

Traumatic Events

Sometimes a shocking, scary, or dangerous experience can be so intense that it can have an emotional, cognitive, behavioral, and physical impact on a person. Some examples of traumatic events that can happen in workplaces are:

- Explosions or chemical releases
- Building, crane, or other equipment collapses
- Co-workers being injured or dying on the job
- Abuse or assault of a co-worker or client

It is normal to feel terrified during and after a traumatic event. This is part of the body's "fight or flight" response to possible danger.

Traumatic events can happen to workers in all industries.

After experiencing a traumatic event people may:

- Feel anxious, sad, or angry
- Have terrifying thoughts or flashbacks
- Have recurring nightmares

- Be confused or unable to think clearly
- Have a hard time falling and staying asleep
- Frighten easily



If these symptoms continue long after the event or affect day-to-day life, they can be signs of acute stress disorder, or post-traumatic stress disorder. Both require professional help to address.

Substance Use Disorder

Substance use disorder is a persistent desire for substances even in the face of negative consequences. Some people come to rely on opioids, stimulants, alcohol, or other substances even when the substances cause harm. People may develop a dependence on drugs, including prescription medications, and alcohol for many reasons, including the presence of other mental health conditions, chronic pain, or injuries. Regardless of the underlying reason, substance use disorder can be treated and controlled.



MAY

Mental Health
Awareness Month

JUNE

Post Traumatic Stress
Disorder Awareness Month

SEPTEMBER

National Suicide Prevention Month
National Recovery Month

Suicide

Suicide can touch anyone, anywhere, at any time. But it is not inevitable. Help is available.

According to the CDC^{1,2}

- More than 12 million adults seriously think about suicide each year.
- More than 3 million adults make a plan to commit suicide each year.
- More than 1 million adults attempt suicide each year.
- More than 48,000 people die by suicide in the United States each year.

People of any age, gender, and background can have thoughts of suicide. Untreated mental health conditions can lead to these thoughts and even suicidal actions. That is why it is important to provide resources and encourage people to get help when they are having mental health concerns, experiencing traumatic events, or battling substance use disorders.



Certain factors may increase an individual's risk of developing suicidal thoughts and attempting suicide such as:

- Mental health conditions like depression, bipolar disorder, schizophrenia, anxiety disorders, and substance use disorders

- Traumatic events
- Health issues like chronic pain or illness
- Prolonged stress
- Recent tragedy or loss
- Criminal or legal problems
- Job loss or financial problems
- Substance use disorder
- Childhood trauma
- Domestic violence

References

1. [Centers for Disease Control and Prevention \(2021\)](#)
2. [Centers for Disease Control and Prevention Statistics \(2021\)](#)

Resources

Employers can help change the stigma of mental health by prioritizing it as part of their workplace culture, having conversations about it, and knowing how to support those workers who say they need assistance. [Workplace Stress - Overview | Occupational Safety and Health Administration \(osha.gov\)](#)

- [OSHA Suicide Prevention in Construction](#)
- [OSHA Workplace Stress](#)
- [Call or text 988 for free, confidential crisis counseling anytime, 24/7](#)
- [Text a counselor at 838255 for Veterans Crisis Line](#)
- [Text Talk to 741741 for English](#)
- [Text Ayuda to 741741 for Spanish](#)

Get Help



Long-Term Stress Harms Everyone in the Workplace



Stress is not always bad. In fact, in the workplace, stress can prompt workers to stay focused on a task or meet a deadline. Extensive and prolonged stress in the workplace, however, can harm workers' physical and mental health, negatively affecting an organization's success. Employers can help alleviate workplace stress by supporting their workers. Unions and worker organizations can also support workplace mental health and well-being through their member services, outreach, and community engagement work.

How Does Long-Term Stress Harm Workers?

Physical harm:

- Heart disease
- High blood pressure
- Muscle tension and pain (e.g., back pain)
- Headaches
- Poor sleep
- Stomach discomfort
- Excessive weight gain or loss



Mental health challenges or behavioral changes:

- Depression
- Anxiety
- Burnout
- Emotional outbursts
- Social withdrawal
- Drug or alcohol use
- Restlessness
- Fatigue
- Anger and irritability
- Lack of motivation or focus



How Does Long-Term Stress Harm Employers?

- **Increases potential for workplace incidents.** Stressed and fatigued workers are less attentive in recognizing and avoiding hazards.
- **Reduces productivity.** Stressful working conditions can cause workers to lose motivation, become easily distracted, lose focus, make mistakes, experience a decline in performance, and develop mental health challenges. The [World Health Organization](#) estimates that for every dollar U.S. employers spend treating common mental health issues, they receive a return of \$4 in improved health and productivity.
- **Increases absenteeism.** Exposure to long-term stress undercuts workers' physical and mental health, causing them to miss more days of work.
- **Undermines morale and leads to high turnover.** Stressed workers are less likely to be energized to perform well or to stay at a company that does not show interest in improving work conditions.



Resources

- OSHA: [Worker Fatigue](#)
- Healthy Work Campaign: [Healthy Work Tools](#)
- Mayo Clinic: [Stress Management](#)
- National Institute of Mental Health: [5 Things You Should Know About Stress](#)
- National Institute of Mental Health: ["I'm So Stressed Out!" Fact Sheet](#)
- National Safety Council's [SAFER: Mental Health and the Workplace](#)
- NIOSH's [Stress at Work](#) booklet

Occupational Safety and Health Administration

Workplace Stress

Workplace Stress Menu

Workers' Rights

Overview

Statistics

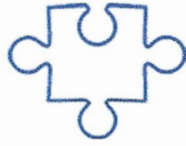
- Nearly one in five US adults live with a mental illness².
- Workplace stress has been reported to cause 120,000 deaths in the US each year³.
- Approximately 65% of U.S. workers surveyed have characterized work as being a very significant or somewhat significant source of stress in each year from 2019-2021⁴.
- 83% of US workers suffer from work-related stress and 54% of workers report that work stress affects their home life⁵.
- For every \$1 spent on ordinary mental health concerns, employers see a \$4 return in productivity gains

Stress can be harmful to our health and increase mental health challenges. Mental health challenges can include clinical mental illness and substance use disorders as well as other emotions like stress, grief, feeling sad and anxious, where these feelings are temporary and not part of a diagnosable condition. While there are many things in life that induce stress, work can be one of those factors. However, workplaces can also be a key place for resources, solutions, and activities designed to improve our mental health and well-being.

Workplace stress and poor mental health can negatively affect workers through¹:

- Job performance
- Productivity

- Work engagement and communication
- Physical capability and daily functioning



Understanding the Problem



Guidance and Tips for Employers



Training Resources



Real-World Solutions



Outreach Materials

¹ Centers for Disease Control and Prevention. (July 2018). Mental Health in the Workplace.

² National Institute of Mental Health. (January 2022). Mental Illness.

³ Goh, J., Pfeffer, J., & Zenios, S. A. (2015). The relationship between workplace stressors and mortality and health costs in the United States. *Management Science*, 62(2), 608-628.

⁴ American Psychological Organization. (October 2021). [Stress in America: Stress and decision-making during the pandemic.](#)

⁵ The World Health Organization (2022). [Mental health in the workplace.](#)

OSHA Standards Enforcement Topics Media Center Contact Us



U.S. DEPARTMENT OF LABOR

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FEDERAL GOVERNMENT **OCCUPATIONAL SAFETY & HEALTH**

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U.S. Office of Special Counsel	

Workplace Stress

Workplace Stress Menu

Workers' Rights

Understanding the Problem

Loneliness. Isolation. Uncertainty. Grief. Fear. Stress can increase these and other mental health challenges and can be harmful to our health. The amount and type of stress experienced varies from person to person due to many factors, including those experienced at work.

While there are many things in life that induce stress, work can be one of those factors. Workplace stress and poor mental health can negatively affect workers through their job performance and productivity, as well as with their engagement with others at work. It can also impact worker physical health, given that stress can be a risk factor for various cardiovascular diseases. However, workplaces can also be a key place for resources, solutions, and activities designed to improve our mental health and well-being.

Work has always presented various stress. Workers are constantly dealing with new stressors introduced to the workplace, and in some instances, these stressors have amplified other issues at work. More than 80% of US workers have reported experiencing workplace stress, and more than 50% believe their stress related to work impacts their life at home. Workplace stressors may include:

- Concerns about job security (e.g., potential lay-offs, reductions in assigned hours).
- Lack of access to the tools and equipment needed to perform work safely.
- Fear of employer retaliation
- Facing confrontation from customers, patients, co-workers, supervisors, or employers.
- Adapting to new or different workspace and schedule or work rules.
- Having to learn new or different tasks or take on more responsibilities.
- Having to work more frequent or extended shifts or being unable to take adequate breaks.
- Physically demanding work.

schooling or juggling other caregiving responsibilities while trying to work, such as caring for sick, elderly, or disabled household members.

- Concerns about work performance and productivity.
- Concerns about the safety of using public transit as a commuting option.

These, and many other, work-related stressors can take a toll on a person's sense of well-being and negatively impact their mental health. For some, these stressors can contribute to serious problems, such as the development or exacerbation of mental health challenges (e.g., anxiety disorder, depression disorder or substance use disorders.) Psychologists and psychiatrists are sounding the alarm about a mental health crisis forming, and data supporting their concerns have started to emerge. As one example, survey results from the Centers for Disease Control and Prevention (CDC) suggest that about 40 percent of U.S. adults were experiencing negative mental or behavioral health effects in June 2020, including symptoms of anxiety disorder or depressive disorder, trauma-related symptoms, new or increased substance use, or suicidal thoughts. An article published by the National Safety Council in August 2020 detailing a spike in opioid overdoses further highlights the need for more mental health resources.

Because of the many potential stressors workers may be experiencing, a comprehensive approach is needed to address stressors throughout the community, and employers can be part of the solution. More than 85% of employees surveyed in 2021 by the American Psychological Association reported that actions from their employer would help their mental health. The goal is to find ways to alleviate or remove stressors in the workplace to the greatest extent possible, build coping and resiliency supports, and ensure that people who need help know where to turn. This toolkit offers resources and tips that employers, workers, and co-workers can use to support each other. Unions and worker organizations can also use these resources to support worker mental health.

OSHA Resources

- **Long-Term Stress Harms Everyone in the Workplace**. This fact sheet explains how workplace stress harms individual workers and employers.
- **Workplace Mental Health Fact Sheet**. This fact sheet is designed to equip workplaces with vital information and resources to address mental health concerns effectively. Available in **Spanish**.

Resources Provided by Other Organizations

- **CDC: Coping with Stress**. This webpage identifies stressors impacting the general population, provides tips to reduce stress, and links to crisis intervention services.
- **CDC: Support for Employees**. This resource identifies work-related stressors and provides stress management tips.
- **EBSA: Mental Health and Substance Use Disorder Parity**. Learn your rights about job-based mental health and substance use disorder benefits, the information your health plan must give you, and how to appeal a denied benefit claim.
- **NIOSH: Mission Possible: Measuring Worker Well-Being**. This post discusses ways employers can measure worker well-being.
- **NIOSH: Healthy Work Design and Well-Being Program**. This resource focuses on how work affects overall health and well-being, including physical, psychological, social, and economic aspects.
- **National Safety Council (NSC)::**
 - **SAFER: Mental Health and the Workplace**. This document discusses the relationship between mental health, mental illness, and the workplace; and identifies barriers preventing people from getting support.
 - **Promote Employee Mental Health and Well-being**. This resource addresses topics like mental health, stress reduction, substance misuse and more.
 - **What Employers Can do When it Comes to Mental Health**. This blogpost shares information related to new tools employers can use to improve employee well-being and how that saves company's money.
- **CDC's Mental Health Data and Statistics**. Provides resources that provide up-to-date statistics around mental health and mental illness.
- **HWC: The Healthy Work Campaign**. is a public health campaign focused on raising awareness in the U.S. about the health impacts of work stress on working people. The campaign includes a variety of resources with sections specific to employers, individual workers, and union and worker advocates.
- The Jed Foundation: **Tips for Managing Stress**. This blog provides an overview of stress and 5 ways to manage stress.

Occupational Safety and Health Administration

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Guidance and Tips for Employers

Workplaces can have many stressors. Issues in the workplace can exacerbate the risk of experiencing mental health challenges. Combined, these stressors can make it more difficult for workers to get their tasks done; threaten their productivity, happiness, and well-being; and lead to burnout. Because of the many potential stressors employees may be experiencing, a comprehensive approach is needed to address stressors throughout the community, and employers can be part of the solution. More than 85% of employees surveyed in 2021 by [the American Psychological Association](#) reported that actions from their employer would help their mental health.

The goal is to find ways to alleviate or remove stressors in the workplace to the greatest extent possible, build coping and resiliency supports, and ensure that people who need help know where to turn. Reducing workplace stress benefits everyone across an organization. It can improve morale and lead to increased productivity and better focus, fewer workplace injuries, fewer sick days, and improved physical health (e.g., lower blood pressure, stronger immune system). All these factors can also lead to reduced turnover among an employer's workforce.

In fact, the [World Health Organization](#) estimate that for every dollar U.S. employers spend treating common mental health issues, they receive a return of \$4 in improved health and productivity. Employers can make a difference when it comes to helping their staff manage stress. Key things they can do include:

- **Be aware** and acknowledge that people can carry an emotional load that is unique to their own circumstances. They may be experiencing heightened levels of loneliness, isolation, uncertainty, grief, and stress; and some may face additional demands, such as

parents caring for children or elderly household members; and those with existing mental health or substance use challenges.

- **Identify factors are making it harder for workers to get their jobs done** and determine if adjustments can be made.
- **Show empathy.** Ensure workers that 1) they are not alone, 2) their employer understands the stress they are under, 3) there is no shame in feeling anxious, and 4) asking for help is important. Employers can reassure employees they are open and receptive to discussions about employees' work stress, by creating a safe and trustworthy space.
- **Provide access** to coping and resiliency resources, workplace and leave flexibilities without penalty, or other supportive networks and services. Research from the American Psychological Association suggests 50 % of employees find that a lack of paid time off or sick leave has a negative impact on stress levels at work.

The following resources provide guidance to help employers alleviate workplace stress and support mental health.

OSHA Resources

- **Getting Started Guides for Employers.** These aim to help employers gain confidence about talking to workers about workplace stress, mental health, and substance use.
 - [Getting Started Guide for Senior Managers](#)
 - [Getting Started Guide for Front-line Supervisors](#)
- **Mental Health Checklists for Employers.** These identify ways for employers to alleviate workplace stressors and support mental health.
 - [Checklist for Senior Managers](#)
 - [Checklist for Front-line Supervisors](#)
- [Workplace Stress Sample Survey Questions](#). This document provides sample questions that employers could ask to determine whether adjustments can be made to reduce workplace stress, and if staff need mental health support.
- [Myth Buster Fact Sheet](#). This dispels myths that might make workers reluctant to talk about workplace stress and mental health challenges. Employers could distribute this to employees or display in the workplace to reduce the stigma surrounding these topics.
- [Preventing Suicides](#). This webpage provides information on the [988 Suicide & Crisis Lifeline](#), and links to access to useful resources.
- [Mental Health Employer Tips – Workplace Stress Statistics](#) (ZIP) [Spanish](#) (ZIP)
- [Mental Health Employer Tips – Provide More Information](#) (ZIP) [Spanish](#) (ZIP)
- [TALK/DILO Infographic](#) (ZIP) [Spanish](#) (ZIP)
- [Start the Conversation – ABC Mental Health Videos](#)
- [Tips to Improve Relationships – ABC Mental Health Videos](#)

- Build Your mental Health Toolkit – ABC Mental Health Videos

Resources Provided by Other Organizations

- **American Foundation for Suicide Prevention** with resources and aid to those affected by suicide, including Risk Factors and Warning Signs.
- **The Center for Construction Research and Training (CPWR) - Opioid Resources** to help prevent opioid deaths in construction.
- **Centers for Disease Control and Prevention (CDC) Suicide Prevention Webpage**, providing information on facts, risks and protective factors, prevention strategies, tips for dealing with stress, and other resources.
- **Construction Industry Alliance for Suicide Prevention (CIASP)** with resources, articles, and websites.
- **Construction Working Minds**, highlighting resources on how to address workplace suicide for workers, managers, and industry associations.
- **EBSA: Mental Health and Substance Use Disorder Parity**. Browse these tools and resources for employers who offer job-based health benefits.
- **Federal Recovery Ready Workplace Interagency Workgroup – Recovery Ready Workplace Toolkit**: Resource is designed to help businesses and other employers prevent and respond more effectively to substance misuse among employees, build their workforces through hiring of people in recovery, and develop a recovery-supportive culture.
- **HWC: The Healthy Work Campaign**. Resource includes tools that are specific to employers including a healthy work survey with recommendations
- **Suicide in the Construction Industry: Breaking the Stigma and Silence: American Society of Safety Professionals** with recommendations on how to start a conversation in the industry, and three keys for providing help.
- **U.S. Department of Labor Office of Workers' Compensation Programs - New Opioid Policy to Protect Federal Injured Workers** that provides resources to combat the opioid epidemic and reduce the potential for opioid misuse and addiction among injured federal workers.
- **U.S. Department of Veterans Affairs - Suicide Prevention** with resources for veterans and their loved ones, friends, and health care providers.
- **NIOSH Total Worker Health® Program**. This program provides a holistic approach to worker well-being to assist employers in improving the safety and health of workers.
- **NIOSH Center of Excellence: Oregon Healthy Workforce Center**. This center provides fact sheets and articles that identify actions employers can take to support

workers and alleviate their stress.

- **The National Safety Council** has provided a list of top mental health, stress reduction, and substance misuse resources, including:
 - SAFER: Stress, Emotional & Mental Health Considerations. This playbook educates leaders, supervisors, and human resources representatives about ways to ensure that workers returning to the workplace have the mental health support they need.
 - Working With Benefits Providers: Mental Health Issues Checklist. This identifies specific services that employee assistance programs and health insurance providers can offer to help workers cope with stress.
 - Training and Supporting Supervisors in Addressing Substance Use. This fact sheet speaks of the importance of being a recovery-friendly workplace.
 - Opioids At Work Employer Toolkit. This free toolkit offers materials that will help employers create recovery-friendly workplaces, including sample policies, fact sheets, posters, and videos.
 - Addressing Employee Mental Health and Distress: NSC Recommendations for Employers. This resource provides a list of recommendations and steps employers can take to support mental health in the workplace.
- **SHRM Foundation - Field Guide for Mental Health in Your Workplace**: Resource provides tools to evaluate mental health resources, inform processes for supporting mental health within an organization, and, ultimately, to help develop a strategy that demonstrates improved mental health within the workforce.
- **The American Psychiatric Association Foundation's Center for Workplace Mental Health**
 - Making the Business Case. This website shares information highlighting why investing in a mentally healthy workforce is good for your business.
 - Mental Health Topics. This webpage provides information about various mental health topics including specific disorders, warnings signs, and access to care.
- **Mental Health America**
 - Workplace Mental Health Programs. This website offers resources that employers can use to create supportive work environments and highlights a national certification program (the Bell Seal for Workplace Mental Health) that recognizes employers who stand out in this area.
 - Mental Health Resources for Employers. Resources include extensive list on mental health tips, how to integrate better practices, and how to put employees first.
- **National Alliance on Mental Illness (NAMI)**

- [The Mental Health Movement in the Workplace](#). This blog entry discusses the benefits of addressing mental health in the workplace and lists actions that employers can take to do so.
- [The Ultimate Workplace Mental Health Toolkit](#). This document, produced by NAMI's Chicago affiliate, provides a primer for employers on mental health, stigma, stress and toxic stress, and burnout. It also outlines the components of an overall approach that employers can take to promote worker well-being and offers several tools (e.g., checklists, surveys, conversation planners) to help them achieve success.
- **American Psychological Association**
 - [Supporting Employee Mental Health When Reopening the Workplace](#)
This article offers suggestions on ways that employers can make the transition back to onsite work easier after working remotely for a lengthy period of time.
 - [Stress Management for Leaders Responding to a Crisis](#)
This fact sheet offers tips for leaders (e.g., supervisors, managers) to help them handle their internal stressors so they can lead effectively.
 - [Striving for Mental Health in the Workplace Guide](#). This resource shares tips on how to shift workplace culture to address mental health stigma and support employee well-being.
- **The U.S. Department of Veterans Affairs**
 - [For Leaders: Helping Employees in the Aftermath of Loss](#). This document explains what employers can do to support grieving staff.



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Training Resources

The idea of talking about stress and mental health at work might feel scary or too personal. These can be sensitive topics that require a foundation of trust and goodwill to broach, or alternatively, the support for a worker to seek external resources and assistance outside of the workplace.

However, there are ways in which employers, supervisors, and co-workers can support each other, and training is available on a variety of relevant topics. Ideally, employers should provide training for supervisors and workers to help them recognize the signs and symptoms of stress. Through this training, Employers, supervisors, and workers will know what to say, how to listen, and how to support others at the workplace who are struggling; learn about ways to build coping and resiliency skills; and know what avenues are available if professional help is needed either for themselves or their co-workers. Unions and worker organizations can also serve an important role in supporting workplace mental health and well-being through their member services as well as their outreach and community engagement work.

These training resources offer useful starting points for employers, supervisors, and employees:

- The National Council for Mental Wellbeing offers [Mental Health First Aid](#), which teaches people how to identify, understand and respond to signs of mental illness and substance use disorders. Multiple trainings are offered (some of which are virtual), and they target different areas (e.g., workplace in general, fire and EMS sector). Train-the-trainer programs are offered for employers that wish to have a staff member become a qualified trainer and then provide training more broadly throughout the organization. Additionally, companies

insight on how to **question (Q)**, **persuade (P)**, and **refer (R)** someone who may be suicidal.

- The U.S. Department of Veterans Affairs offers a [Stress First Aid slide deck](#), which is a 30-minute presentation (developed for first responders) that provides a framework to improve recovery from stress reactions.

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Real World Solutions

There's no one-size-fits-all strategy when it comes to alleviating workplace stress. The most effective approach is to identify the specific stressors associated with a particular job or industry and take concrete and practical steps to remove or lessen those stressors. Much can be learned by exploring what others are already doing and tips experts in the field have identified to address workplace stress. Some of the approaches discussed below can be applied to any workplace; others focus on specific groups, such as hybrid and remote workers, working parents and other caregivers, young workers, frontline workers, those in customer service roles, and workers who do manual labor, among other workers.

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Outreach Materials

It is imperative to talk about mental health; shine light on the stressors; strategize about ways to alleviate stress them; and be on the lookout for signs and symptoms of stress and mental health emergencies so that people can either direct themselves, their friends, co-workers or family members to helpful coping and resiliency resources or other supportive networks and services if needed. The key is to build awareness, and the outreach products identified below will help with that goal. Workers and employers alike will benefit from the information, and the latter may wish to use these resources as building blocks for creating an awareness campaign within their organization. Employers, unions, and worker organizations can and should take all steps to protect the mental health of workers. Unions and worker organizations can also serve an important role in supporting workplace mental health and well-being through their member services as well as their outreach and community engagement work.

OSHA Resources

- **Support One Another Toolkit** ([ZIP](#)) Spanish ([ZIP](#)). Provides tips on creating a workplace culture that support mental health by talking about mental health.
- **Working Together poster**. Provides a brief overview of steps employers and workers can take to address stress and mental health in the workplace.
- **Supporting Your Co-Workers poster**. Provides concrete tips that people can use to support their co-workers, offering suggestions on how to be respectful when broaching stress and mental health topics, how to listen compassionately, how to determine if more assistance is needed, and how to follow up on concerns.
- **Worker-Fatigue Webpage**. Focuses on worker fatigue and includes information about the impact of demanding work schedules and measures workers and employers can take to

and co-workers can help each other address stress and mental health, and advice for those currently facing mental health challenges.

Resources Provided by Other Organizations

- **CDC Foundation: How Right Now**. Interactive site was created to support mental health. It asks users how they are feeling (e.g., stressed, afraid, grieving, lonely) and then directs them to a variety of stress relief tools and mental health supports.
- **EBSA: Mental Health and Substance Use Disorder Parity**. Learn about your job-based mental health and substance use disorder rights and get assistance from a live Benefits Advisor.
- **HHS: 5 Things About Staying Mentally Healthy**. Two-minute video that offers five tips for coping with the mental strain: 1) avoiding alcohol and drugs as a coping mechanism, 2) staying active, 3) exploring wellness programs, 4) staying connected, and 5) seeking help if needed.
- **The U.S. Department of Veterans Affairs' Free Mobile App: Mindfulness Coach**. Walks users through mindfulness meditation to help reduce stress and cope with unpleasant emotions.
- **SAMHSA: Your Recovery is Important: Virtual Recovery Resources**. Tip sheet that identifies virtual resources that people can use to support their recovery from mental health/substance use disorders.
- **SAMHSA: Decisions in Recovery: Treatment for Opioid Use Disorder**. Offers a variety of resources to support recovery and treatment for those who are ready to address their opioid use.
- **NIOSH Science Blog: Improve Sleep: Tips to Improve Your Sleep When Times Are Tough**. Blogpost that emphasizes the importance of high-quality sleep during stressful times and offers evidence-based suggestions on how to improve it.
- **Mental Health America**
 - **Workplace Mental Health Programs**. This website offers resources that employers can use to create supportive work environments and highlights a national certification program (the Bell Seal for Workplace Mental Health) that recognizes employers who stand out in this area.
 - **Mental Health Resources for Employers**. Resource includes extensive list on mental health tips, how to integrate better practices, and how to put employees

mental health condition (e.g., anxiety, depression, addiction, eating disorders).

- **American Psychological Association: Psychologists' Advice for Newly Remote Workers**. Article with tips for remote workers to reduce stressors and prevent isolation, advising them to minimize distractions, set goals and boundaries, make a communication plan, and seek social connections.
- **The National Institute of Mental Health: My Mental Health: Do I Need Help?** Poster that differentiates between mild and severe symptoms, identifies self-care techniques, and explains how to seek professional help.
- **Existing Mental Health Campaigns and Toolkits:**
 - Healthy Work Campaign
 - National Prevention Week
 - Mental Health Awareness Month
 - Suicide Prevention Month
 - List of Awareness Events
 - Mental Health Awareness Charity Walks and Runs
 - Opioids At Work Employer Toolkit
 - The ICU program, which stands for Identifying, Connecting, and Understanding, as well as “I See You.”
 - Right Direction
 - Mental Health in Rural Communities Toolkit
 - Upper Midwest Agricultural Health and Safety Center: Stress and Mental Health
 - National Center for Farmworker Health Resource Hub
- **The Jed Foundation**
 - How to Practice Gratitude. This blog provides an overview of gratitude and how it can strengthen our mental health, including gratitude exercises that can help you practice it in your daily life.
 - How to Relieve Stress: Breathing Exercises You Can Do Anywhere: This blog provides an overview of the importance of breathing during stressful events. The blog provides examples of breathing exercises that anyone can do anywhere and anytime to relieve stress.

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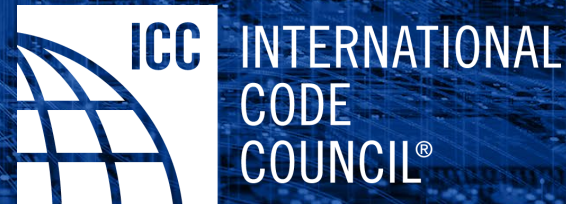
2026 Continuing Education for Electricians

(For **All Electrical License Holders**)

**Part 3 – 2023 National Electrical Code Chapters 1 – 3 Changes
2026 Required Calculations Published by Electrical Examining Board**

IAEI's Analysis of Changes- 2023 *NEC*

*Your essential guide to the most important changes
in the 2023 National Electrical Code*



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A collaborative effort based on
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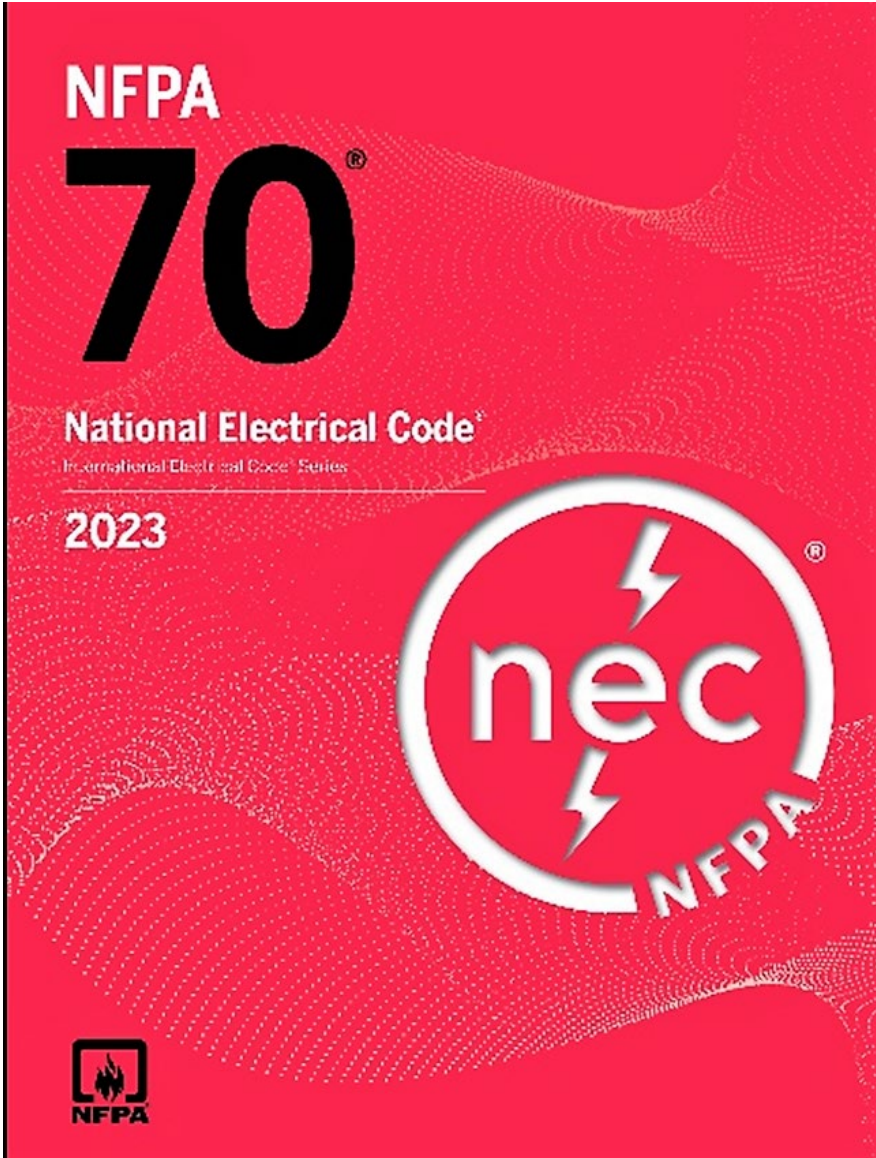
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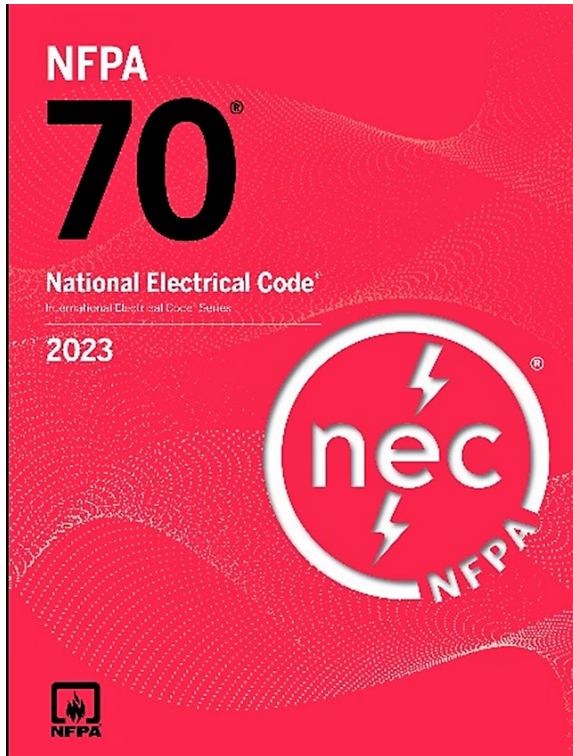


NFPA 70[®] National Electrical Code[®]

This presentation is based on the requirements of the 2023 edition of the *National Electrical Code (NEC)*

NFPA LINK[®]

The IAEI appreciates the National Fire Protection Association (*NFPA*) for allowing us to insert code language links for the 2023 *NEC* into the text slides of this presentation



The links were provided by the NFPA, and they control the accuracy of the link address

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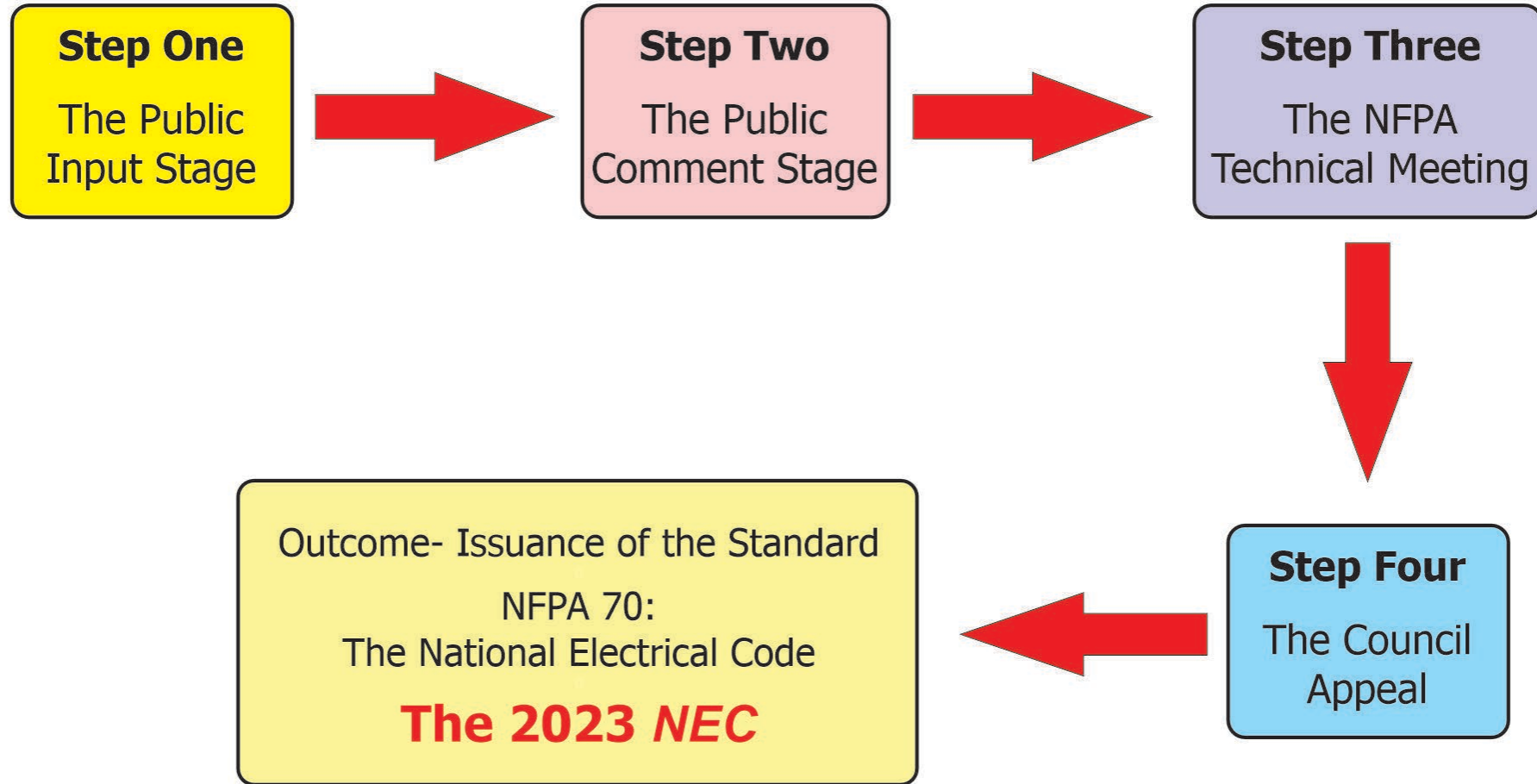
General Information

2023 National Electric Code

- Model Code Development
- IAEI Involvement
- IAEI Codes and Standards
- *NFPA NEC 1st and 2nd Draft Meeting*
- Public Input and Public Comments
- General Terms and IAEI Characters

Model Code Development Process

The process of updating the National Electrical Code from one cycle to the next



The Development of the 2023 *NEC*

Interesting information about this revised document

- ⚠ IAEI provided 36 members as CMP representatives to the *NEC* revision process
- ⚠ IAEI Codes and Standards Committee vetted and submitted IAEI endorsed Public Inputs and Public Comments to NFPA for consideration
- ⚠ NFPA *NEC* First and Second Draft meetings were conducted virtually instead of in person
- ⚠ Code Making Panel Task Group meetings were also conducted virtually
- ⚠ There following were submitted to NFPA for this edition of the *Code*:
 - 🔧 **4006 Public Inputs**
 - 🔧 **1805 First Revisions**
 - 🔧 **1956 Public Comments**
 - 🔧 **900 Second Revisions**
 - 🔧 **441 Correlating Notes**
 - 🔧 **55 Certified Amending Motions**
- ⚠ Several IAEI members served on NFPA Correlating Committee Task Groups to work on issues needing to be resolved



IAEI Code Making Panel Representatives

CMP-1

- Paul Sood
- Greg Chontow

CMP-2

- **David Humphrey***
- Joseph Wages, Jr.

CMP-3

- Timothy Mikloiche
- Rhonda Parkhurst

CMP-4

- **Jim Rogers***
- Pete Jackson

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- **Robert Fahey***
- James Hathorn

NEC Correlating Committee

- David Williams
- Donny Cook

** Denotes Chair Position of CMP*



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-  Donny Cook
-  Thomas Domitrovich
-  Pete Jackson
-  Tim McClintock
-  Jim Rogers
-  Mike Savage
-  Joseph Wages, Jr.
-  David Williams



IAEI Subject Matter Experts

A special thank you to electrical industry experts who provided input or conducted reviews of this material

 Paul Dobrowsky

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 Tim McClintock

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 David Williams

 Thomas Domitrovich

 David Humphrey

 Cliff Norton

 Chris Faucette

 Donny Cook

 Jim Rogers

 Pete Jackson

 Rob Bowman

 Scott Humphrey

 Steve Thomas



Terms Used During the Presentation

AHJ- Authority Having Jurisdiction

CMP- Code Making Panel

CPSC- Consumer Products Safety Commission

IAEI- International Association of Electrical Inspectors

ICSC- IAEI Codes and Standards Committee

NEC- National Electrical Code

NECA- National Electrical Contractors Association

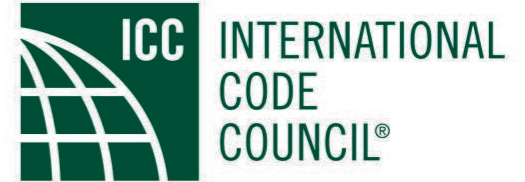
NEMA- National Equipment Manufacturers Association

NFPA- National Fire Protection Association

UL- Underwriters Laboratories

IAEI Industry Partnerships

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Independent Electrical Contractors



Code-Wide Changes

- **NEC Style Manual Changes**
- **Definition Location**
- **Reconditioned Equipment**
- **Medium Voltage Requirements**
- **Copper Clad Aluminum**
- **New Articles for 2023 NEC**

The *NEC* Style Manual

Revised in 2020 and used for the 2023 *NEC* and 2024 version of *NFPA 70E*

- ⚠ Purpose of the Style Manual is to make the code usable and clear and to provide formatting provisions
- ⚠ Deletion of redundant language (*prohibits repeating language from Chapters 1-4 in other chapters of the NEC*)
- ⚠ Significant Changes for the 2020 edition include actions involving:
 - ✂ Parts
 - ✂ Definitions
 - ✂ Searchability
 - ✂ Article Numbers
 - ✂ CMP References
 - ✂ Multiple Definitions
 - ✂ Similar and Alternate Terms
 - ✂ Informational Notes
 - ✂ Acronyms



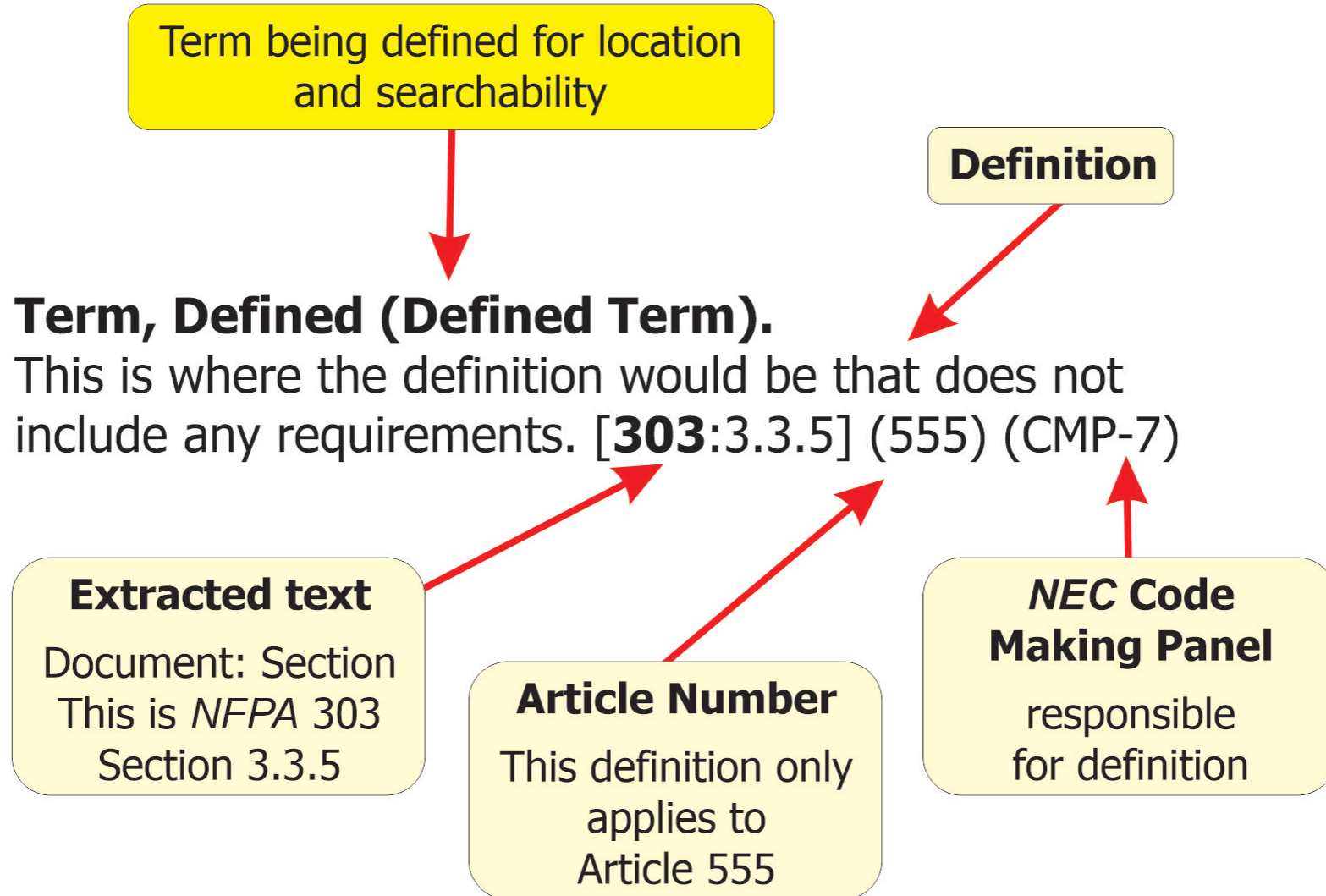
Definitions

Definitions were relocated to Article 100 and arranged in alphabetical order with no parts

- ⚠ Article 100 now contains approximately 800 definitions
- ⚠ Additional definition structure requirements were also added to this *Code* cycle
- ⚠ This allows the *NEC* to follow the same layout as other *NFPA* documents that have all definitions in one chapter
- ⚠ Similar terms and acronyms may be used along with provisions for electronic searching
- ⚠ Relocation revealed multiple terms defined differently in the code, which were also addressed with the *NEC Style Manual* revision
- ⚠ All definitions apply throughout the *Code* (*An article number appearing after the defined term indicates the definition only applies to that article*)



Article 100- Definitions



Reconditioned Equipment

The xxx.2 sections in many chapters have become “placeholders” for requirements for reconditioned equipment

- ⚠ This placeholder location (xxx.2) was made possible by the movement of all definitions that used to reside in these sections to Article 100
- ⚠ This will allow code-making panels the opportunity to place requirements for reconditioned equipment in sections of the *NEC* that they have purview over
- ⚠ These changes will make the *NEC* a more user-friendly document

Reconditioned Equipment

110.20 Reconditioned

110.21 Marking

210.2 Reconditioned Equipment

240.2 Reconditioned Equipment

242.2 Reconditioned Equipment

245.2 Reconditioned Equipment

362.2 Reconditioned Equipment

348.2 Reconditioned Equipment

350.2 Reconditioned Equipment

369.2 Reconditioned Equipment

404.16 Reconditioned Equipment

406.2 Reconditioned Equipment

408.2 Reconditioned Equipment

410.2 Reconditioned Equipment

411.2 Reconditioned Equipment

430.2 Reconditioned Motors

470.2 Reconditioned Equipment

495.2 Reconditioned Equipment

495.49 Reconditioned Switchgear

517.6 Patient Care-Related
Electrical Equipment

660.10 Equipment Installations

695.2 Reconditioned Equipment

700.2 Reconditioned Equipment

701.2 Reconditioned Equipment

702.2 Reconditioned Equipment

708.2 Reconditioned Equipment

800.2 Reconditioned Equipment

Note: Not all Code Making Panels (CMPs) used xxx.2 for reconditioned equipment

Medium Voltage Requirements

Several new articles appeared in the 2023 *NEC* regarding the inspection and installation requirements for medium voltage conductors and equipment

- ⚠ **Article 235** Branch Circuits, Feeders and Services Over 1000 Volts ac, 1500 Volts dc, Nominal
- ⚠ **Article 245** Overcurrent Protection for Systems Rated Over 1000 Volts AC, 1500 Volts DC
- ⚠ **Article 305** Wiring Methods and Materials for Systems Rated Over 1000 Volts ac, 1500 Volts dc, Nominal
- ⚠ **Article 315** Medium Voltage Conductors, Cable, Cable Joints, and Cable Terminations
- ⚠ **Article 495** Equipment Over 1000 Volts AC, 1500 Volts DC, Nominal

Copper-Clad Aluminum (CCA)

- ⚠️ Copper-clad aluminum (CCA) underwent extensive review and testing overseen by the NFPA Bimetallics Task Group formed at the direction of the Standard's Council after the 2020 *NEC* cycle
- ⚠️ The Task Group represented industry stakeholders, and the testing data provided a direct comparison of the performance of 14 AWG CCA to 14 AWG copper at their respective 60 degree C ampacities, demonstrating the safety of CCA
- ⚠️ A new table was added to 210.24, identified as 210.24(2), which summarizes the branch circuit applications for aluminum and CCA as had been permitted for over 50 years, where only copper conductors had this summary information provided in previous code editions



Copper-Clad Aluminum (CCA)(cont.)

- ⚠ In addition to the listings for finished insulated conductors and cable assemblies, **conductors made with CCA must carry a listing for the bimetal itself [310.3(B)(4)]**
- ⚠ The core of the CCA must be AA-8000 series aluminum **[310.3(B)(3)]**
- ⚠ The copper of CCA must be a minimum of 10 percent of the cross-sectional area of a solid conductor or each strand of a stranded conductor **[310.3(B)(3)]**
- ⚠ The marriage between copper and aluminum in CCA is such that a metallurgical bond exists between the aluminum core and the copper outer layer



Copper-Clad Aluminum (CCA)(cont.)

- ⚠ Listing will prove that it meets ASTM product design requirements
- ⚠ The smallest standard size of overcurrent protection is 10 amperes due to more energy- efficient products such as LED lighting and in anticipation of 14 AWG CCA being added to the ampacity tables in Article 310
- ⚠ Code-Making Panel 1 reconfirmed in Section 110.14, Electrical Connections, that CCA and copper are only dissimilar to single metal aluminum when intermixed but not to each other for the application of the requirement
- ⚠ Parenthetical text “such as copper and aluminum, copper and copper-clad aluminum, or aluminum and copper-clad aluminum” was removed



Photo courtesy of COPPERWELD Bimetallics, LLC.

New Articles for the 2023 *NEC*

Thirteen (13) new articles have been added to the 2023 *NEC*:


Article 235

-  Branch Circuits, Feeders and Services Over 1000 Volts ac, 1500 Volts dc, Nominal

Article 245

-  Overcurrent Protection for Systems Rated Over 1000 Volts ac, 1500 Volts dc

Article 305

-  Wiring Methods and Materials for Systems Rated Over 1000 Volts ac, 1500 Volts dc, Nominal

New Articles for the 2023 *NEC* (cont.)

Thirteen (13) new articles have been added to the 2023 *NEC*:

Article 315

 Medium Voltage Conductors, Cable, Cable Joints, and Cable Terminations

Article 335

 Instrumentation Tray Cable

Article 369

 Insulated Bus Pipe/Tubular Covered Conductors

Article 371

 Flexible Bus Systems

New Articles for the 2023 *NEC* (cont.)

Thirteen (13) new articles have been added to the 2023 *NEC*:

Article 395

 Outdoor Overhead Conductors Over 1000 Volts

Article 495

 Equipment Over 1000 Volts AC, 1500 Volts DC, Nominal

Article 512

 Cannabis Oil Equipment




New Articles for the 2023 *NEC* (cont.)

Thirteen (13) new articles have been added to the 2023 *NEC*:


Article 722

-  Cables for Power-Limited Circuits, Fault-Managed Power (*Class 4*) Circuits

Article 724

-  Class 1 Power-Limited Circuits and Class 1 Power-Limited Remote-Control and Signaling Circuits

Article 726

-  Class 4 (*CL4*) Power Systems



Deleted Articles for the 2023 *NEC*

 **Article 311** Medium Voltage Conductors and Cables

 *(contents moved to new Article 315)*

 **Article 510** Hazardous (*Classified*) Locations - Specific

 **Article 490** Equipment Over 1000 Volts, Nominal

 *(contents moved to new Article 495)*

 **Article 712** Direct Current Microgrids

 **Article 720** Circuits and Equipment Operating at Less Than 50 Volts

Article 90

Introduction

- Use and application, arrangement, and enforcement of this *Code*
- Mandatory, permissive, and nonmandatory text

90.5 Mandatory Rules, Permissive Rules, and Explanatory Material

(C) Explanatory Material

Revised to state that unless a standard referenced in the *NEC* contains a date, that reference is to be considered the latest edition of the standard

- ⚠ CMP members spend a lot of time and effort making date changes to referenced standards that appear in the *NEC*
- ⚠ In instances where a date is not included with the referenced standard, the user of the *Code* should understand this to mean the latest standard available
- ⚠ Will reduce the number of public inputs and public comments submitted to modify a date for a standard referenced in the *NEC*



90.5(C) Explanatory Material

SANDIA REPORT

SAND2004-3535
Unlimited Release
Printed December 2004

Photovoltaic Array Performance Model

D.L. King, W.E. Boyson, J.A. Kratochvill

Prepared by
Sandia National Laboratories
Albuquerque, New Mexico 87185 and Livermore, California 94550

Sandia is a multiprogram laboratory operated by Sandia Corporation,
a Lockheed Martin Company, for the United States Department of Energy's
National Nuclear Security Administration under Contract DE-AC04-94AL85000.

Approved for public release; further dissemination unlimited.



Photovoltaic Wire

UL Standard

- [Scope](#)
- [Summary of Topics](#)

Standard 4703, Edition 1

Edition Date: September 30, 2014

ANSI Approved: July 21, 2020

In instances where a date is not included with the referenced standard, the user of the Code should understand this to mean the latest standard available

Example: 690.31 Wiring Methods.
(C) Cables.

Informational Note: See UL 4703, Standard for PV Wire and UL 3003, Distributed Generation Cables, for DG Cable

(no date posted, assume latest available)

Chapter 1

General

- Article 100
- Article 110

Article 100

Definitions

- Covers all defined terms used in the *Code*

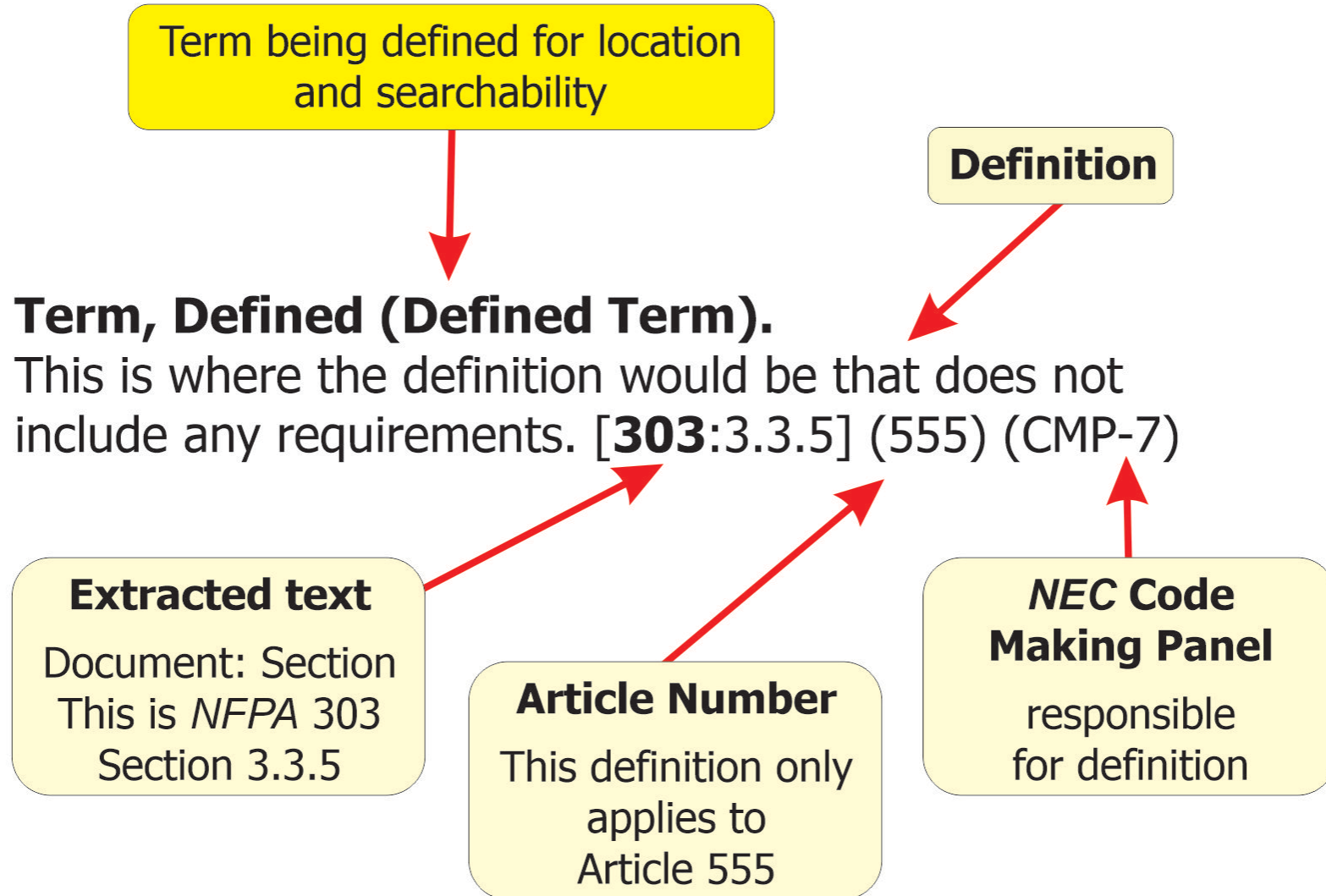
Article 100 Definitions

The definitions that were in various locations of the *NEC* and in the XXX.2 placeholders have been relocated to Article 100

- ⚠ Article 100 has changed its scope to reflect these changes
- ⚠ Contains definitions essential to the application of the *Code*
- ⚠ This change is in response to changes in the *NEC Style Manual*
- ⚠ Helps to standardize the *NEC* with other *NFPA* standards
- ⚠ The three parts of Article 100 have been eliminated
- ⚠ The definitions will be found in alphabetical order
- ⚠ Several new definitions were also added to Article 100
- ⚠ Definitions followed by brackets have been extracted from another standard



Article 100- Definitions

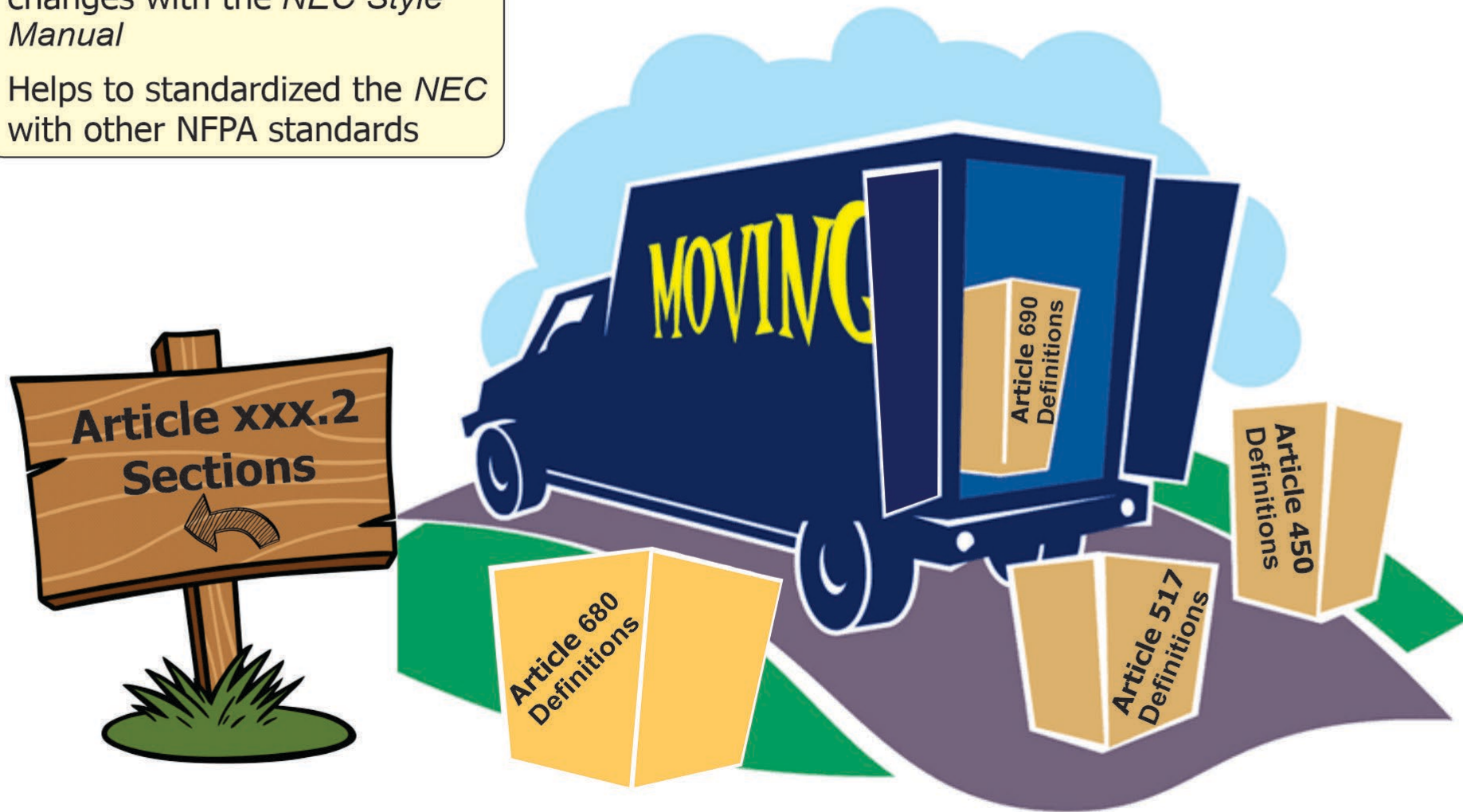


Article xxx.2 Sections to Article 100

All definitions will now be found in Article 100 of the National Electrical Code

This change is in response to changes with the *NEC Style Manual*

Helps to standardized the *NEC* with other NFPA standards



Reconditioned Equipment

110.20 Reconditioned

110.21 Marking

210.2 Reconditioned Equipment

240.2 Reconditioned Equipment

242.2 Reconditioned Equipment

245.2 Reconditioned Equipment

362.2 Reconditioned Equipment

348.2 Reconditioned Equipment

350.2 Reconditioned Equipment

369.2 Reconditioned Equipment

404.16 Reconditioned Equipment

406.2 Reconditioned Equipment

408.2 Reconditioned Equipment

410.2 Reconditioned Equipment

411.2 Reconditioned Equipment

430.2 Reconditioned Motors

470.2 Reconditioned Equipment

495.2 Reconditioned Equipment

495.49 Reconditioned Switchgear

517.6 Patient Care-Related
Electrical Equipment

660.10 Equipment Installations

695.2 Reconditioned Equipment

700.2 Reconditioned Equipment

701.2 Reconditioned Equipment

702.2 Reconditioned Equipment

708.2 Reconditioned Equipment

800.2 Reconditioned Equipment

Note: Not all Code Making Panels (CMPs) used xxx.2 for reconditioned equipment

Article 100 Definitions- Searchability

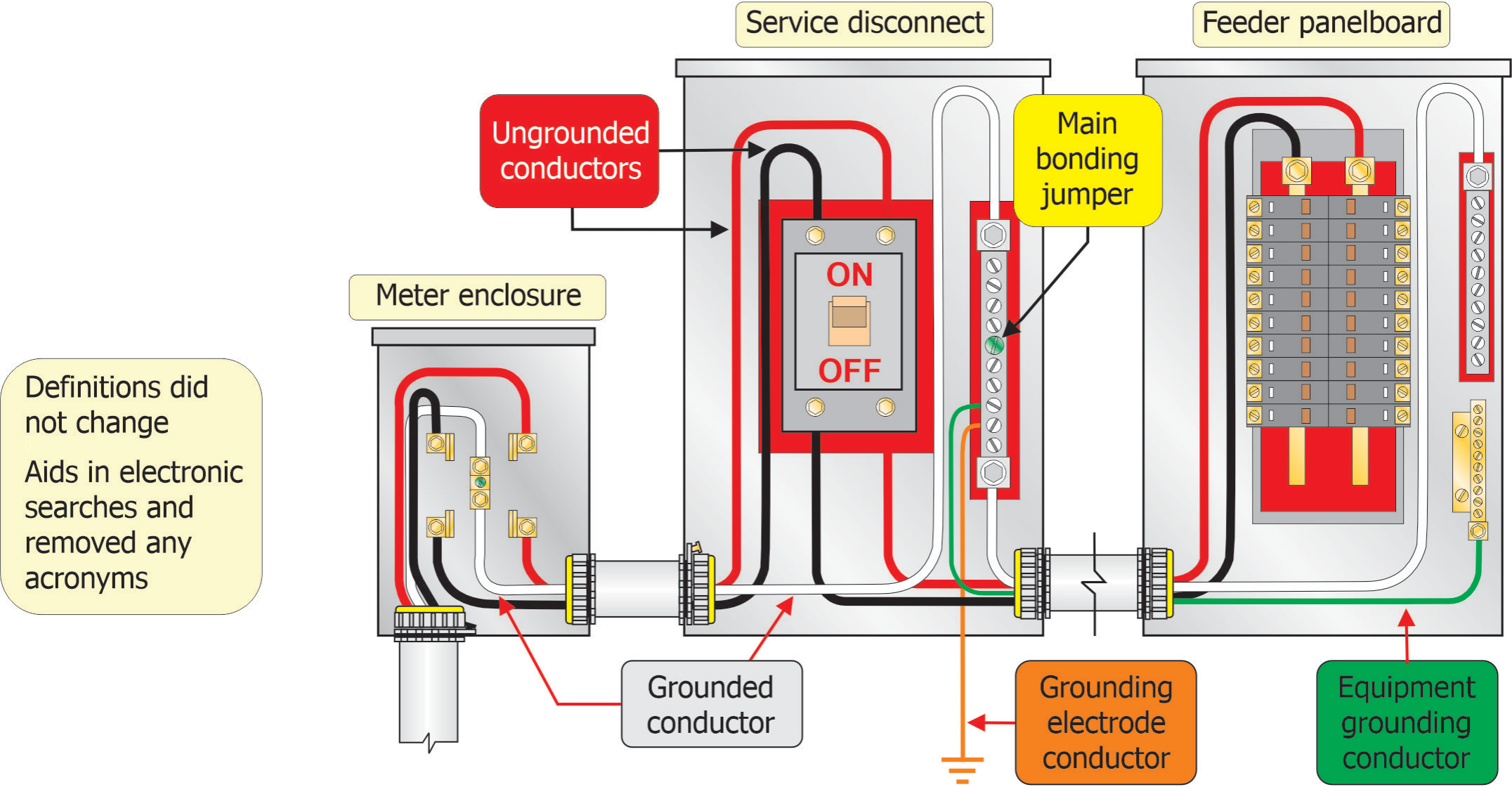
Revised these definition titles to aid in electronic searches

- ⚠ Bonding Conductor. (*Bonding Jumper*)
- ⚠ Bonding Jumper, Equipment. (*Equipment Bonding Jumper*)
- ⚠ Bonding Jumper, Main. (*Main Bonding Jumper*)
- ⚠ Bonding Jumper, Supply-Side. (*Supply-Side Bonding Jumper*)
- ⚠ Bonding Jumper, System. (*System Bonding Jumper*)
- ⚠ Grounded, Solidly. (*Solidly Grounded*)
- ⚠ Grounding Conductor, Equipment (EGC). (*Equipment Grounding Conductor*)

Note: Language for the above definitions has not changed



Article 100- Definitions (Multiple Definitions)



Definitions did not change
Aids in electronic searches and removed any acronyms

Article 100- Accessible (*applied to wiring methods*)

Revision clarifies that wiring and electrical equipment made inaccessible by piping, ductwork, drains, raceways, or other mechanical systems **is not considered as accessible** as applied to wiring methods

- ⚠ Access to the wiring contained within this equipment is sometimes made very difficult
- ⚠ This can require removal or disassembling of piping, raceways, or other equipment, which, where present, tended to defeat the purpose of using the term “accessible” in *Code* requirements that use the term
- ⚠ Building-related items such as electrical raceways, plumbing pipes, and mechanical systems were considered accessible because they are not part of the structure or finish of the building, and the definition did not cover anything else



Article 100- Accessible (*applied to wiring methods*)

Modifications were made to the definition of "Accessible" as it applies to wiring methods

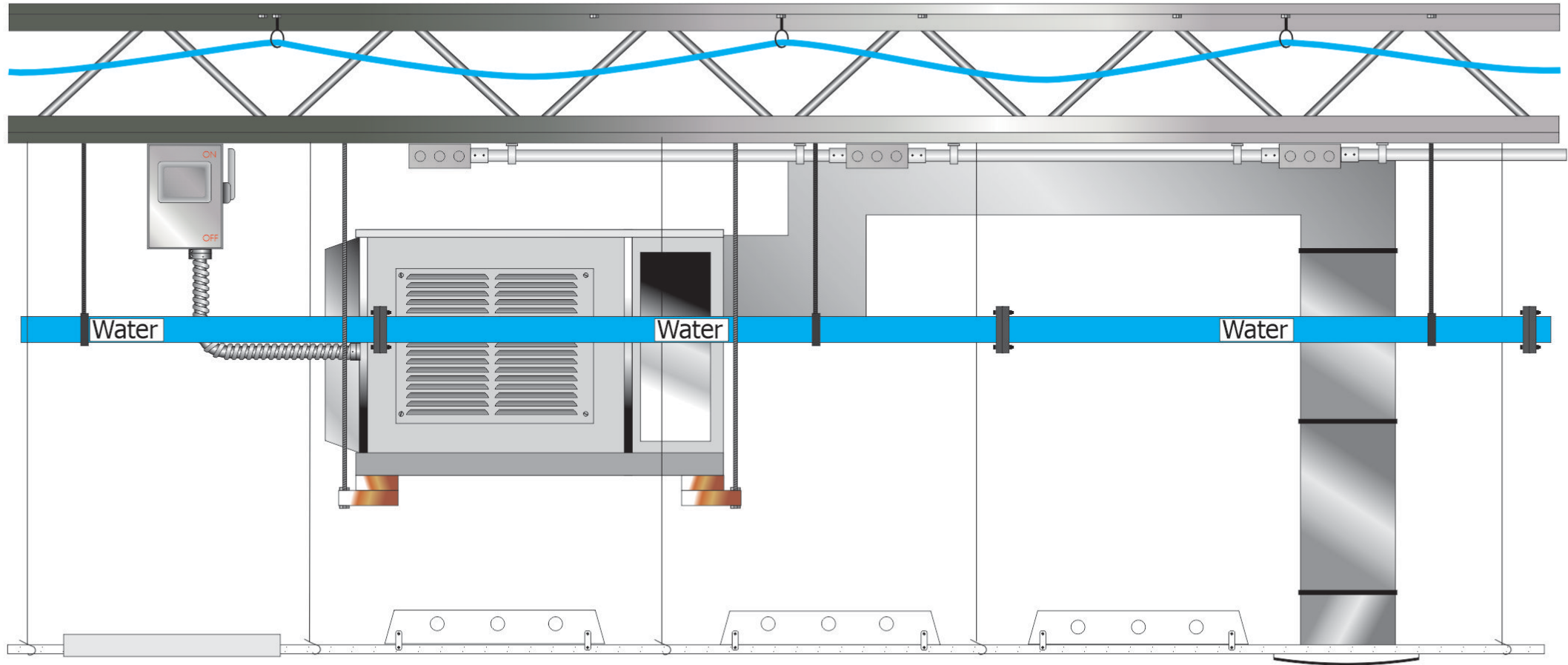
Clarifies that wiring and electrical equipment **cannot be made inaccessible** by piping, ductwork, drains, raceways, or other mechanical systems



Photos courtesy of IAEI Archives

Article 100- Accessible (*applied to wiring methods*)

This helps to clarify that wiring and electrical equipment **cannot be made inaccessible** by piping, ductwork, drains, raceways, or other mechanical systems



Water piping in front of electrical equipment making it **inaccessible for maintenance**

Article 100- Class 4 Circuit

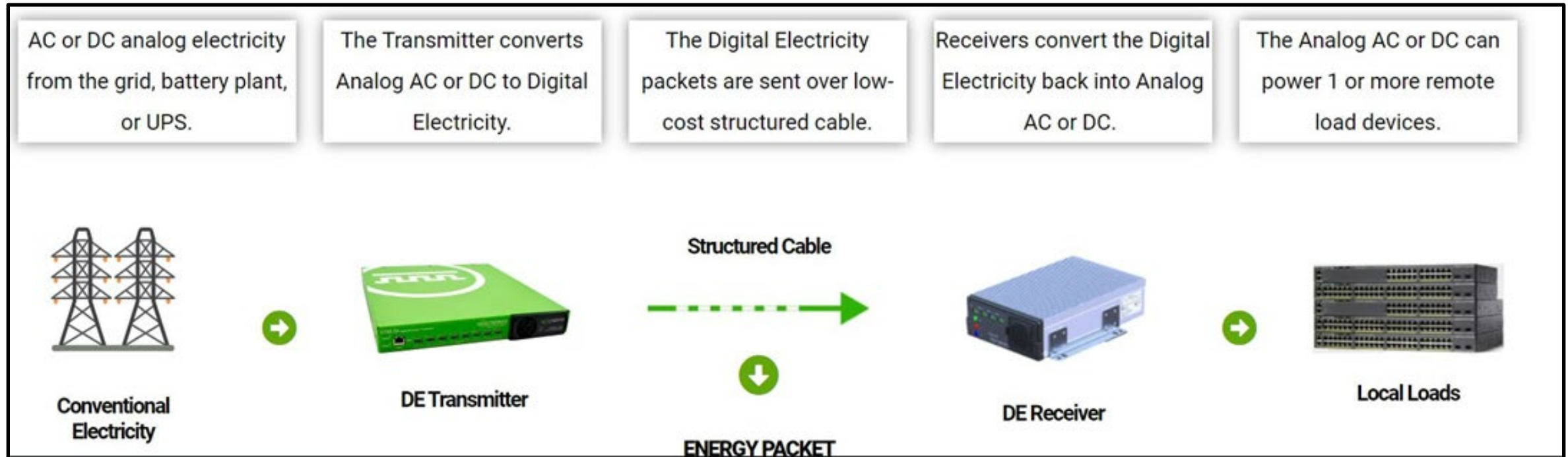
A new definition for a Class 4 Circuit has been added as it applies to equipment and installations located in Article 726

- ⚠ This was the result of the **Packet Energy Transfer** (*PET*) Systems Task Group tasked to provide guidance towards this new technology
- ⚠ This emerging technology has been referred to in the past as Packet Energy Transfer (*PET*), Digital Electricity (*DE*), Pulsed Power, Smart Transfer Systems and Fault Managed Power (*FMP*)
- ⚠ Involves a fault-managed system that verifies the powered device is present and operating correctly prior to a greater than Class 2 power being applied (*a fault would cause a termination of the output power*)
- ⚠ Must ensure safety in the design, implementation, installation, and use of this technology
- ⚠ There are now a total of six (6) definitions associated with this Class 4 technology



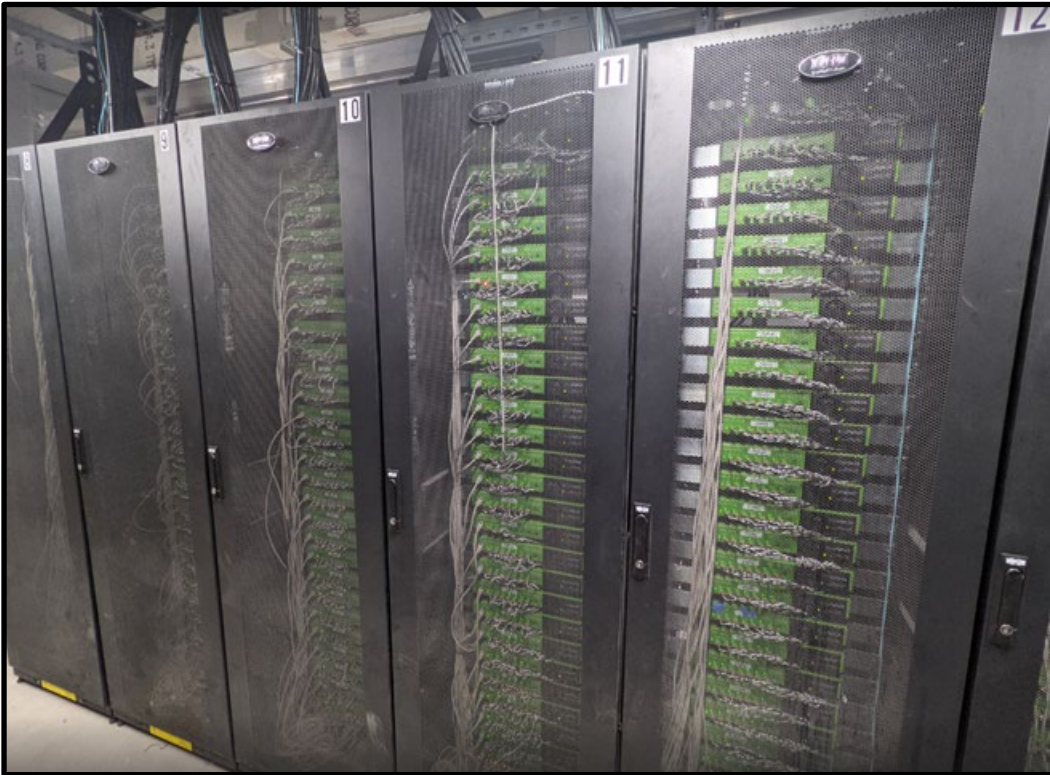
Article 100- Class 4 Circuit (cont.)

Flowchart describing how this process works (courtesy of Voltserver)



Article 100- Class 4 Circuit (cont.)

Equipment associated with Class 4 Circuit distribution *(courtesy of Voltserver)*



Article 100 Definitions- Counter (Countertop)

A new definition was added to help users of the Code understand what constitutes a “**Counter (Countertop)**” location

- ⚠ There appears to be installer and enforcement **confusion**, as well as **frequent product misapplications** resulting from electrical equipment being installed incorrectly on these surfaces
- ⚠ The key distinction between a work surface and a countertop is the **quantity of spillage** that the surfaces may be subjected (*Generally, a counter application assumes a greater volume of spillage*)
- ⚠ The electrical professional will be directed to the industry standards that aid in the proper application of receptacles in these locations
- ⚠ See **Informational Note No. 1** for a reference to *UL 498, Receptacles and Attachment Plugs*, and *UL 943, Ground-Fault Circuit-Interrupters*
- ⚠ See **Informational Note No. 2** for information on receptacles for counters and countertops distinguished from receptacles for work surfaces



Article 100 Definitions- Counter (Countertop)

The key distinction between a **work surface or a countertop** is the quantity of spillage that the surfaces may be subjected (see *Work Surface definition in upcoming slide*)



Features:

- listed for application
- flange raised above surface to prevent liquid from entering
- sealed when in the closed position to prevent liquid from entering
- only energized in the upright position
- GFCI protected



Courtesy of ABB, Thomas and Betts

Article 100 Definitions- Work Surface

Work Surface

- A container with **8 oz of saline solution**, with 8 g of table salt per liter of distilled water
- Container is placed on the counter surface 12 inches from the sample
- Container is tipped over all at once with an effort to direct the spill toward the most disadvantageous area of the assembly

Countertop

- A container with **1/2 gallon of saline solution** with 0.28 ounce of table salt per liter of distilled water
- Container is placed on the counter surface 12 inches from the sample
- Container is tipped over all at once with an effort to direct the spill toward the most disadvantageous area of the assembly



Article 100 Definitions- Work Surface

- ⚠ Reference 406.5(E), 406.5(G)(1), and 406.5(H) for information on receptacles for counters and countertops distinguished from receptacles for work surfaces
- ⚠ 2020 *NEC* introduced work surface and countertop recognizing the differences are important but there were no definitions for these terms (*210.11 & 210.52*)



Article 100 Definitions- Energy Management System

A new definition for Energy Management System has been created and added to the 2023 *NEC*

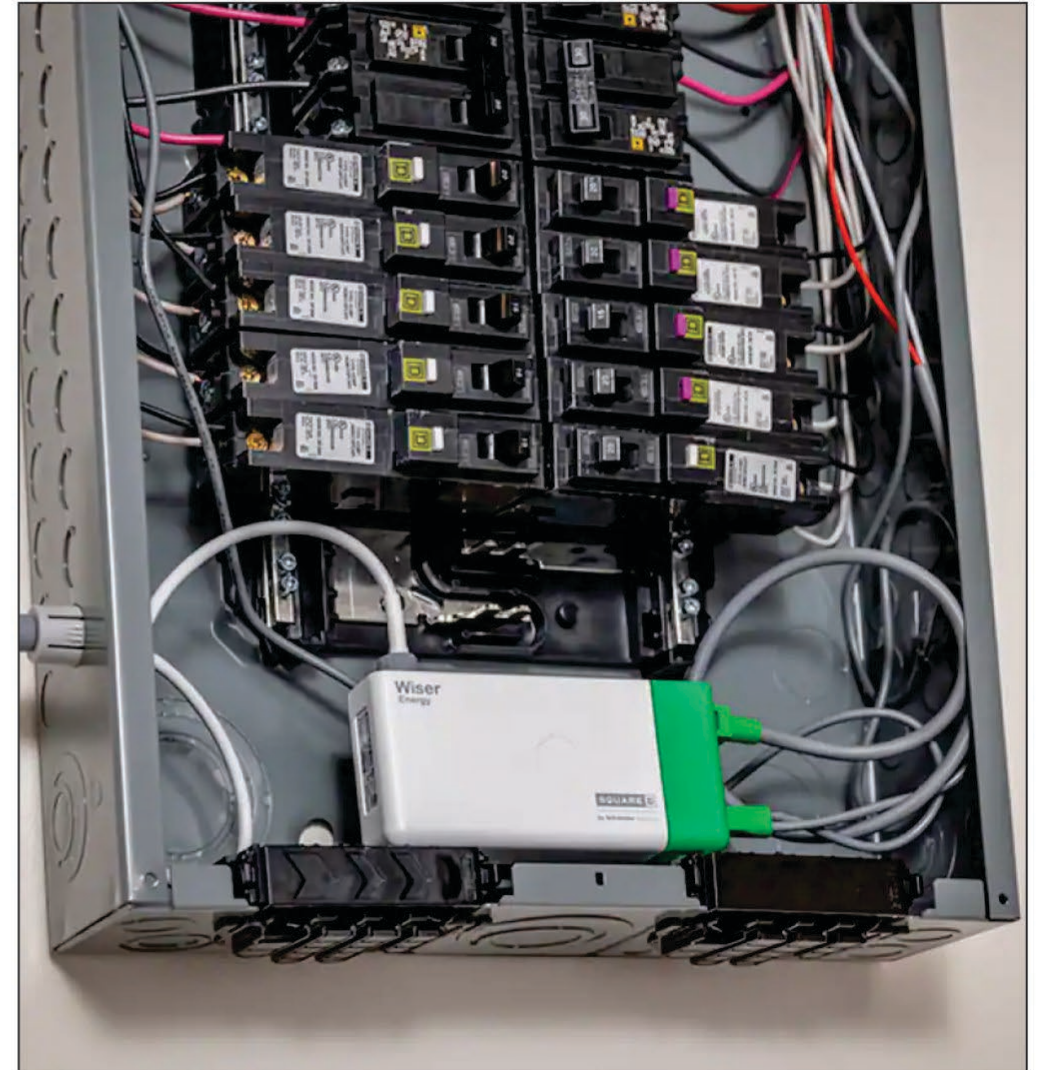
- ⚠ The Energy Management Task group was asked to review all current and proposed definitions and requirements
- ⚠ Items reviewed were load management, load management system, power control system, energy management system, and related terms
- ⚠ Need to promote a coordinated approach and understanding throughout the *Code*
- ⚠ An energy management system will contain a monitor, a form of communication equipment, some type of controller and timer, and other devices responsible for monitoring or controlling an electrical load, a form of power production, or a type of storage source

Article 100 Definitions- Energy Management System

A new definition for **Energy Management System** has been created and added to the 2023 *NEC*

An energy management system will contain a monitor, a form of communication equipment, some type of controller and timer, and other devices responsible for monitoring or controlling an electrical load, form of power production, or a type of storage source

Photos courtesy of Schneider Electric



Article 100 Definitions- Feeder Assembly

This new definition will provide consistency when referencing the factory cord or cable assembly between the electrical equipment and the mobile home, recreational vehicle, or park trailer panelboard

- ⚠ In previous editions of the *Code*, there were different definitions in the *NEC* articles under CMP-7 purview that basically covered the power cord assembly
- ⚠ Adding the term “feeder assembly” consistently throughout Articles 550, 551, and 552 clarifies that these conductors, although connected to a receptacle, are considered feeders in order to forgo the GFCI protection
- ⚠ This alleviates concerns about “unwanted tripping” that could be caused by the accumulation (*multiple portable appliances*) of leakage current at the source



Article 100 Definitions- Feeder Assembly



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Article 100 Definitions- Fibers/Flyings, Combustible

A new definition for “Fibers/Flyings, Combustible” includes 3 informational notes that identify particle size and types of fibers/flyings

- ⚠ Part of a Standards Council directive to CMP committees to resolve conflicts among the documents
- ⚠ This change is a result of members from several technical committees as part of a Task Group on Combustible Dusts
- ⚠ Informational notes following the new definition to include specific information pertaining to combustible metal fibers/flyings



Article 100 Definitions- Ground Fault

Changed the words from “metallic” to “metal” in the definition of *Ground Fault* in Article 100

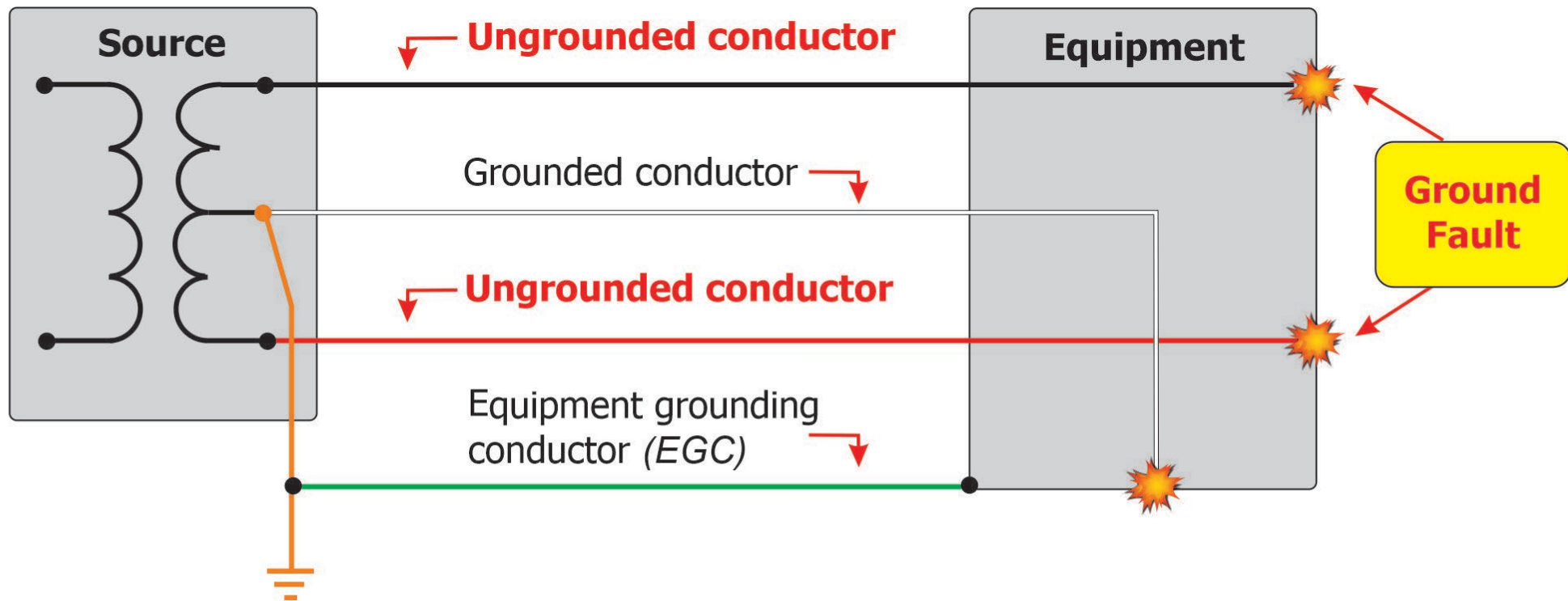
- ⚠ Change was made from “metallic” to “metal” to comply with the *NEC Style Manual*
- ⚠ Helps to add clarity and useability by updating the words of the definition
- ⚠ This received considerable debate at the *NEC* Correlating Committee meeting



Article 100 Definitions- Ground Fault



An unintentional, electrically conductive connection between an **ungrounded conductor** of an electrical circuit and the normally non-current-carrying conductors, **metal** enclosures, **metal** raceways, **metal** equipment, or earth.



Article 100- Impedance Grounding Conductor

A new term was added for *Grounding Conductor, Impedance*

- ⚠ There was no definition until the 2023 *NEC* for a conductor that made a connection between the neutral point for an impedance grounded system and the grounding impedance device
- ⚠ The impedance grounding conductor will carry fault current that has been reduced by a designated impedance
- ⚠ This conductor did not meet the definition of a neutral conductor as it is not intended to carry current under normal conditions
- ⚠ It also did not meet the definition of a *grounding electrode conductor*



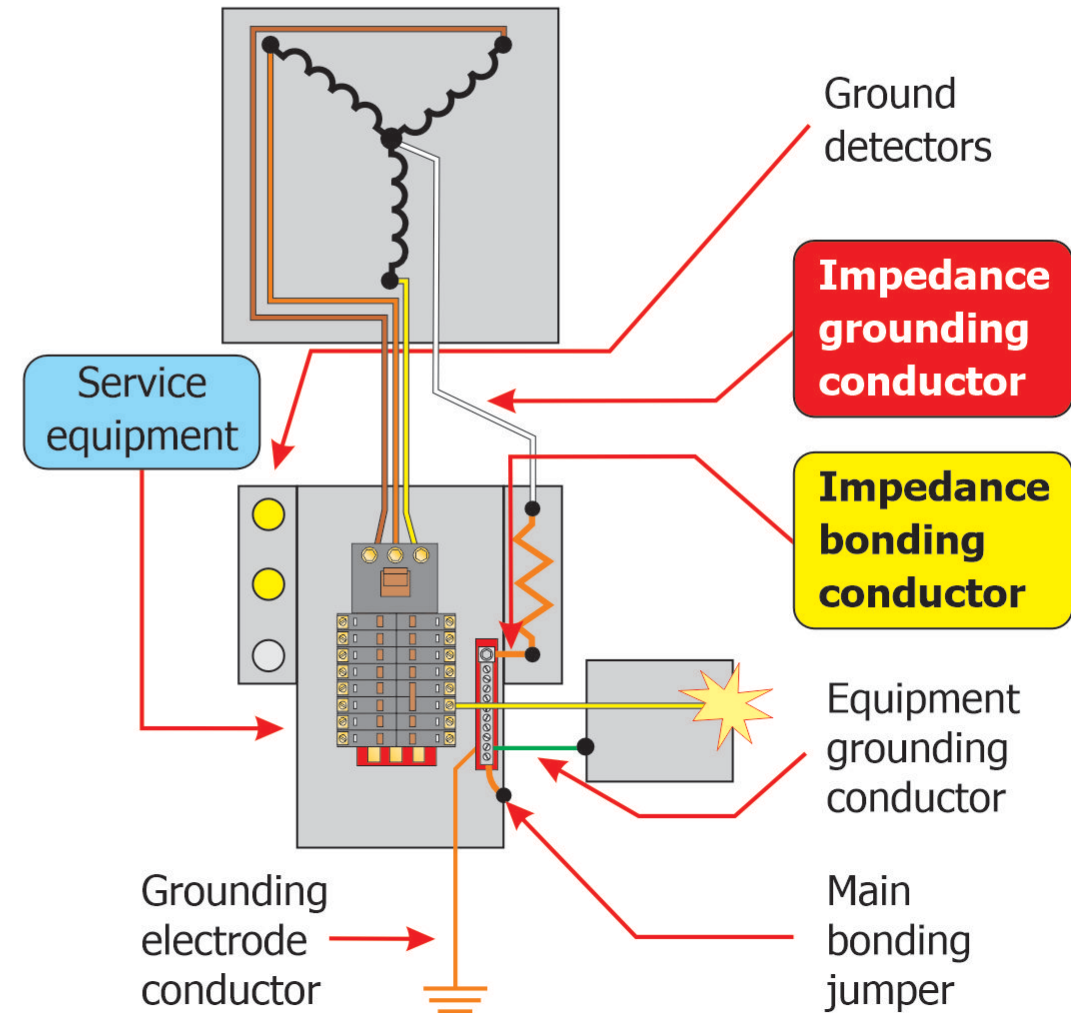
Article 100- Impedance Grounding Conductor

New definition for **"impedance grounding conductor"** was created to replace the phrase "grounded system conductor"

There was no definition until the 2023 *NEC*

This conductor makes a connection between the neutral point for an impedance grounded system and the grounding impedance device

The impedance grounding conductor will carry fault current that has been reduced by a designated impedance



Article 100- Grounded System, Impedance (*Impedance Grounded System*)

A new term was added for *Grounded System, Impedance*

- ⚠ There was no definition for an *impedance grounded system* before the 2023 NEC code cycle
- ⚠ An electrical system that is grounded by intentionally connecting the system neutral point to ground through an impedance device (*CMP-5*)
- ⚠ This resulted in an inconsistent use and understanding of these systems as they applied with high impedance grounded neutral systems and impedance grounded neutral systems
- ⚠ Electrical professionals will have a new definition that is accurate and consistently defines elements that make up this system

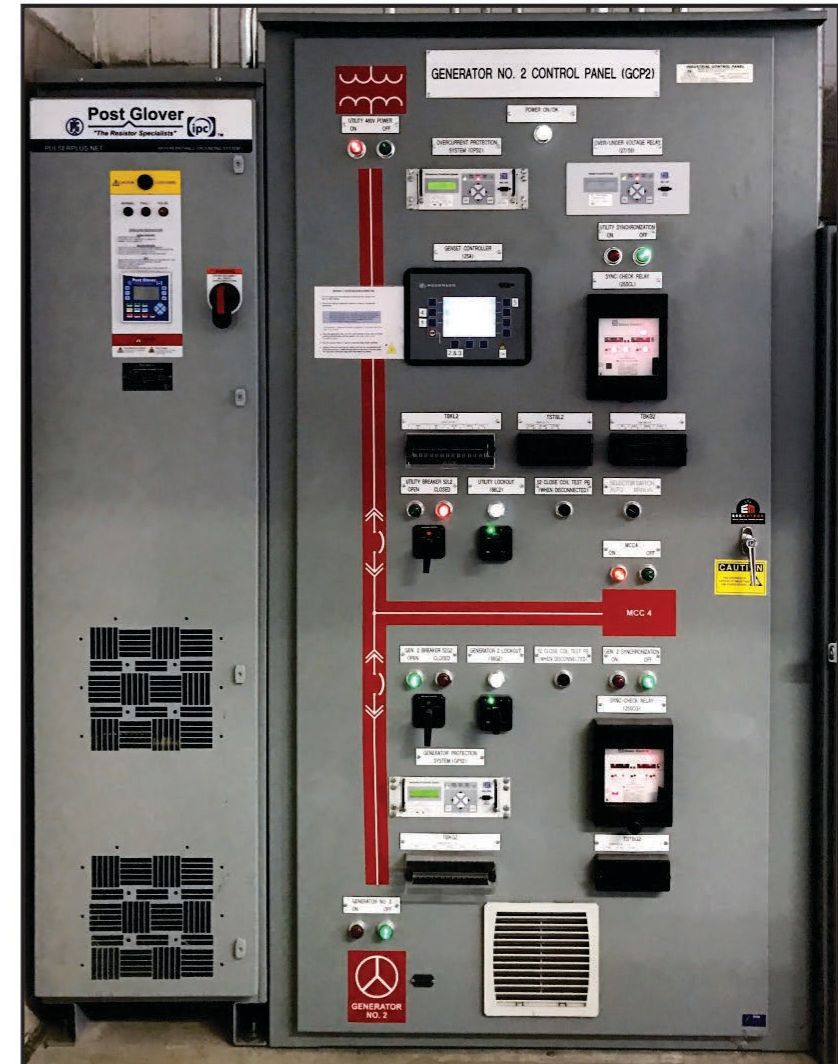
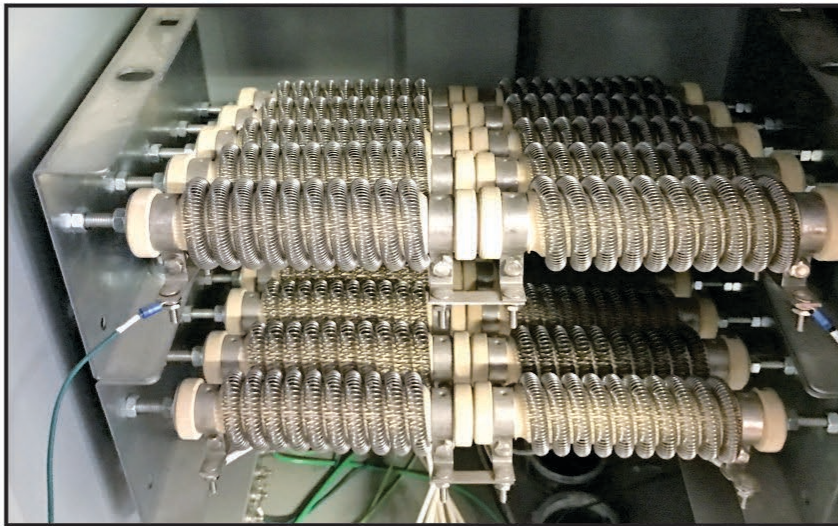


Article 100- Impedance Grounded System

Substantiation was submitted for the creation of a new definition for Grounded System, Impedance

No definition for an impedance grounded system before the 2023 *NEC*

This resulted in an **inconsistent use** and understanding of these systems as it applied with high impedance grounded neutral systems and impedance grounded neutral systems



Photos courtesy of Rob Bowman

Article 100- Impedance Grounded System

Photo shows the typical ground detection and alarm system associated with an impedance grounded system

Has visual as well as audible alarm features

These systems help maintain continuity of power, and are recognized in NFPA 70E as a method of reducing arc flash severity

Manufactured by Post Grover



Photo courtesy of Rob Bowman



Article 100 Definitions- In Sight From

The definition of “*In Sight From (Within Sight From), (Within Sight)*” has been modified per requirements of the *NEC Style Manual*

- ⚠ The *NEC Style Manual* states that definitions shall not contain requirements or recommendations
- ⚠ See the new section for “*In Sight From (Within Sight From), (Within Sight)*” in 110.29 for requirements
- ⚠ Definition revised for clarity and uniform enforcement
- ⚠ Equipment that is visible and not more than 15 m (50 ft.) distant from other equipment is considered to be in sight from that other equipment



Article 100- In Sight From (*Within Sight From, Within Sight*)

Distance is to be **visible** and not more than 15 m (**50 ft**) from the other equipment
[Note: see 110.29 for requirements for In Sight From (Within Sight From, Within Sight)]

Transformer disconnecting means is located in the electrical panel and is labeled

Transformer is labeled as to the panel and branch circuit it is controlled from

Always test for the presence of electricity before beginning the troubleshooting of electrical issues



Article 100- Likely to Become Energized

A new term is now defined explaining the phrase *Energized, Likely to Become*

- ⚠️ There was no definition of this phrase that appears 25 times within the *NEC*
- ⚠️ Annex B of the *NEC Style Manual* defines “likely to become energized” as a “failure of insulation on” (*Annex B is units of measure*)
- ⚠️ There is a very important distinction between what can become energized compared to what is likely to become energized
- ⚠️ Likely to become energized was up to interpretation with opinions that differed from jurisdiction to jurisdiction
- ⚠️ This caused frustration among electrical professionals when applying requirements from the *NEC*



Article 100- Energized, Likely to Become

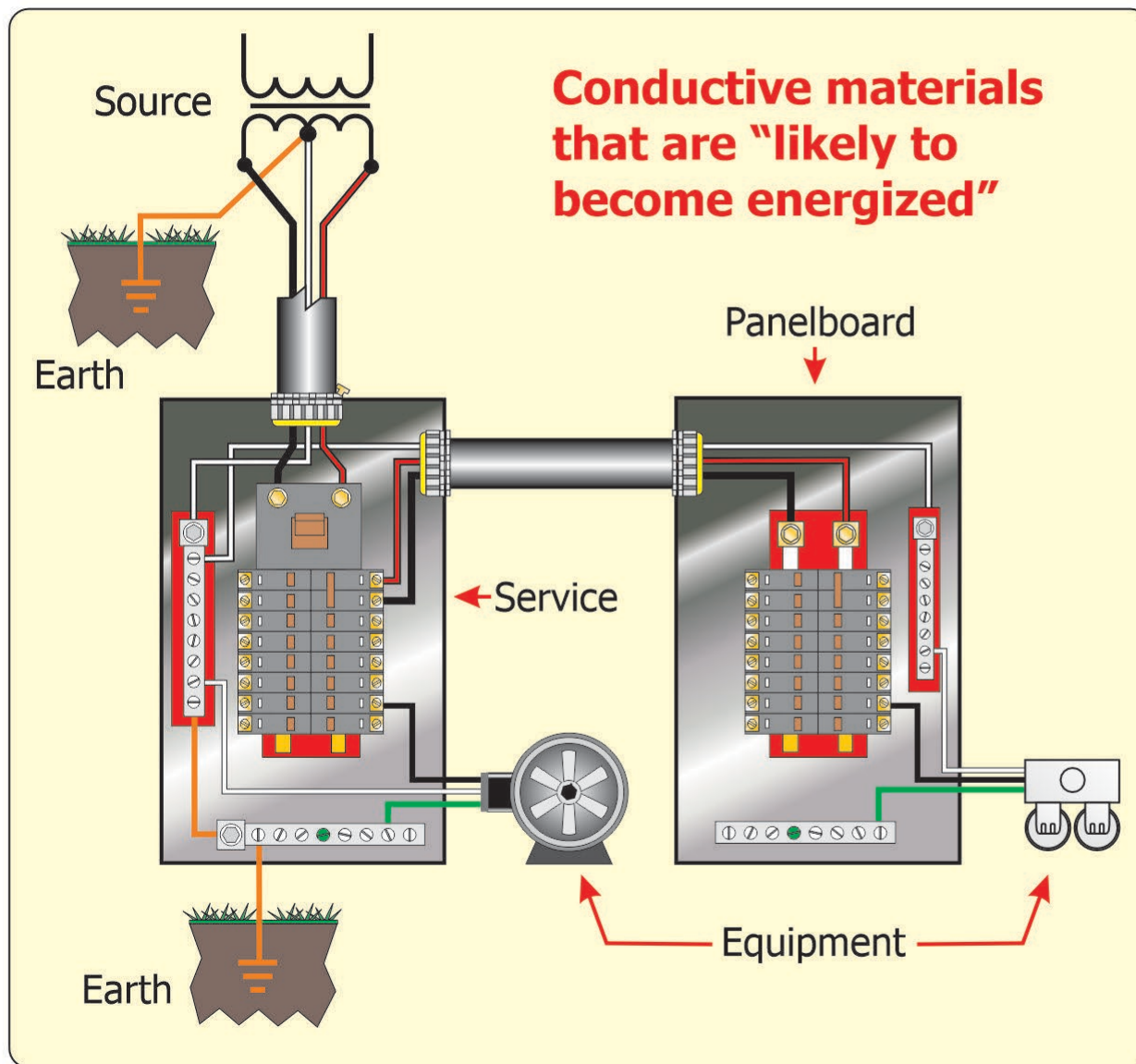
Likely to become energized was up to interpretation with opinions that differ between jurisdictions

Annex B of the *NEC Style Manual* defines "likely to become energized" as a "failure of insulation on"

Many people have never heard of an NEC Style Manual

Definition factors:

- a conductive material
- this conductive material could become energized
- could be due to failure of electrical insulation or electrical spacing



Article 100- Load Management

A new term is now defined for *Load Management*

- ⚠ The result of the Energy Management Task Group who was asked to review current as well as proposed definitions and requirements
- ⚠ Review topics included load management, load management system, power control system, energy management system, and related terms
- ⚠ This will result in a coordinated approach and understanding throughout the *NEC*
- ⚠ Task group proposed several public comments for energy management items located throughout the *NEC*
- ⚠ Load management is considered a function of a listed energy management system
- ⚠ The definition will now correlate with Article 750, *Energy Management Systems*



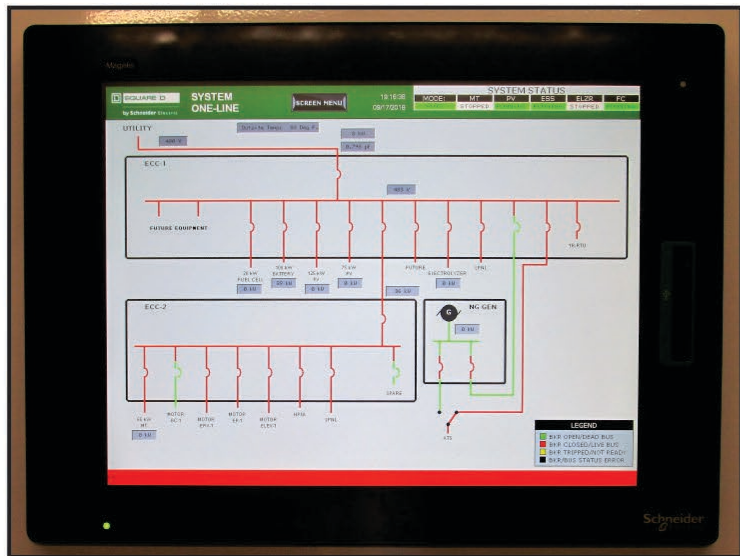
Article 100- Load Management

A new definition for Load Management has been added to the *NEC*

Review topics included load management, load management system, power control system, energy management system and related terms

This will result in a coordinated approach and understanding throughout the *NEC*

The definition will now correlate with Article 750 *Energy Management Systems*



Square D Load Management Systems



Photo from IAEI Archives

Article 100 Definitions- Normal High-Water Level

This new definition will help the authority having jurisdiction (AHJ) determine the elevation for the electrical datum plane distances used in Articles 551, 555, and 682

- ⚠ Previously, there was no consistent way to determine the elevation next to a body of water to validate or confirm where electrical equipment could be placed and where the electrical datum plane is located
- ⚠ This will provide an easier and more consistent way to determine the elevation for the electrical datum planes
- ⚠ See this definition for further definitions of the following:
 - 🔩 Natural or Artificially Made Shorelines
 - 🔩 Rivers and Streams
 - 🔩 Flood Control Bodies of Water
 - 🔩 Nonflood Control Bodies of Water



What is an Electrical Datum Plane?

- ⚠ The electrical datum plane is a horizontal plane, a specified distance above the normal high-water level
- ⚠ It governs, by applicable *Code* rules, the lowest level that specified electrical equipment can be installed, and the electrical connections can be made
- ⚠ One good example is 555.3(A) for floating piers
- ⚠ The electrical datum plane for floating piers and landing stages is installed to permit located to accommodate the rise and fall of the pier or stage in response to water level, without lateral movement
- ⚠ In these cases, the datum plane above the floating pier or landing stage is specified as being 30 inches above the water level at the floating pier or landing stage and a minimum of 12 inches above the level of the deck





Photo courtesy of IAEI Archives



Photo courtesy of IAEI Archives

Article 100 Definitions- PV DC Circuit

New terms and revised definitions for PV System DC elements

- ⚠ PV System Source Circuit and PV String Circuit subsets of a PV System DC Circuit
- ⚠ **PV Source Circuit** is inclusive of the series and/or parallel dc circuit conductors between the modules and combiners, inverters or PV system dc disconnect
- ⚠ **PV String Circuit** is inclusive of the series dc circuit conductors between the modules
- ⚠ Previous terms and definitions were difficult to apply to current designs
- ⚠ Decided to clarify these definitions as well as relocate all definitions to Article 100
- ⚠ The definitions relocated to comply with the *NEC* Style manual requirements



Article 100- PV DC Circuit

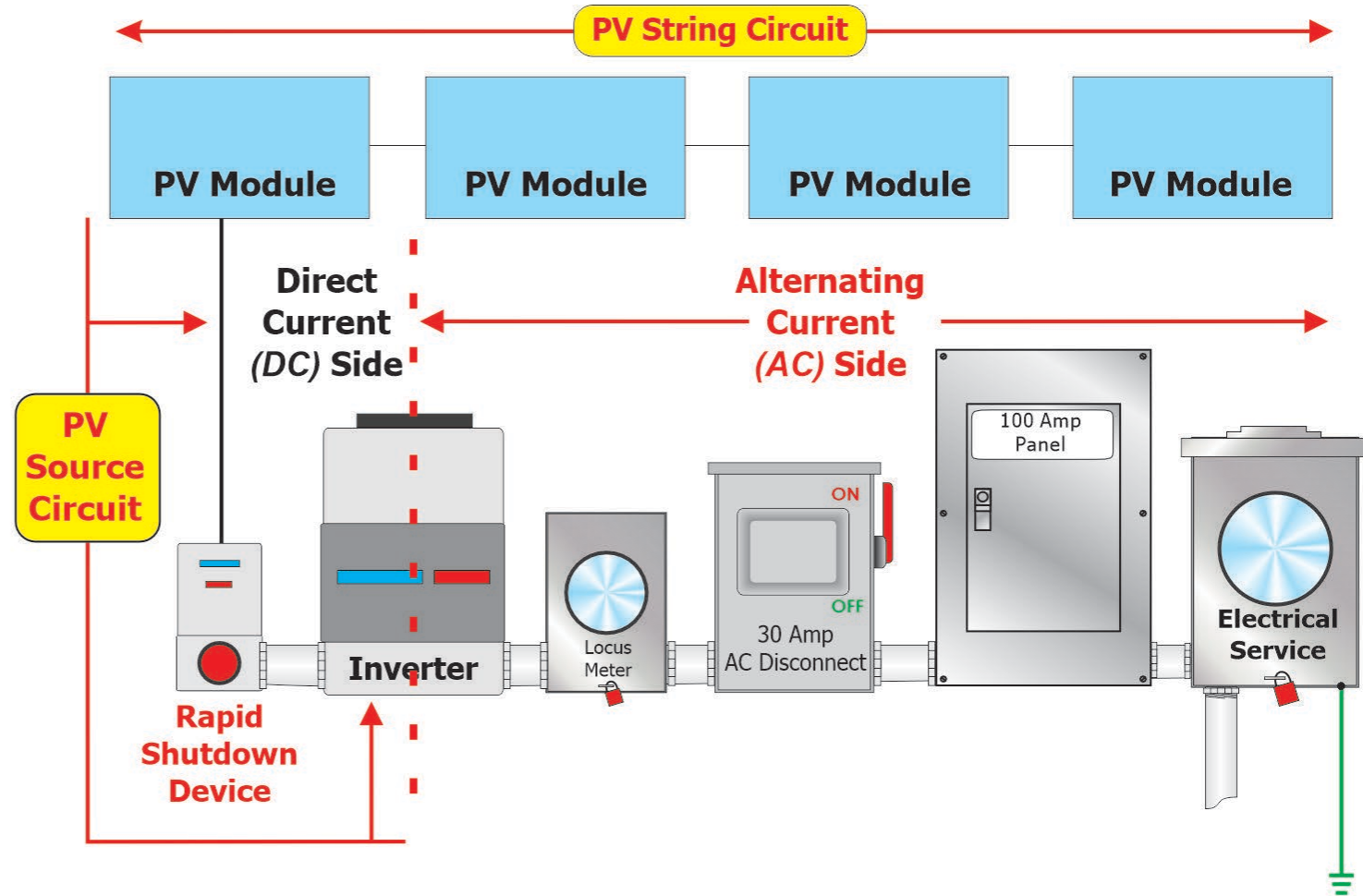
PV System Source Circuit and PV String Circuit are subsets of a PV System DC Circuit

PV String Circuit

is the series dc circuit conductors between the modules

PV Source Circuit

is the series and/or parallel dc circuit conductors between the modules and combiners, inverters or PV system dc disconnect



Article 100 Definitions- Restricted Industrial Establishment

New definition in Article 100 created to align with requirements for installations specifically found within hazardous (*classified*) locations

- ⚠️ Resulted in more concise wording in the definition and deleted unnecessary/redundant text for defining an industrial facility
- ⚠️ Removed the phrase “In industrial establishments with restricted public access, where the conditions of maintenance and supervision ensure that only qualified persons service the installation”
- ⚠️ Now states it is **an establishment** with restricted public access where there are conditions of maintenance where supervision ensures only qualified persons service the installation
- ⚠️ The above text was repeated in over 40 subdivisions for wiring methods permitted in hazardous (*classified*) locations
- ⚠️ This addressed an NFPA Correlating Committee request for all *code* panels to reduce redundant text that would not impact the *Code* requirements



Article 100- Definitions- Restricted Industrial Establishment

New definition in Article 100 created to **align with requirements** for installations specifically found within hazardous (*classified*) locations

Resulted in more concise wording in the definition and deleted unnecessary/redundant text for defining an industrial facility

Addressed NFPA Correlating Committee request to reduce redundant text but not impact code language



Photo courtesy of Brian Rock- Hubble

Article 100 Definitions- Servicing

A new definition for servicing of electrical equipment to assist in maintenance and repair activities

- ⚠ There has been confusion between what is considered reconditioning versus normal servicing, maintenance, and repair of electrical equipment
- ⚠ This definition distinguishes the act of servicing and maintenance of electrical equipment from reconditioning of electrical equipment
- ⚠ It will help assure the operational performance of the electrical equipment during the life of the equipment
- ⚠ See *NEMA CS 100-2020, NEMA Technical Position on Reconditioned Electrical Equipment*, for additional information on the proper application of rules related to reconditioning



Article 100- Servicing

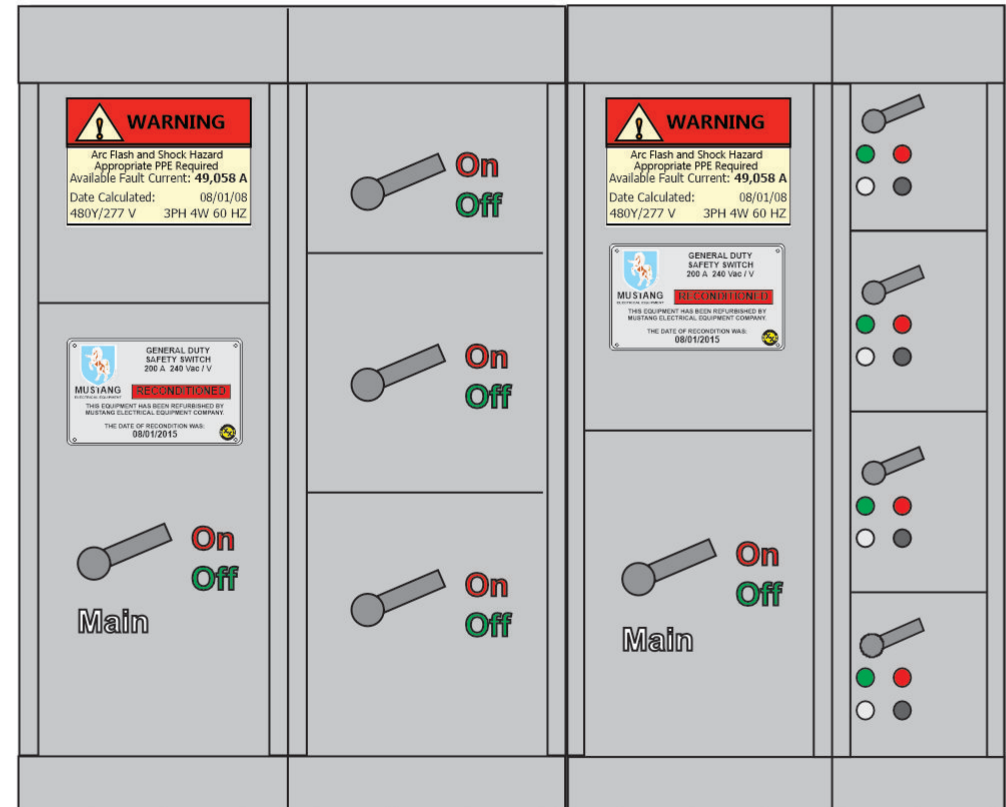
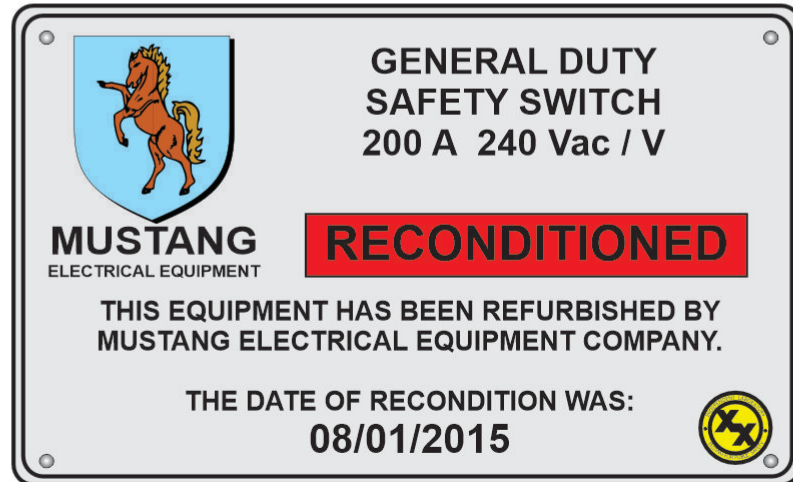
Reconditioning and servicing of equipment **is not** the same

Switchboards and Switchgear **Permitted** to be reconditioned

Definition of **“Servicing”** helps to explain difference

To service equipment means to perform maintenance and repair of electrical equipment

Label shown that has been applied to the switchgear denoting it has also been reconditioned



Article 100 Definitions- Short Circuit

A new definition for “short circuit” has been added to the *Code* by CMP-10

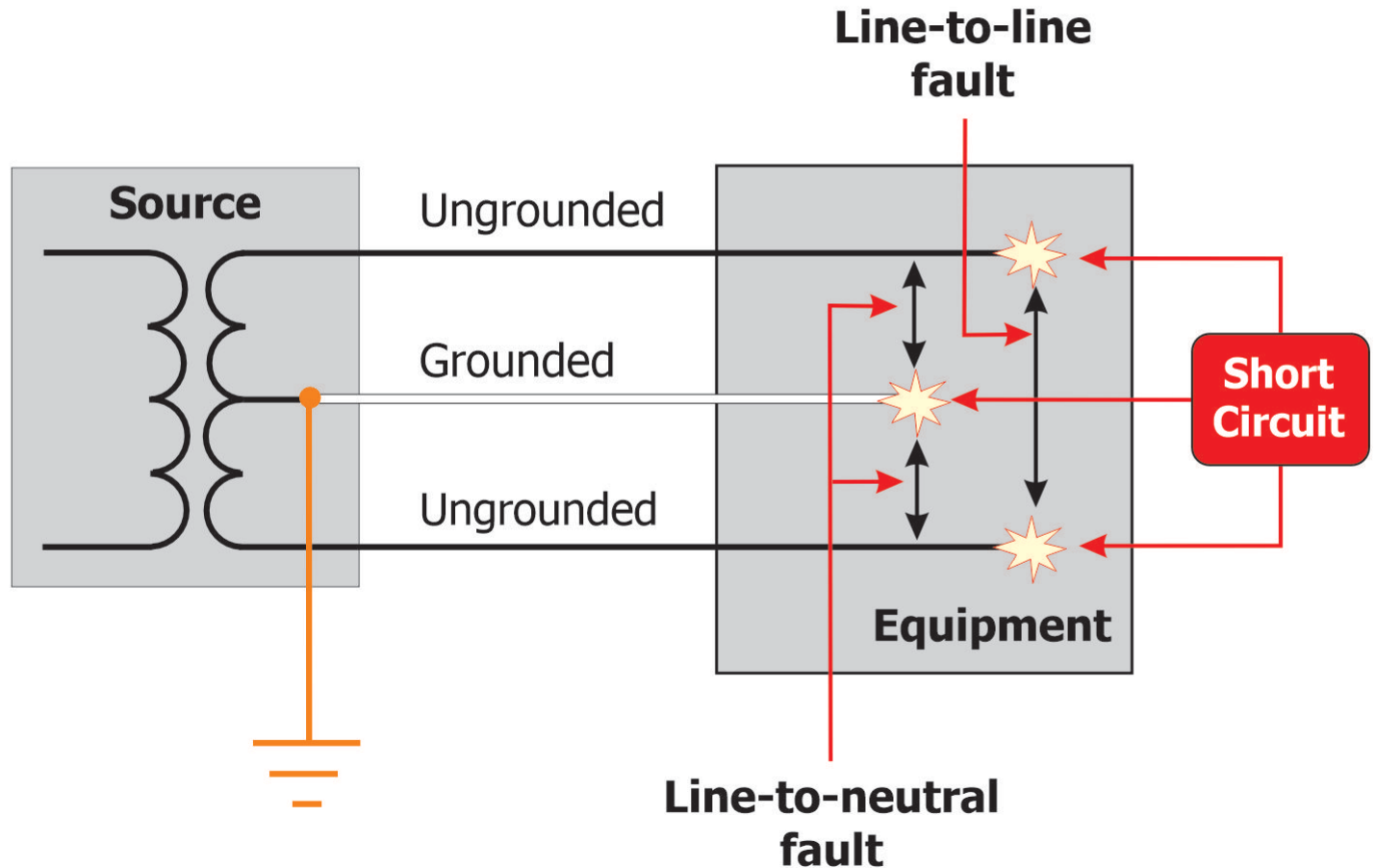
- ⚠ Short circuit is used several times throughout the *NEC*
- ⚠ The definition is added to improve the usability of the code
- ⚠ Previously, the user of the *Code* had to rely on other industry standards to determine the definition of this term, such as the *IEEE 100-1992, The New IEEE Standard Dictionary of Electrical and Electronic Terms, 5th Edition*



Definition: Short Circuit

Characteristics of a Short Circuit:

- It is a conducting connection
- can exist between any of the conductors of an electrical system
- either from line-to-line or from line to the grounded conductor
- can be accidental or intentional



Article 100 Definitions- Storable Swimming, Wading, or Immersion Pools and Storable/Portable Spas and Hot Tubs

The definition was modified removing the 42 in. depth language thus aligning with current product manufacturing standards

⚠ This new definition covers:

✂ Storable Swimming, Wading, or Immersion Pools and

✂ Storable/Portable Spa and Hot Tub

⚠ The previous water depth limitations were based on typical storable pool construction at that time and not related to any electrical hazard associated with water depth

⚠ AHJs were placed in a position of identifying a code violation when the 42-in depth was in the previous definitions (*even though there was not an electrical hazard*)

⚠ This should eliminate the confusion and unnecessary requirements that an equipotential bonding system be installed



Article 100 Definitions- Storable Swimming, Wading, or Immersion Pools and Storable/Portable Spas and Hot Tubs



Photo courtesy of Bestway

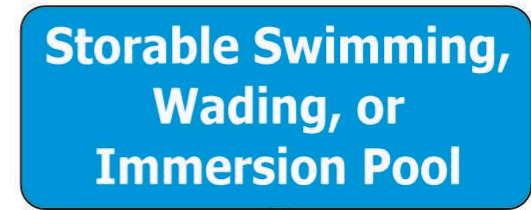


Photo courtesy of Summer Waves

The **42 in. depth** language has been removed
This now aligns with product manufacturing standards

Article 100 Definitions- Transformer

A new definition for a transformer has been created and added to the 2023 *NEC*

- ⚠ The word “transformer” occurs approximately 1500 times in the *NEC*
- ⚠ This new definition covers both single and polyphase equipment operating by electromagnetic induction
- ⚠ The definition was careful not to state “changing voltage or current” because isolating transformers filter noise without changing nominal voltages





Photos courtesy of IAEL Archives



Article 100 Definitions- Work Surface

A new definition was added to help users of the *Code* understand what constitutes a “**Work Surface**” location

- ⚠ There appears to be installer and enforcement **confusion** as well as **frequent product misapplications** resulting from electrical equipment being installed incorrectly on these surfaces (*Work surfaces involve lower volumes of spillage than countertops*)
- ⚠ The key distinction between a work surface and a countertop is the **quantity of spillage** that the surfaces may be subjected
- ⚠ The electrical professional will be directed to the industry standards that aid in the proper application of receptacles in these locations
- ⚠ See **Informational Note No. 1** for UL 111, *Outline of Investigation for Multioutlet Assemblies*, and UL 962A, *Furniture Power Distribution Units*
- ⚠ See **Informational Note No. 2** for information on receptacles for work surfaces distinguished from receptacles for counters and countertops



Article 100 Definitions- Work Surface

Work Surface

- A container with **8 oz of saline solution**, with 8 g of table salt per liter of distilled water
- Container is placed on the counter surface 12 inches from the sample
- Container is tipped over all at once with an effort to direct the spill toward the most disadvantageous area of the assembly

Countertop

- A container with **1/2 gallon of saline solution** with 0.28 ounce of table salt per liter of distilled water
- Container is placed on the counter surface 12 inches from the sample
- Container is tipped over all at once with an effort to direct the spill toward the most disadvantageous area of the assembly



Article 100 Definitions- Work Surface

- ⚠ Reference 406.5(E), 406.5(G)(1), and 406.5(H) for information on receptacles for counters and countertops distinguished from receptacles for work surfaces
- ⚠ 2020 NEC Introduced work surface and countertop recognizing the differences are important but there were no definitions for these terms (*210.11 & 210.52*)



Work Surface Locations

Listing of **receptacle assemblies for work surfaces** is based on the amount of liquid spillage verses that of a counter top location



Work surface photos courtesy of IAEI Archives

Note: Need to know what type surface you are dealing with in order to install the correct receptacle assembly

See UL 111, Outline of Investigation for Multioutlet Assemblies, and UL 962A, Furniture Power Distribution Units

Article 110

General Requirements for Electrical Installations

110.3 Examination, Identification, Installation, Use, and Listing (*Product Certification*) of Equipment.

(A) Examination

List Item 8: Changes addresses cybersecurity for network-connected life safety equipment




- ⚠️ Cybersecurity is a technology hazard that can cause many disturbances to electronic equipment
- ⚠️ Cybersecurity must be considered when evaluating equipment for safety
- ⚠️ Does not mandate that the electrical professional conduct a cybersecurity evaluation but to remember and recognize that it is a hazard



110.3 Examination, Identification, Installation, Use, and Listing (*Product Certification*) of Equipment.

(A) Examination

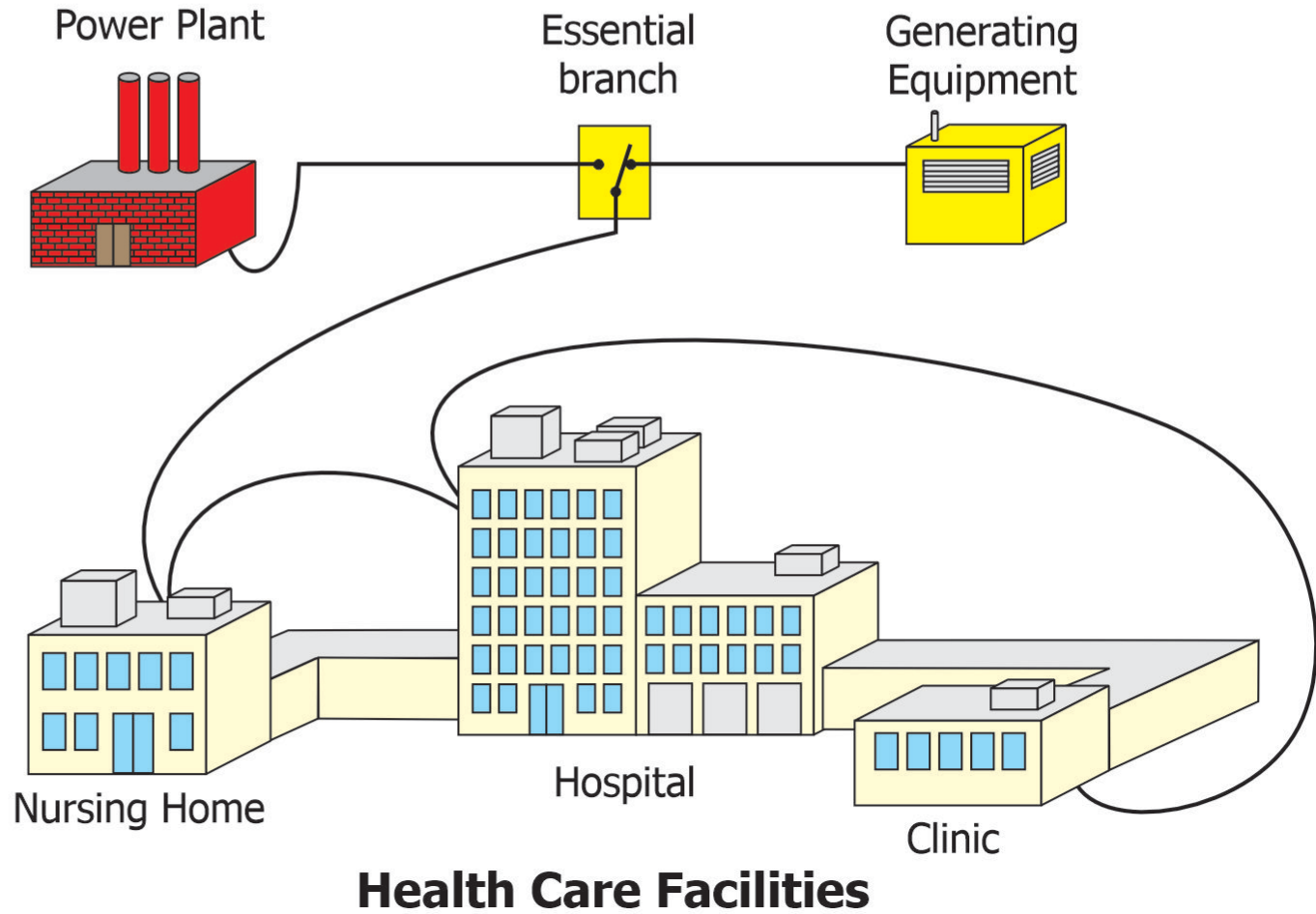
 **Informational Note No. 3** introduces the following valuable standards for consideration towards cybersecurity concerns for electrical equipment:

-  IEC 62443 series of standards for Industrial Automation and Control Systems
-  UL 2900 series of standards for Software Cybersecurity for Network-Connectable Products
-  UL 5500, the Standard for Remote Software Updates

110.3 Examination, Identification, Installation, Use, and Listing (*Product Certification*) of Equipment

Addresses cybersecurity for network-connected life safety equipment in (A) Examination (*list item 8*)

Does not mandate the electrical professional to conduct a cybersecurity evaluation but remember and recognize that it is a hazard



110.3 Examination, Identification, Installation, Use, and Listing (Product Certification) of Equipment.

(B) Installation and Use

A new informational note was added allowing the use of a QR code to access installation instructions

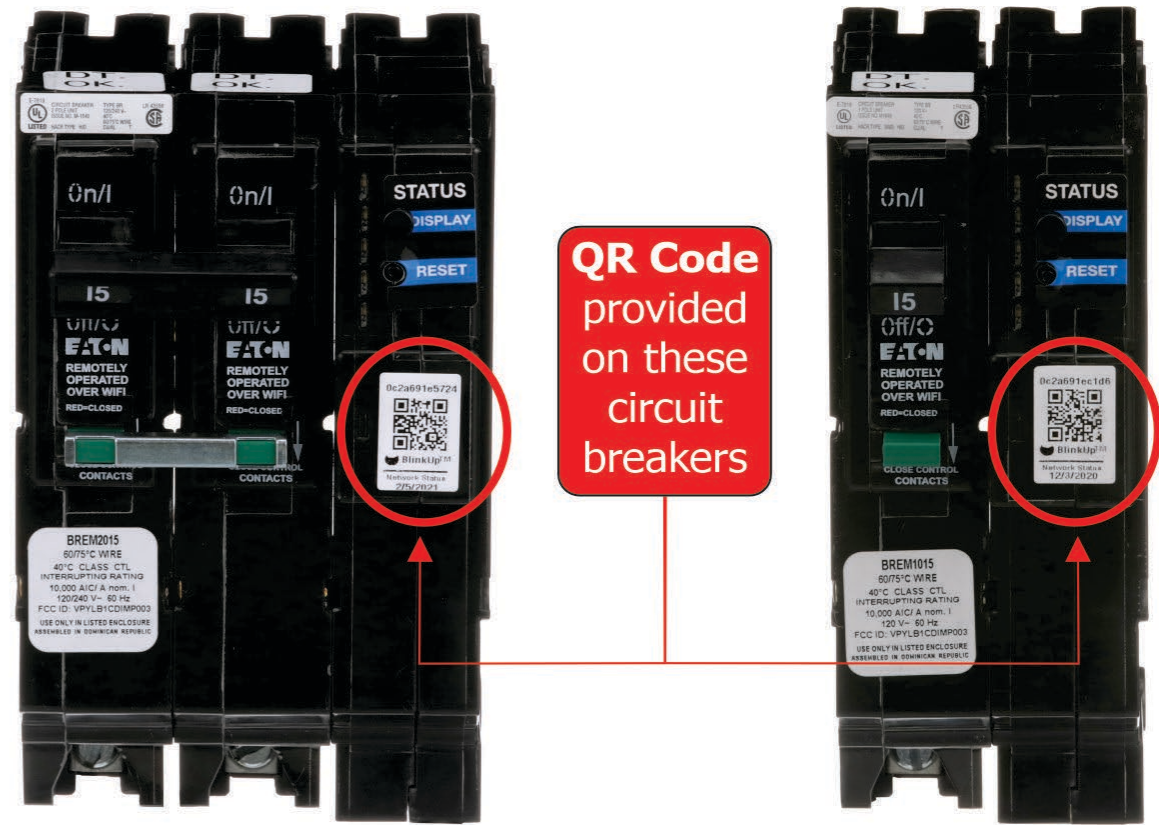
- ⚠ QR codes are appearing on many different items
- ⚠ These allow the user to access vast amounts of information about a product
 - 🔧 **An example:** Arc-Fault Circuit-Interrupters (AFCIs) allow the use of printed materials, **QR codes**, and internet addresses as avenues to find product information
- ⚠ New Informational Note assures the electrical professional that a QR code (*if available*) is allowable for use in finding this important information



110.3 Examination, Identification, Installation, Use, and Listing (Product Certification) of Equipment

Use of QR codes are now addressed in the New I-Note following (B) Installation of Use

Assures the electrical professional that a QR code (if available) is allowable for use in finding this important information



In case you are wondering, QR stands for “quick response”

Photos courtesy of Eaton

110.14 Electrical Connections

- ⚠️ Parent text removed parenthetical content: “(*such as copper and aluminum or aluminum and copper-clad aluminum*)”
- ⚠️ Copper and copper-clad aluminum are considered similar metals and not dissimilar metals as a CCA conductor
- ⚠️ Terminals are suitable for use with copper-clad aluminum conductors when evaluated for both copper and aluminum



110.14 Electrical Connections

(A) Terminals

“*Thoroughly good*” was replaced with “***mechanically secured***” for clarity and the word “*electrical*” was added for accuracy

- ⚠ Adds clarity as to what kind of connection (*mechanically secure electrical connection*) is being discussed as it applies to terminations found with various types of electrical equipment
- ⚠ The listing of the product will also determine the acceptability of the connection



110.16 Arc-Flash Hazard Warning

(B) Service Equipment/Feeder Supplied Equipment

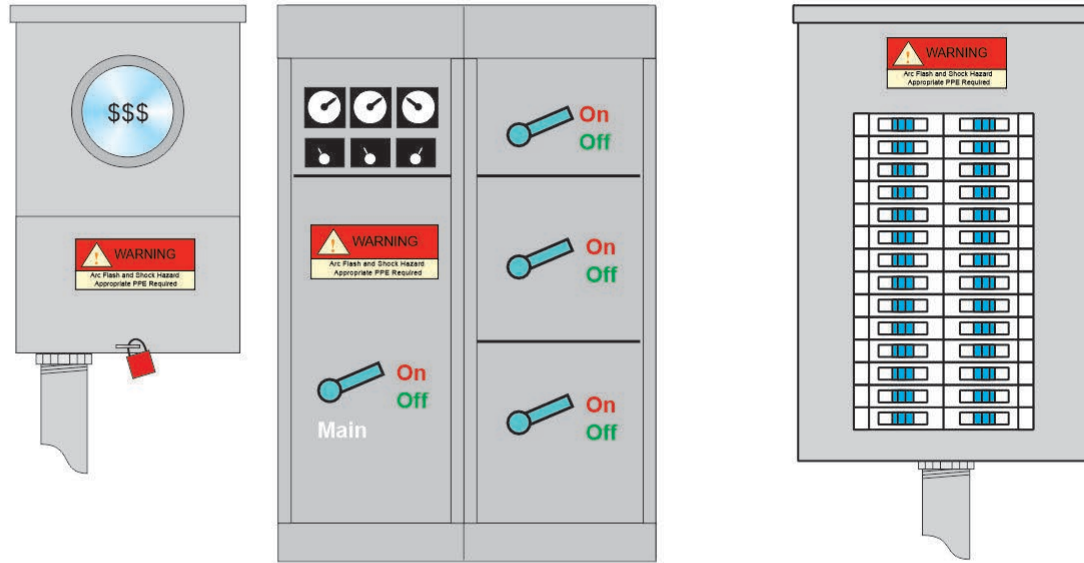
This adds “Feeder Supplied Equipment” to the title, adds the phrase “arc flash” for the type of permanent label required, and reduces 1200 to 1000 amperes for equipment rating amperes

- ⚠ Clarifies that the requirements apply to both service equipment and feeder-supplied equipment
- ⚠ It was necessary to add the phrase “arc flash” to clarify the type of permanent label required for this equipment
- ⚠ The revision from 1200 to 1000 amperes will protect worker safety
- ⚠ The four previous list items and exception were deleted, and now references label to meet applicable industry practice



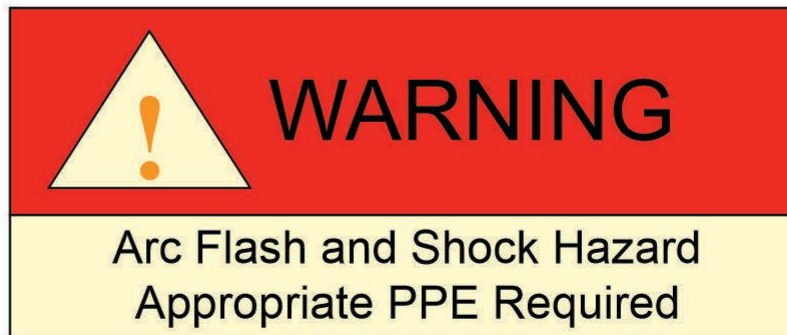
110.16(B) Service Equipment/Feeder Supplied Equipment

“Feeder Supplied Equipment” added to the title, “arc flash” added for the type of permanent label required, and reduced 1200 to 1000 amperes



Service Equipment

Feeder Equipment



Clarifies that the requirements apply to both service equipment and feeder-supplied equipment

Made sure that the electrical professional understood the label was for an “arc flash”


Revised **1200 amperes down to 1000 amperes** to provide greater safety to the worker

*Not all required warning labels shown

110.16(B) Service Equipment/Feeder Supplied Equipment

“Feeder Supplied Equipment” added to the title, “arc flash” added for the type of permanent label required, and reduced 1200 to 1000 amperes

Arc flash label is required to contain the following information

 WARNING	
Arc Flash and Shock Hazard Failure to comply can result in death or serious injury. Refer to NFPA 70E. Appropriate PPE Required.	
Nominal System Voltage:	<u>480 VAC</u>
Available Fault Current:	<u>23.3 kA</u>
Clearing Time of Service OCPD:	<u>0.03 sec (2 cycles)</u>
Date Label Applied:	<u>08/01/16</u>
Equipment ID: <u>Production Panel 420</u>	
Sidewinder Electrical Contractors Celina, TX 800-444-1212	

110.17 Servicing and Maintenance of Equipment

A new section addresses servicing and maintenance of electrical equipment and restricts this work to qualified persons trained to perform the work

- ⚠ Requires the use of identified replacement parts that have been verified per applicable product standards
- ⚠ A list of these options is provided for approval of these replacement parts
- ⚠ Parts are to be provided by either the original equipment manufacturer (*OEM*), designed by an engineer with applicable experience, or as approved by the AHJ
- ⚠ Manufacturer's instructions and any additional information included in the listing must be utilized
- ⚠ The applicable industry standards should also be consulted for additional information
- ⚠ See *NFPA 70B, The Recommended Practice for Electrical Equipment Maintenance*



110.17 Servicing and Maintenance of Equipment

New section addresses servicing and maintenance of electrical equipment and **restricts this work to qualified persons trained to perform the work**

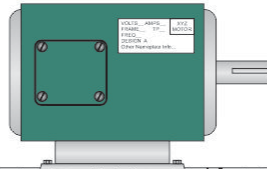
Requires the use of identified replacement parts that have been verified per applicable product standards

Parts are to be provided by either the:

- original equipment manufacturer (*OEM*)
- designed by an engineer with applicable experience or
- as approved by the AHJ

See NFPA 70B, The Recommended Practice for Electrical Equipment Maintenance

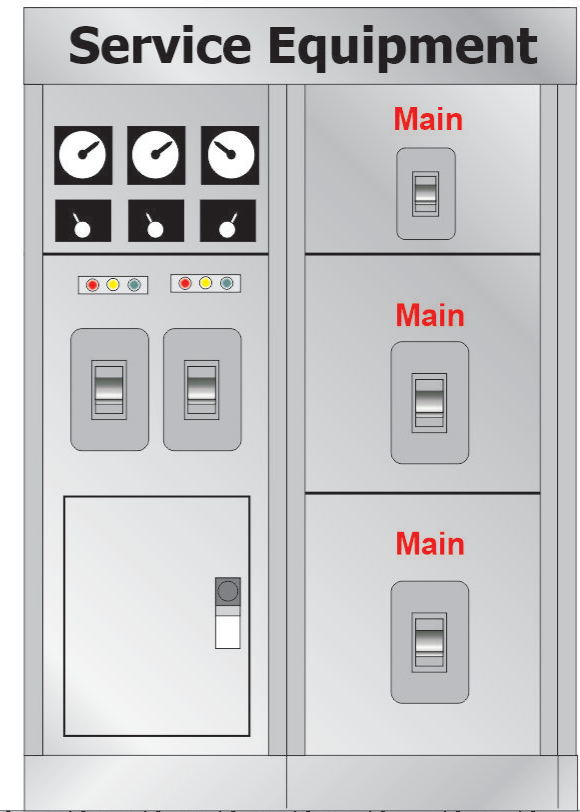
Motor



Transformer



Service Equipment



Various Types of Electrical Equipment

Working safely is important!
Please disconnect electricity
to equipment you are
working on.

Refer to NFPA
70E for further
information



Wear your Personal
Protection
Equipment (PPE)
when necessary

Photo courtesy
of Bill McGovern



Photo courtesy
of Scott Humphrey

110.20 Reconditioned Equipment

A new section for the establishment of general requirements that will apply to all equipment that is reconditioned

- ⚠ Requires the use of identified replacement parts verified under applicable standards, provided by the original equipment manufacturer (*OEM*) or designed by an engineer with applicable experience
- ⚠ **When equipment is to be listed**, reconditioned equipment must be listed, or a field label applied stating it has been reconditioned using information from the OEM
- ⚠ **When equipment is not required to be listed**, two options exist:
 - 🔧 The first states that the equipment can be listed or field labeled as reconditioned
 - 🔧 The second states that the equipment can be reconditioned per the instructions provided by the OEM



110.20 Reconditioned Equipment (cont.)

A new section for the establishment of general requirements that will apply to all equipment that is reconditioned

- ⚠ A third option (C) is permitted when either option (A) or (B) will not work:
 - ✎ The authority having jurisdiction (AHJ) is permitted to approve reconditioned equipment when listing, field labeling, and OEM guidance are not available
- ⚠ This grants the AHJ the ability to review the documentation regarding the changes that have been made to the equipment
- ⚠ Based on this review, the AHJ may be able to approve the equipment



110.20 Reconditioned Equipment

New section for the establishment of general requirements that will apply to all equipment that is reconditioned

When equipment is not required to be listed, three options exist:

Option A

- it can be listed, or field labeled as reconditioned

Option B

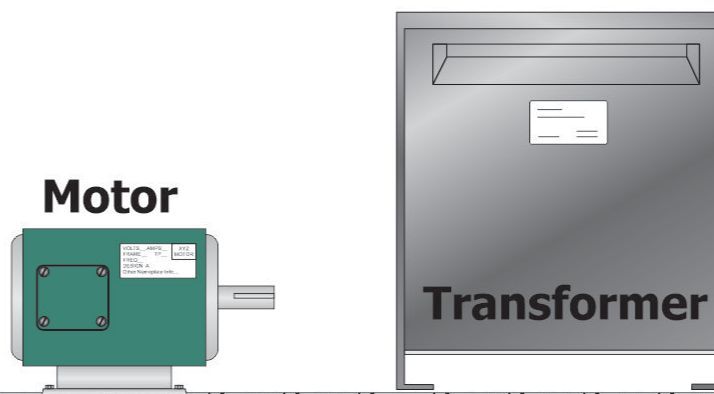
- the equipment can be reconditioned per the instructions provided by the OEM

Option C is permitted when either option (A) or (B) will not work:

- The AHJ is **permitted to approve** reconditioned equipment when listing, field labeling, and OEM guidance is not available

When equipment is to be listed:

- reconditioned equipment must be listed or
- a field label applied stating it has been reconditioned using information from the OEM



Major flooding resulted in damage to these circuit breakers.

Not all circuit breakers can be reconditioned.

(P.S.- the use of WD-40 is not the solution either!)



*Photo courtesy of Danny King,
City of Fort Smith Arkansas*

The harsh reality:

Sometimes, things just cannot be reconditioned and must be replaced

Large hail event- Plano, Texas



Photos courtesy of Bill McGovern

110.21 Marking

(A) Marking- (1) General

Changes to requirements for equipment marking to clarify how to apply or affix labels on all electrical equipment

- ⚠ Clarifies how to apply labels on electrical equipment for the safety of the equipment
- ⚠ There is a need to apply or affix labels onto the equipment instead of using the term “placed on the equipment”
- ⚠ This will make sure the label stays there permanently and does not fall off with the passage of time
- ⚠ Must be evaluated as to the longevity of these labels in the various environment in which the equipment is placed into service

110.21(A)(1) General (*Equipment Labels*)

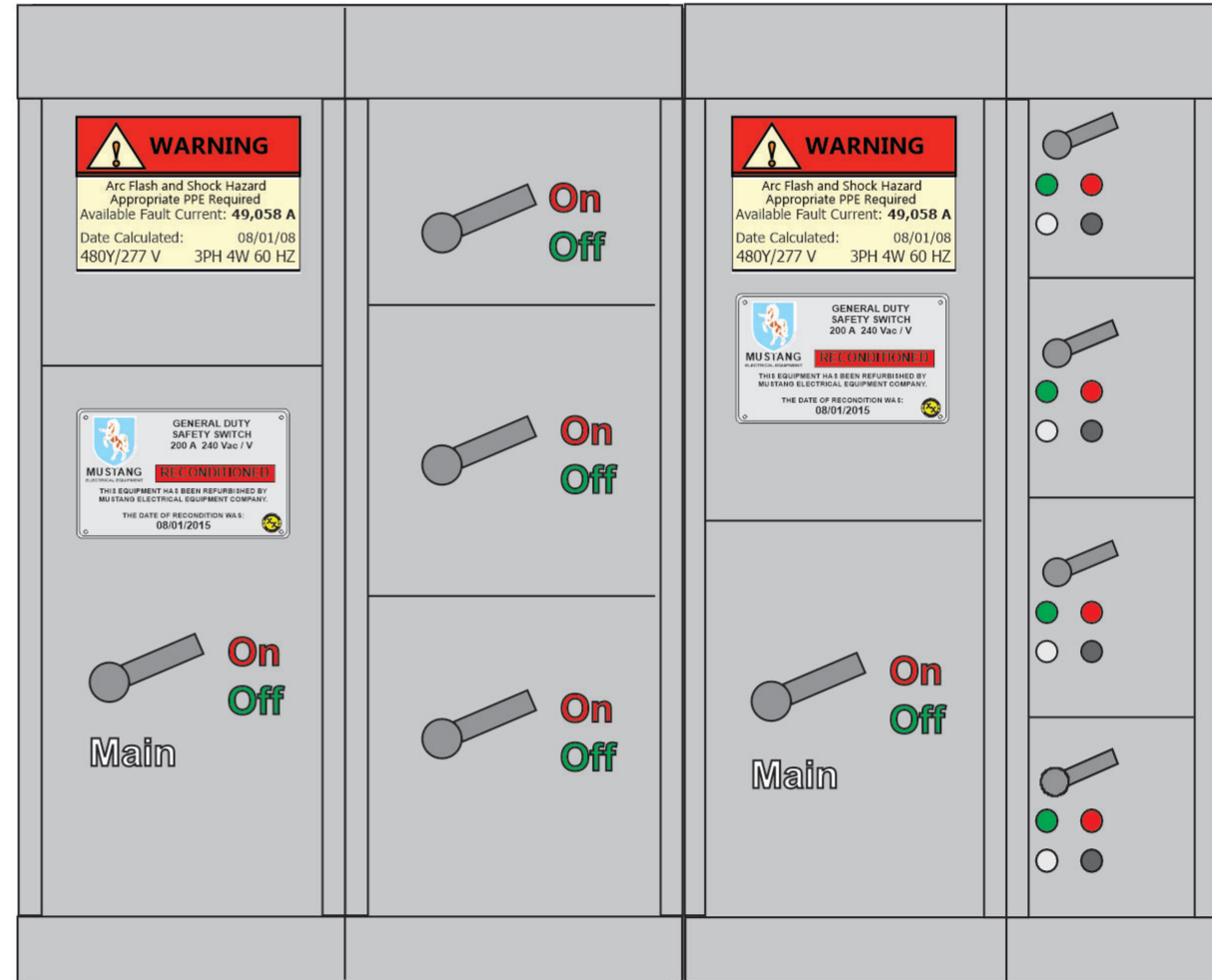
Clarified requirements for equipment marking for affixing labels on all electrical equipment

Labels need to be **affixed** to electrical equipment

Label needs to remain with the equipment for the life of the installation

The **environment of the equipment** (*rain, ice, snow, corrosion, etc*) must be considered

Items such as rivets or bolts with nuts may be needed



110.21 Marking

(A) Marking- (2) Reconditioned Equipment

Has reorganized information into a list format and clarifies that the original listing mark is to be removed or made permanently illegible

- ⚠ The information previously found in a sentence format has been placed into a list format making it easier to follow and understand
- ⚠ Clarification that the original listing mark is to be removed or made permanently illegible
- ⚠ Clarifies the misunderstanding by some that the nameplate should be removed
- ⚠ This assures that important information stays with the equipment for future use
- ⚠ Further clarifies that the approval of this equipment should not be based on the original listing mark



110.21(A)(2) Reconditioned Equipment

Reorganized information into a list format and clarifies that the **original listing mark is to be removed or made permanently illegible**

Original listing mark



Original listing mark scratched out

Original listing marks made permanently illegible

Original listing mark scratched out on the equipment nameplate
 This assures that important information stays with the equipment for future use

Original listing marks



HPS Sentinel® G
 Energy Efficient Distribution Transformer
 Transformateur de Distribution à Bon Rendement Énergétique

Hammond Power Solutions
 Guelph, ONT Compton, CA Baraboo, WI Monterrey, MX

Part No. **SG3A0075DB**

Cust. Ref. Ref. du Client	Serial No. No. de Serie	CB00981468	VOLTS	CURRENT COURANT	% RATED VOLTAGE % TENSION NOMINALE	CONNECTION EACH PHASE CONNEXION PAR PHASE	VENTILATED ENCLOSURE PANEL AND ANY ADJACENT WALL SHALL BE A MINIMUM OF 5 INCHES EXCEPT WHEN WALL MOUNTED USING APPROVED WALL MOUNTING KIT
Phase	HV/HT	240V	252	172	105	1	
Type	BIL	10 kV	246	176	102.5	2	
Cooling Refroidissement	Term Bornes	H1 H2 H3	240	180	100	3	
kVA	LV/BT	208Y/120V	234	185	97.5	4	
Temp. Rise Echauffement	BIL	10 kV	228	190	95	5	
Temp Class Classe Temp	Term Bornes	X0 X1 X2 X3	222	195	92.5	6	
Winding Enroulement	Energy Regulations Règlements de Energetique	DOE 10 CFR PART 431:2016	216	200	90	7	

SEISMIC QUALIFICATIONS, OSP-0136-10 AS FLOOR MOUNT ONLY IBC 2012/ASCE 7-10 SDS <= 2.0g Z/h=1 Ip=1.5 H19NH

110.21 Marking

(B) Field-Applied Hazard Marking

List Item 1: Language added regarding durability for hazard marking labels and signs for electrical equipment installed in various environments

- ⚠ A field-applied hazard marking is an important sign or label
- ⚠ It is important this **marking is durable** to remain with the electrical equipment in environments that are wet, damp, dry, or even corrosive
- ⚠ This applies to signs and labels attached to items such as ingress and egress doors to areas that contain electrical equipment
- ⚠ In some environments this might include the use of rivets to ensure these hazard markings (**caution, warning, or danger**) are securely attached
- ⚠ See Informational Note No. 1 *ANSI Z535.2-2011 (R2017), Environmental and Facility Safety Signs*
- ⚠ **Note:** *Be sure screws or rivets comply with the new rules in 312.10 and 314.5*



110.21(B)(1) Field-Applied Hazard Marking

Language added regarding durability for hazard marking labels and signs for electrical equipment installed in various environments

It is important that this marking is durable to remain with the electrical equipment

In some environments this might include the use of screws, bolts and nuts, or rivets

DANGER indicates a hazardous situation which, if not avoided, **will result** in death or serious injury

WARNING indicates a hazardous situation which, if not avoided, **could result** in death or serious injury

CAUTION indicates a hazardous situation which, if not avoided, **may result** in minor or moderate injury



See ANSI Z535.2-2011 (R2017), *Environmental and Facility Safety Signs* for additional information



! DANGER

**HAZARD OF ELECTRIC SHOCK,
EXPLOSION OR ARC FLASH**

- Apply appropriate personal protective equipment (PPE) and follow safe electrical work practices. See NFPA 70E or CSA Z462.
- This equipment must be installed and serviced only by qualified electrical personnel.
- Turn off all power supplying this equipment before working on or inside equipment.
- Always use a properly rated voltage sensing device to confirm power is off.
- Replace all devices, doors and covers before turning on power to this equipment.

Failure to follow these instructions will result in death or serious injury.



WARNING

**CITY OF MESA STREETLIGHTS
120/240 VAC SINGLE PHASE**

- > ARC FLASH HAZARD**
- > APPROPRIATE PPE REQUIRED**
- > FAILURE TO COMPLY CAN RESULT IN DEATH OR INJURY**
- > REFER TO NFPA 70E**
- > EMERGENCY CONTACT: 480-644-2262**

SERVICE
DISCONNECT



EATON[®]

ON

General Duty Safety Switch
Interrupteur de sécurité à usage général
Interruptor de seguridad de servicio general
600 A, 240 V~, 60 Hz, 250 V ---

Complete Ratings Inside. Further instructions inside.
 Valeurs nominales complètes à l'intérieur. Autres instructions à l'intérieur.
 Información completa de capacidades en el interior. Instrucciones adicionales en el interior.

⚠ DANGER
HAZARDOUS VOLTAGE. WILL CAUSE SEVERE INJURY OR DEATH.
 • Never operate switch with cover open.
 • Turn OFF power ahead of switch before doing any work inside. Replace all parts. Close cover before turning power ON.

TENSION DANGEREUSE. PEUT CAUSER DES BLESSURES GRAVES OU LA MORT.
 • Ne jamais manœuvrer l'interrupteur lorsque le couvercle est ouvert.
 • Couper l'alimentation en amont de l'interrupteur avant toute intervention. Remplacer les pièces. Fermer le couvercle avant de remettre sous tension.

⚠ PELIGRO
VOLTAJE PELIGROSO. PUEDE CAUSAR HERIDAS SEVERAS O LA MUERTE.
 • Nunca opere el interruptor con la cubierta abierta.
 • Desconectar la alimentación del interruptor antes de trabajar dentro del mismo. Reemplazar todas las partes. Cerrar la cubierta antes de energizar el interruptor.

OFF

Made in U.S.A. / Fabriqué aux É.-U. / Hecho en E.U.A. 30-43100-3

A couple of caution signs meaning that this may result in minor or moderate injury

CAUTION
 COVER SCREWS MUST BE SECURED BEFORE
 TURNING SWITCH "ON"

AVERTISSEMENT
 S'ASSURER QUE LES VIS DU COUVERCLE SONT BIEN
 SERRÉES AVANT DE METTRE SOUS TENSION


PRECAUCION
 LOS TORNILLOS DE LA CUBIERTA DEBEN ESTAR BIEN
 ASEGURADOS ANTES DE ENCENDER EL INTERRUPTOR



CAUTION: TURN OFF ALL INTEGRAL
DISCONNECTS BEFORE SERVICING
CAUTION: RISK OF FIRE AND ELECTRIC SHOCK
THIS PRODUCT BE INSTALLED BY THE PERSON
FAMILIAR WITH THE CONSTRUCTION AND
OPERATION OF THE PRODUCT AND THE
HAZARDS INVOLVED IN ACCORDANCE
WITH THE APPLICABLE INSTALLATION CODE

Some colors and signage can deteriorate over time and in harsh environments.

Consult industry standards for assistance with installing labels and signs.

A photograph of a light blue metal electrical cabinet. On the front panel, there is a rectangular red warning label with white text. The text on the label reads: "WARNING. ELECTRIC SHOCK HAZARD. DO NOT TOUCH TERMINALS. TERMINALS ON BOTH THE LINE AND LOAD SIDES MAY BE ENERGIZED IN THE OPEN POSITION." The label shows signs of fading and wear. The cabinet has a handle on the left side and a latch at the bottom center. There are two screws visible at the bottom of the cabinet.

WARNING.
ELECTRIC SHOCK HAZARD.
DO NOT TOUCH TERMINALS.
TERMINALS ON BOTH THE LINE AND
LOAD SIDES MAY BE ENERGIZED
IN THE OPEN POSITION.

Photo courtesy of IAEI Archives

110.22 Identification of Disconnecting Means

(A) General

This change helps determine when the identification of a disconnecting means is required or not required

- ⚠ Clarifies that identification of disconnecting is not required when the location of the circuit source is evident
- ⚠ Marking is to include the identification and location of the circuit source that supplies the disconnecting means
 - ✎ **unless** the equipment is located and arranged so that the identification and location of the circuit source is evident
- ⚠ An example could be the disconnecting means for a water heater or furnace installed close to an electrical panel enclosing the disconnecting means



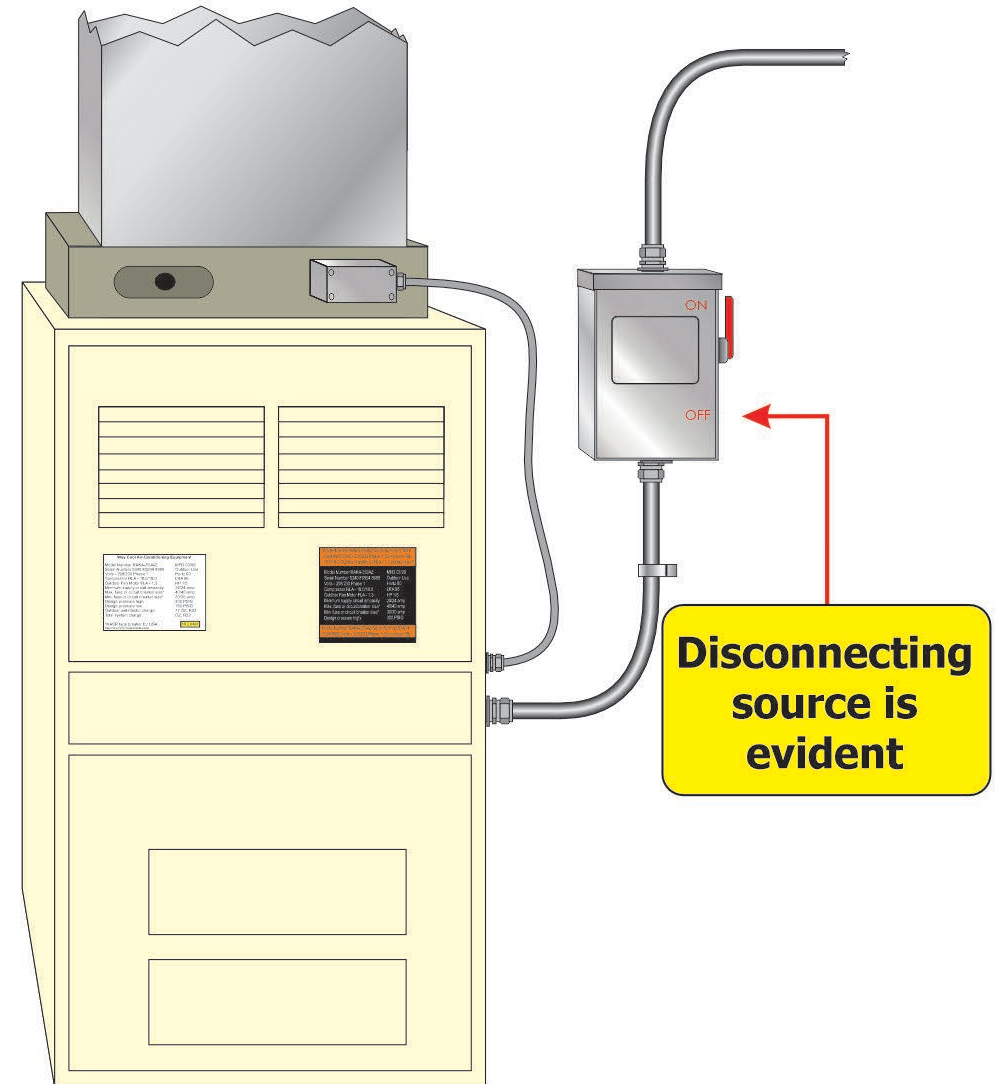
110.22(A) General (*Disconnecting Means*)

This helps determine when the identification of a disconnecting means is required or not required

At a single family dwelling
the disconnect source is
evident from the unit
being serviced

Testing for the absence
of electricity before
troubleshooting the unit

In other than one- and two-family
dwelling, marking shall include the
identification and location of the
source circuit supplying the
disconnecting means



110.26 Spaces About Electrical Equipment

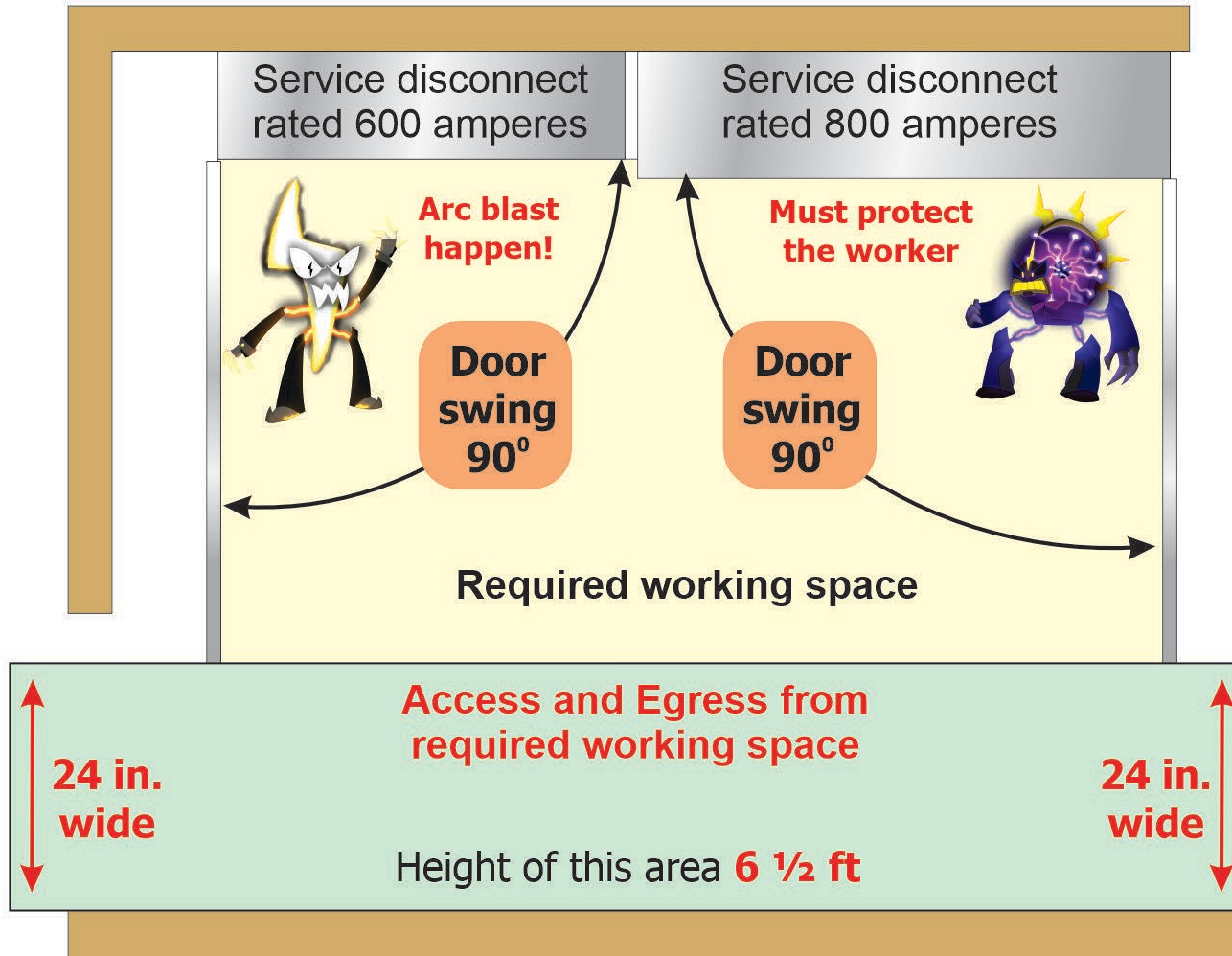
This change concerns equipment doors and their interference with egress and access from the working space moved from 110.26(C)(2)

- ⚠ Many instances of electrical equipment installations violate the previous Code language involving this working space (*entrapment when doors are open*)
- ⚠ Worker entrapment by equipment doors can cause serious injury or death
- ⚠ This change recognizes open equipment doors can impede egress from electrical equipment when dangerous situations arise (*arc blast, etc.*)
- ⚠ Access and egress **are impeded** if an equipment door(s) is opened and **restricts** the working space access to **less than 610 mm (24 in.) wide and 2.0 m (6 ½ ft) high**
- ⚠ This rule also applies to the space between two simultaneously opened doors on opposite sides of the aisleway



110.26 Spaces About Electrical Equipment

This change recognizes open equipment doors can impede egress from electrical equipment when dangerous situations arise (*arc blast, etc.*)



Open equipment doors **not to impede** the access or egress from the working space

Access and egress **is impeded** if an equipment door(s) is opened and restricts the working space access to **less than 610 mm (24 in.) wide and 2.0 m (6 1/2 ft) high**

110.26 Spaces About Electrical Equipment

(A) Working Space- (6) Grade, Floor, or Working Platform

Addresses the working space conditions of the floor at electrical equipment locations

- ⚠ Floor conditions were not addressed by the previous editions of the *Code*
- ⚠ This could be slope of grade or other impediments
- ⚠ These conditions are safety issues for workers that must perform work on electrical equipment
- ⚠ AHJ needed this guidance so that the initial installation is installed in a compliant manner



110.26(A)(6) Grade, Floor, or Working Platform

Floor conditions can present safety issues for workers that must perform work on electrical equipment

This photo is a parking garage

Notice wheel stop in front of electrical equipment

Could pose a tripping hazard injuring the worker



Photo courtesy of IAEI Archives



110.26(A)(6) Grade, Floor, or Working Platform

Floor conditions can present safety issues for workers that must perform work on electrical equipment

Exterior location with electrical service equipment

Surface grade appears to be in good shape to assure worker safety



Photo courtesy of IAEI Archives



110.29 In Sight From (*Within Sight From, Within Sight*)

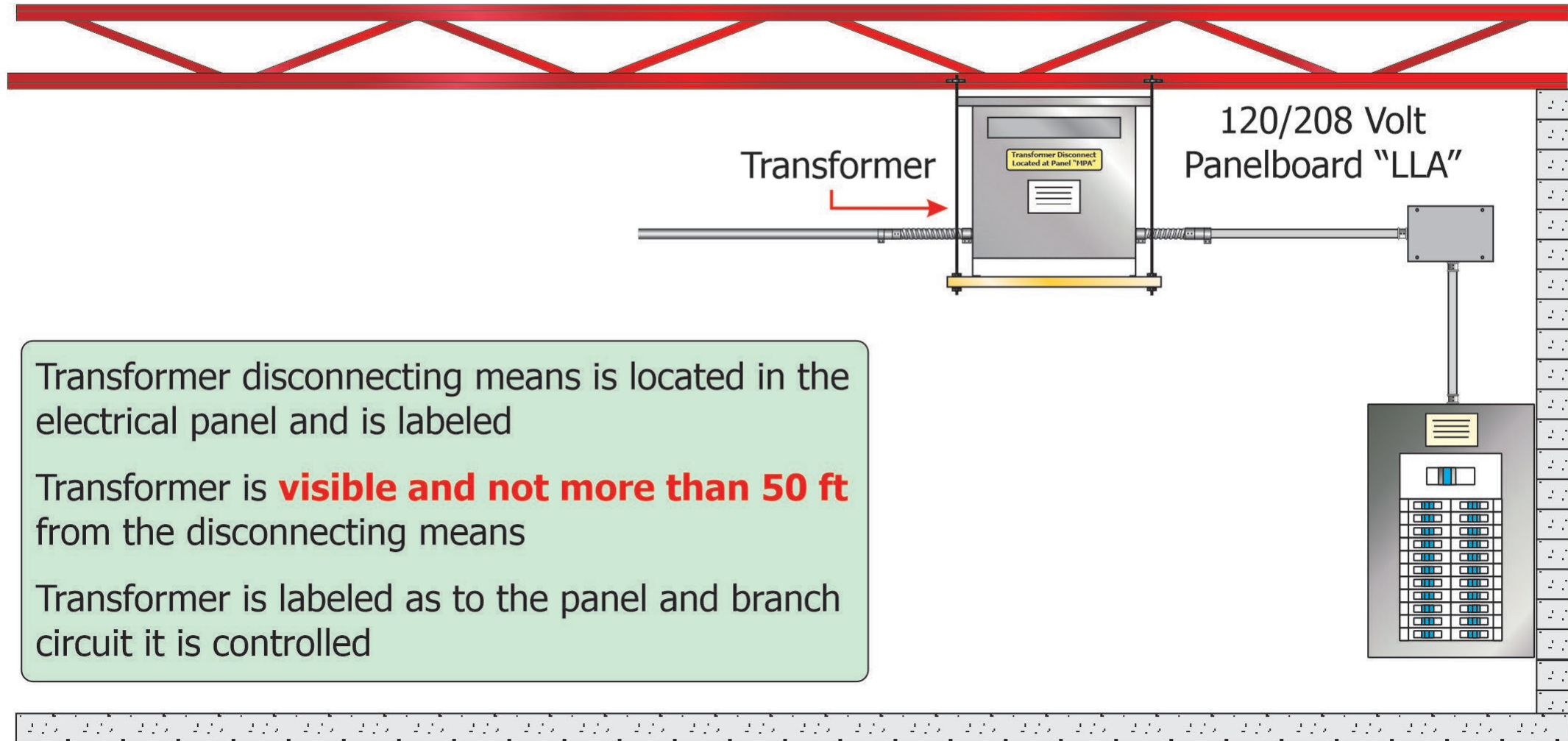
New Section 110.29 has been added to address electrical equipment and the term “In Sight From”

- ⚠️ “In sight from,” “Within Sight From,” and “Within Sight” appears several times throughout the *NEC*
- ⚠️ This sections adds applicability and useability of these phrases
- ⚠️ Addresses *NEC Style Manual* issues that state definitions shall not contain requirements or recommendations
- ⚠️ Distance is to be **visible** and **not more than 15 m (50 ft)** from the other equipment
- ⚠️ Reference defined term in Article 100: “In Sight From (*Within Sight From*) (*Within Sight*)”



110.29 In Sight From (*Within Sight From, Within Sight*)

Distance is to be visible and not more than 15 m (50 ft) from the other equipment



Transformer disconnecting means is located in the electrical panel and is labeled

Transformer is **visible and not more than 50 ft** from the disconnecting means

Transformer is labeled as to the panel and branch circuit it is controlled

110.33 Entrance to Enclosures and Access to Working Space

(A) Entrance

Access to and egress from working space for equipment over 1000 volts, nominal, have been revised and clarified

- ⚠ Very similar to changes discussed for 110.26 concerning arc blast scenarios
- ⚠ It has been substantiated that access or egress is impeded by opened equipment doors in some situations
- ⚠ Conditions that restrict working space access or egress to less than 610 mm (24 in.) wide and 2.0 m (6 ½ ft) high make it a safety concern for the worker due to entrapment
- ⚠ The entrapment is between equipment doors opened simultaneously with the worker trapped within, leaving no egress path





DANGER
Hazardous voltage
Risk of shock, burn,
or severe death.
Keep out
if open or unlocked,
immediately call
electric power and
light company.

DANGER
NO SAFE PPE EXISTS
EMERGENCY WORK PROHIBITED
24 inches High Voltage Circuit
18 inches High Voltage
4000 VAC
12 inches High Voltage
18 inches High Voltage
18 inches High Voltage
Location: PWS-00 SWR

Photo courtesy of Scott Humphrey

110.34 Working Space and Guarding

(A) Working Space

Addresses the condition of the work surface making up the floor, grade, or platform area within the working space of electrical equipment 1000 volts, nominal, and above

- ⚠ Very similar to 110.26(A)(6) for 1000 volts or less conditions
- ⚠ Clarifies that the working clearance space shall be kept clear, level, and flat as practical for the entire required depth and width of the working space
- ⚠ This will help ensure the safety of the worker
- ⚠ This needs to be addressed by the installer and authority having jurisdiction (AHJ) at the time of installation and inspection to assure safety during the life of the electrical installation



Photo courtesy of Scott Humphrey

Chapter 2

Wiring and Protection

- Article 210
- Article 215
- Article 220
- Article 225
- Article 230
- Article 235
- Article 240
- Article 242
- Article 245
- Article 250

Article 210

Branch Circuits Not Over 1000 Volts ac, 1500 Volts dc, Nominal

210.2 Reconditioned Equipment

The information concerning reconditioned equipment (*as it applies to branch circuits*) has been relocated from 210.15 to 210.2

- ⚠ Reconditioned equipment text has been reviewed and modified to remove redundant language in accordance with *NEC Style Manual* Section 4.1.1
- ⚠ The *NEC* Correlating Committee recommended for CMP-2 to move reconditioned equipment information to a standardized placeholder found within the various articles that mentioned this topic to improve the useability of the *Code*
- ⚠ See information at 110.20 entitled *Reconditioned Equipment* for additional information
- ⚠ **Note:** The xxx.2 sections within various chapters have become placeholders for information concerning reconditioned equipment



210.2 Reconditioned Equipment

The information concerning reconditioned equipment has been relocated from 210.15 to 210.2



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

210.8 Ground-Fault Circuit-Interruption Protection for Personnel

The GFCI is now required to be listed

- ⚠ Measurements clarified the cord is a power supply cord
- ⚠ *NEC Style Manual* influenced: Informational notes pointing to 422.5(A), 555.35(F) and the additional GFCI requirements found in Chapters 4, 5, and 6
- ⚠ Informational note pointing to 215.9 GFCI permissions for locating GFCI in the feeder remained



210.8 Ground-Fault Circuit-Interruption Protection for Personnel

(A) Dwelling Units

(3) Outdoors

- ⚠ Exception to (3) was moved to the end of (A) expanding the exception beyond just those receptacles found outdoors.
- ⚠ It doesn't matter if the receptacle is located outside or not, if they are not readily accessible and on a branch circuit dedicated for electric snow-melting, deicing, or pipeline and vessel heating equipment
- ⚠ The reference to 426.28 or 427.22 are still included as a permission



210.8 Ground-Fault Circuit-Interruption Protection for Personnel

(A) Dwelling Units

(5) Basements

- ⚠ Exception to (5) was moved to the end of 210.8(A) as Exception No. 2
- ⚠ This move recognizes that a receptacle supplying only a permanently installed premises security system is not required to be protected by GFCI regardless of its location
- ⚠ The reference to the fire alarm system and the informational notes were removed to align with the *NEC Style Manual* as 760.41(B) and 760.121(B) prohibit the branch circuit supplying this receptacle and equipment from being supplied through a GFCI or AFCI



210.8 Ground-Fault Circuit-Interruption Protection for Personnel

(A) Dwelling Units- (6) Kitchens

Ground-fault circuit-interrupter (*GFCI*) protection has been expanded to include any cord-and-plug equipment in the kitchen, regardless of whether the outlet serves the countertop

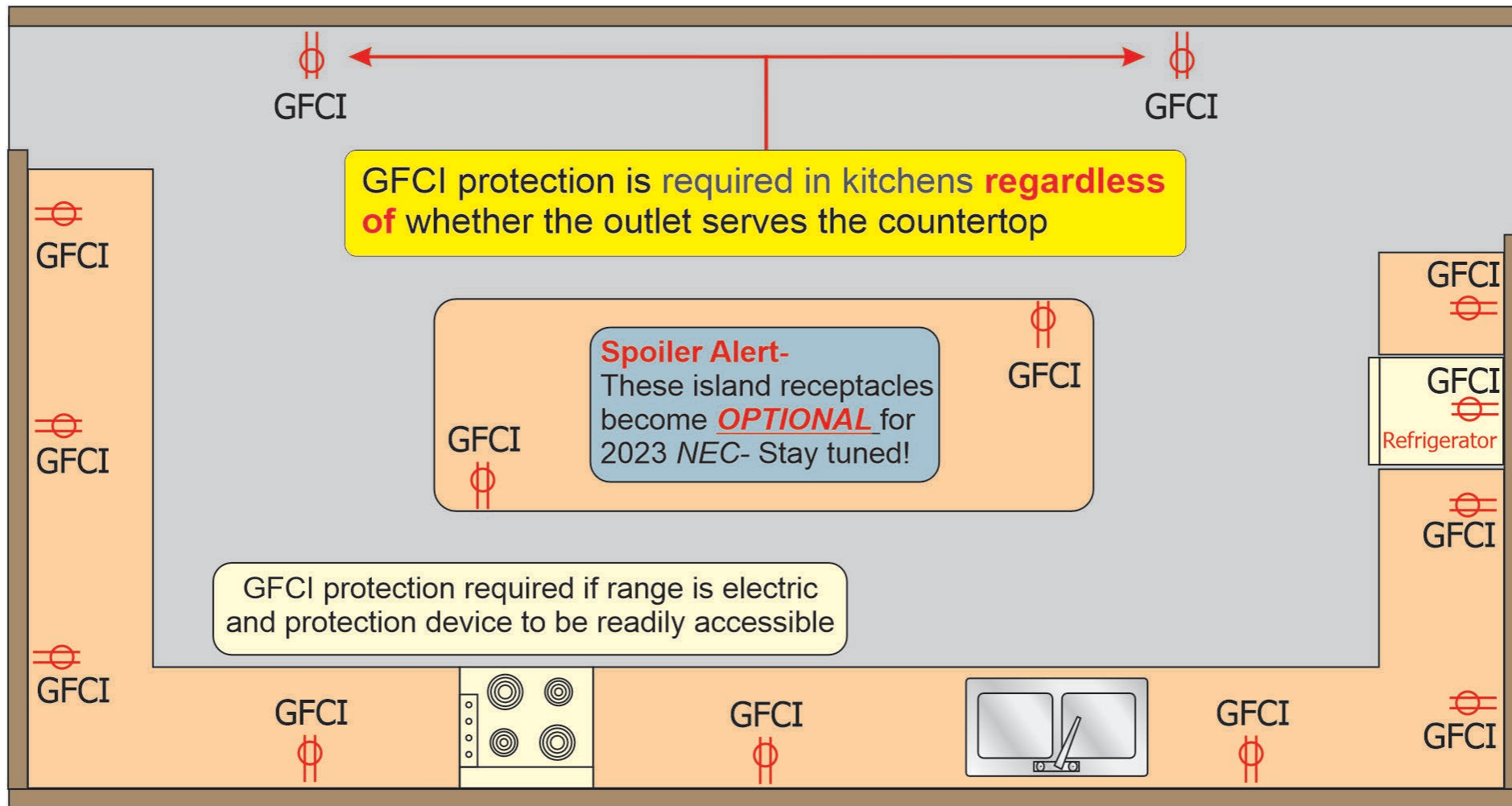
- ⚠ There have been 104 electrocutions that have taken place from 2011 to 2022 based on the Consumer Products Safety Commission (*CPSC*) database
- ⚠ Eighty-one percent of these accidents were from working on an appliance or other equipment
- ⚠ GFCI protection is required within a kitchen for receptacles that are
 - 🔌 125-volt through 250-volt and
 - 🔌 supplied by single-phase branch circuits rated 150 volts or less



210.8(A)(6) Dwelling Unit Kitchens

Ground-fault circuit-interrupter (*GFCI*) protection required for receptacles in a kitchen

- All 125-volt through 250-volt receptacles
- single-phase branch circuits rated 150 volts or less to ground



210.8 Ground-Fault Circuit-Interruption Protection for Personnel

(A) Dwelling Units

(7) Areas with sinks and permanent provisions for food preparation, beverage preparation, or cooking

⚠ Added as an alignment with similar requirement found in 210.8(B)

⚠ **Example of impact:** A dry bar in the living room or dining room would require that area to have all receptacles be protected by GFCI





A dry bar in the living room or dining room would require that area to have all receptacles be GFCI protected

210.8 Ground-Fault Circuit-Interruption Protection for Personnel (*cont.*)

(A) Dwelling Units (*cont.*)

Exception 4: A new Exception No. 4 will help the electrical professional address ground-fault circuit-interrupter (*GFCI*) protection requirements for factory-installed exhaust fans and their receptacles

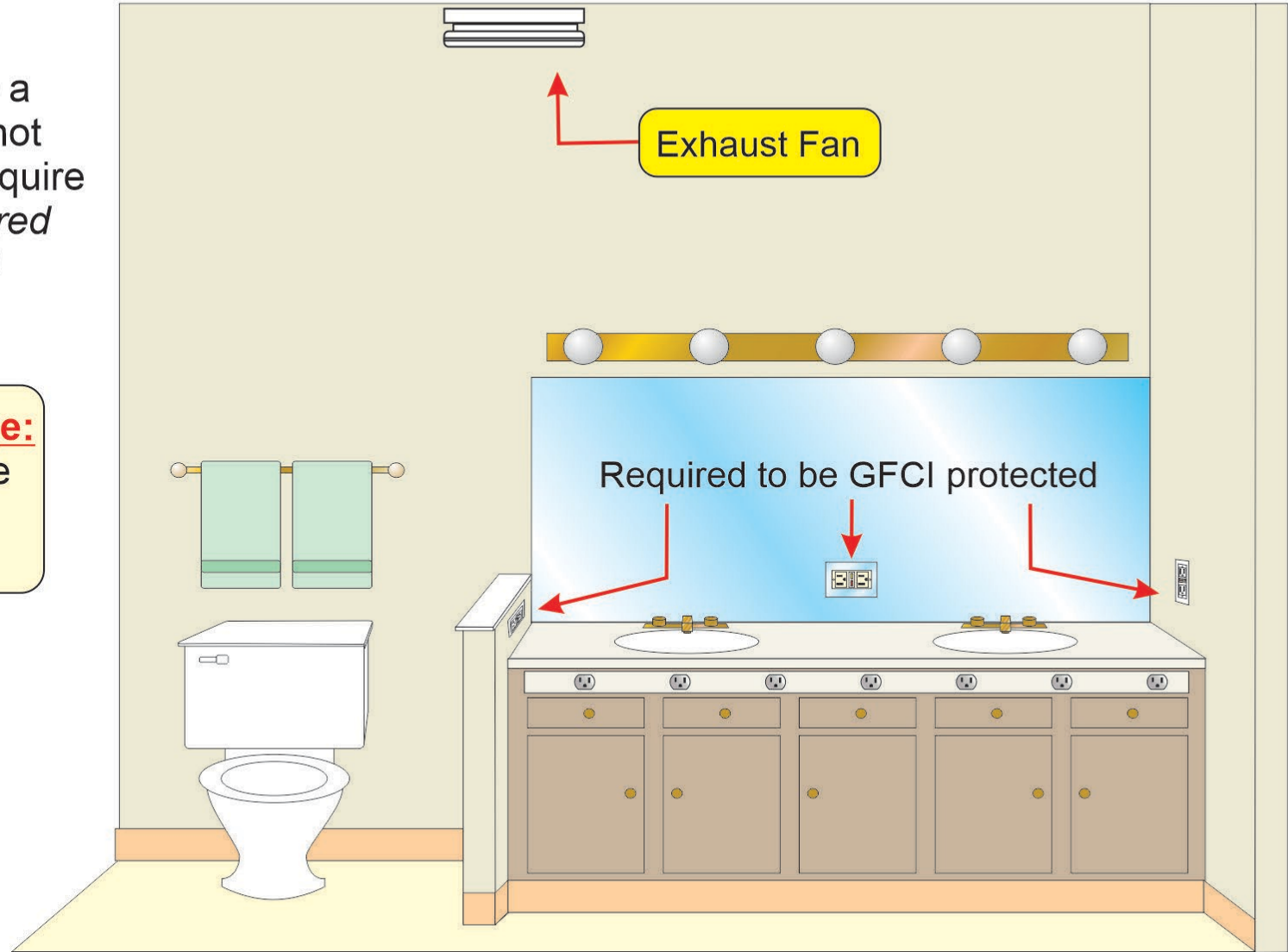
- ⚠ There was confusion as to if a receptacle found within an exhaust fan installed in the bathroom required GFCI protection
- ⚠ This receptacle is typically installed within a fan unit and is not accessible or interactable with people
- ⚠ This will help reduce arguments and misunderstandings in the field
- ⚠ Language specifies that exhaust fans are not readily accessible and that the receptacles be installed integral to the fan assembly



210.8(A) Ex. No. 4- GFCI Protection of Bathroom Receptacles

A receptacle outlet internal to a bathroom exhaust fan that is not readily accessible does not require GFCI protection (*unless required by the manufacturer or listing*)

Inspector Knowledge:
See Article 100 for the definition of readily accessible

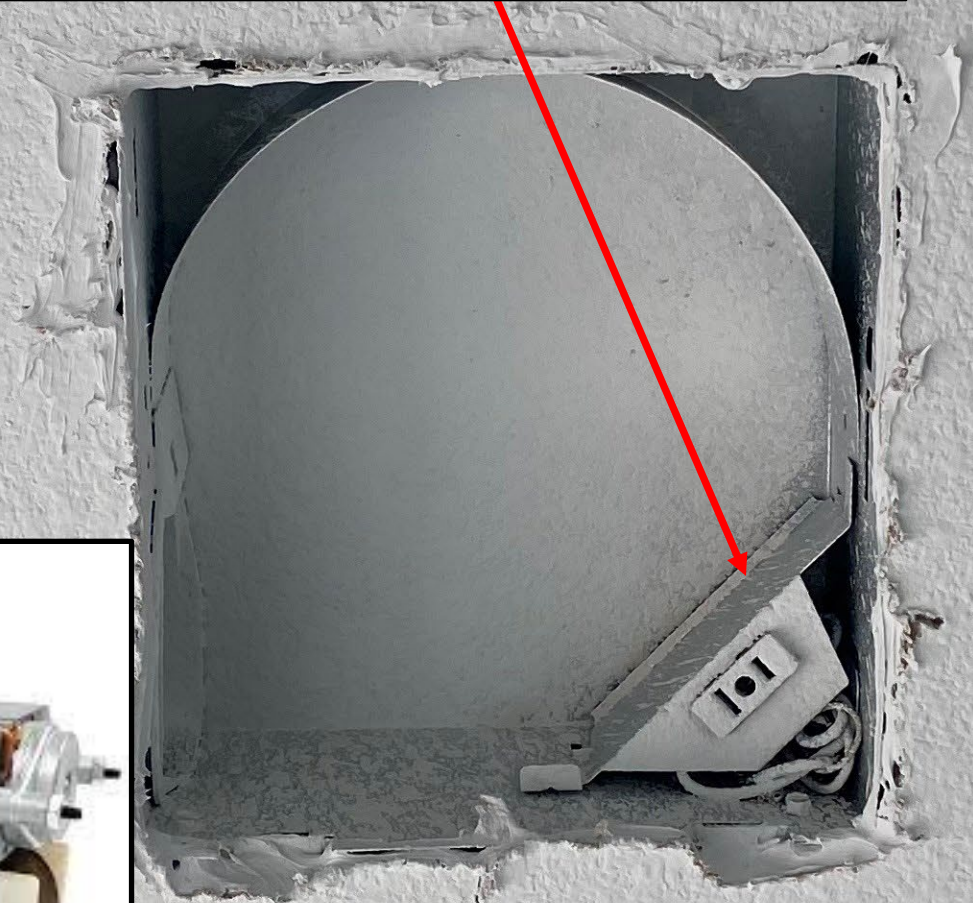


Receptacle within the exhaust fan





Receptacle within the exhaust fan



210.8 Ground-Fault Circuit-Interruption Protection for Personnel

(A) Dwelling Units. Exception No. 3

(B) Other Than Dwelling Units. Exception No. 6

New terms and acronyms introduced for **“Weight Supporting Ceiling Receptacle (WSCR)”** and **“Weight Supporting Attachment Fitting (WSAF)”** - Consistency throughout the *Code*

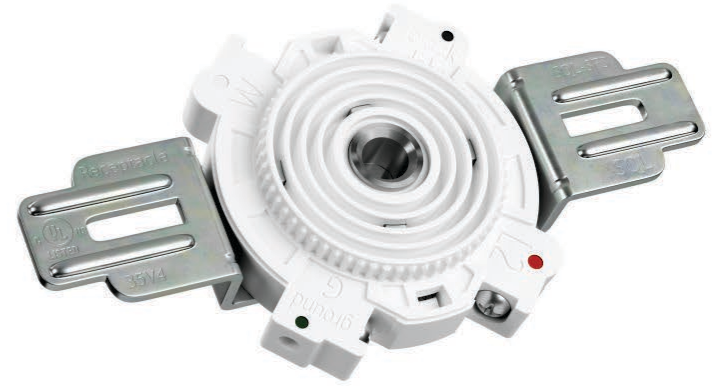
- ⚠ These two exceptions were relocated to the end of 210.8(A) and 210.8(B) as part of the reorganization of 210.8
- ⚠ Exception text was revised to apply the new defined terms “Weight Supporting Ceiling Receptacle (WSCR)” and “Weight Supporting Attachment Fitting (WSAF)”
- ⚠ WSCR has a new definition in Article 100, and the WSAF had its term and definition modified with the acronym added
- ⚠ Similar nomenclature changes were made in 314.27 for *Outlet Boxes* and 422.18 for *Ceiling-Suspended (Paddle) Fans*



210.8(A) Ex. 3 and 210.8(B) Ex. 6 (GFCI Protection)

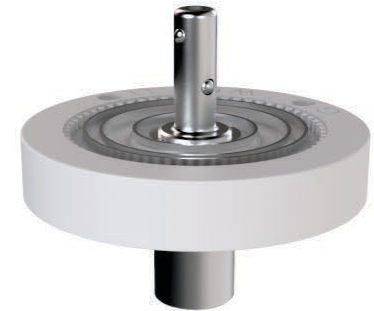
Weight Supporting Ceiling Receptacle (WSCR) and Weight Supporting Attachment Fitting (WSAF) have been introduced as terms and acronyms for consistency throughout the code

These exceptions **permit for the omission of GFCI protection** when supporting a ceiling luminaire or ceiling-suspended fan



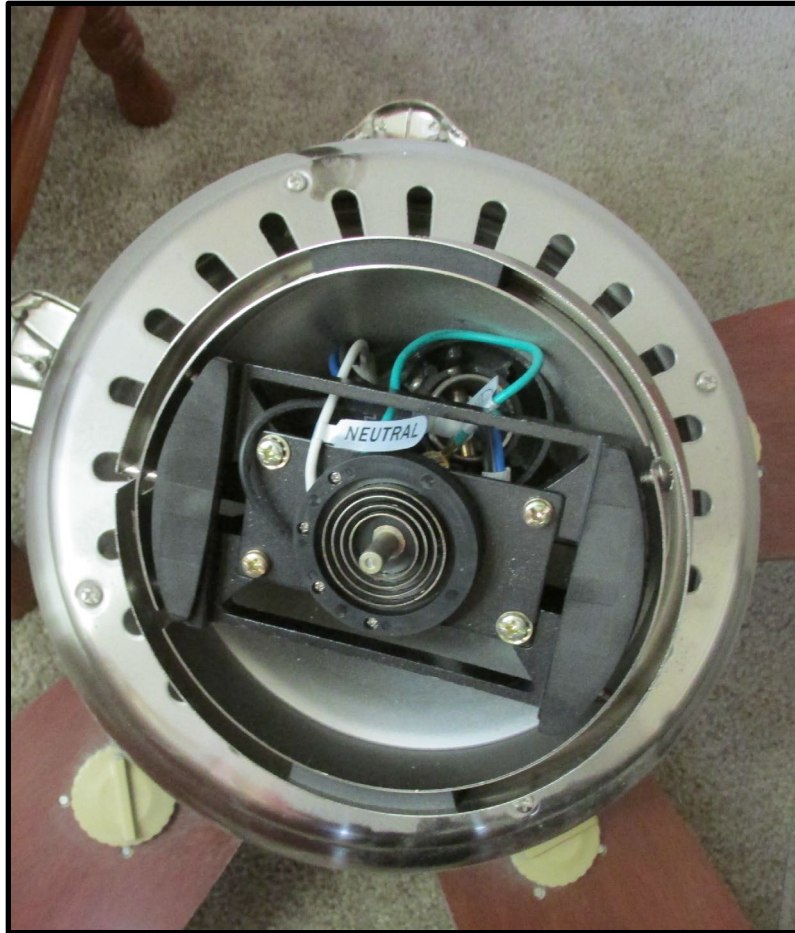
Similar changes were made at:

- 314.27 for Outlet Boxes and
- 422.18 for Ceiling-Suspended (Paddle) Fans



Photos courtesy of Chuck Mello

Ceiling fan installation with the Weight Supporting Ceiling Receptacle and Weight Supporting Attachment Fitting



SQL-F
120 VAC 5A 60Hz
LUZ RÁPIDA DE SEGURIDAD MÁXIMO #
CONDUCTORES 8-18, 6-14, CALIBRE DE
CABLES AMERICANO
INSTALACION DE VENTILADOR MÁXIMO
35 LIBRAS

EMPUJE-15A- SÓLO USE # 14 CABLE
SÓLIDO DE COBRE USE LA CAJA DE
MÍNIMO TAMAÑO 4*1/2" A INSTALAR
UNA CAJA DE SALIDA APROPIADA PARA
INSTALACIÓN DE SUJECIÓN (MÁXIMO
50 LIBRAS) PATENTE NO.6.962.498
OTRAS PATENTES PENDIENTES DE U.S.
Y EXTRANJERA

SQL-F
120VAC 5A 60Hz
SAFETY QUICK LIGHT MAX#
CONDUCTORS 8-18, 6-14, AWG
FAN INSTALLATION MAX 35 LBS

PUSH IN-15A-USE #14 CU
SOLID WIRE ONLY USE MIN
SIZE 4X1/2" BOX INSTALL TO AN
OUTLET BOX SUITABLE FOR
FIXTURE INSTALLATION (MAX 50
LBS) PATENT NO. 6,962,498
OTHER U.S. AND FOREIGN
PATENTS PENDING

Photos courtesy of IAEI Archives

210.8 Ground-Fault Circuit-Interruption Protection for Personnel- (B) Other Than Dwelling Units

A new list item (4) has been added for the addition of buffet serving areas to the list of locations requiring ground-fault circuit-interrupter (*GFCI*) protection

- ⚠ All receptacles are to be GFCI protected if they are:
 - 🔧 Single-phase branch circuits rated 150 volts or less to ground, 50 amperes or less, 125-volt through 250-volt
 - 🔧 Three-phase branch circuits rated 150 volts or less to ground, 100 amperes or less
- ⚠ The buffet serving area typically contains various food wells which hold hot water
- ⚠ Customers or staff members touching the stainless steel are subject to electric shock in the event of an accident
- ⚠ It was demonstrated that these locations are similar in safety concerns to those surfaces which are in kitchens





Photo courtesy of IAEI Archives



Photo courtesy of IAEI Archives



Photo courtesy of IAEI Archives

210.8 Ground-Fault Circuit-Interruption Protection for Personnel- (B) Other Than Dwelling Units

List item (7): Modified to address cord-and-plug-connected **fixed and stationary appliances** within 6 feet of a sink.

- ⚠ The electrical hazard is typically not with the 125-volt through 250-volt receptacle supplying a fixed or stationary piece of equipment but from the equipment itself
- ⚠ Equipment such as a refrigerator or range is typically constructed of metal and located within 6 feet of a sink
- ⚠ A person at the sink making contact with these metal appliances has been injured or killed as a result
- ⚠ This action was necessary to prevent needless electrocutions or shocks to people from occurring

210.8(B) Other Than Dwelling Locations *(GFCI Protection for Personnel)*

Language at list item (7) has been modified addressing cord-and-plug-connected **fixed and stationary appliances at sinks locations** in **other than dwelling units**

Sinks where **fixed or stationary appliances** are installed within 6 ft from the **top inside edge of the bowl of the sink**

Note: fixed or stationary appliances are connected to receptacles or cord connected

Receptacle connected stationary refrigerator →

GFCI Protected

6 ft.

Note: This is not a kitchen area which is already covered in 210.8(B)(2)

6 ft.

Contact between the metal sink and the metal appliances have resulted in shocks and electrocutions

Garage Wood Working Counter

210.8 Ground-Fault Circuit-Interruption Protection for Personnel- (B) Other Than Dwelling Units

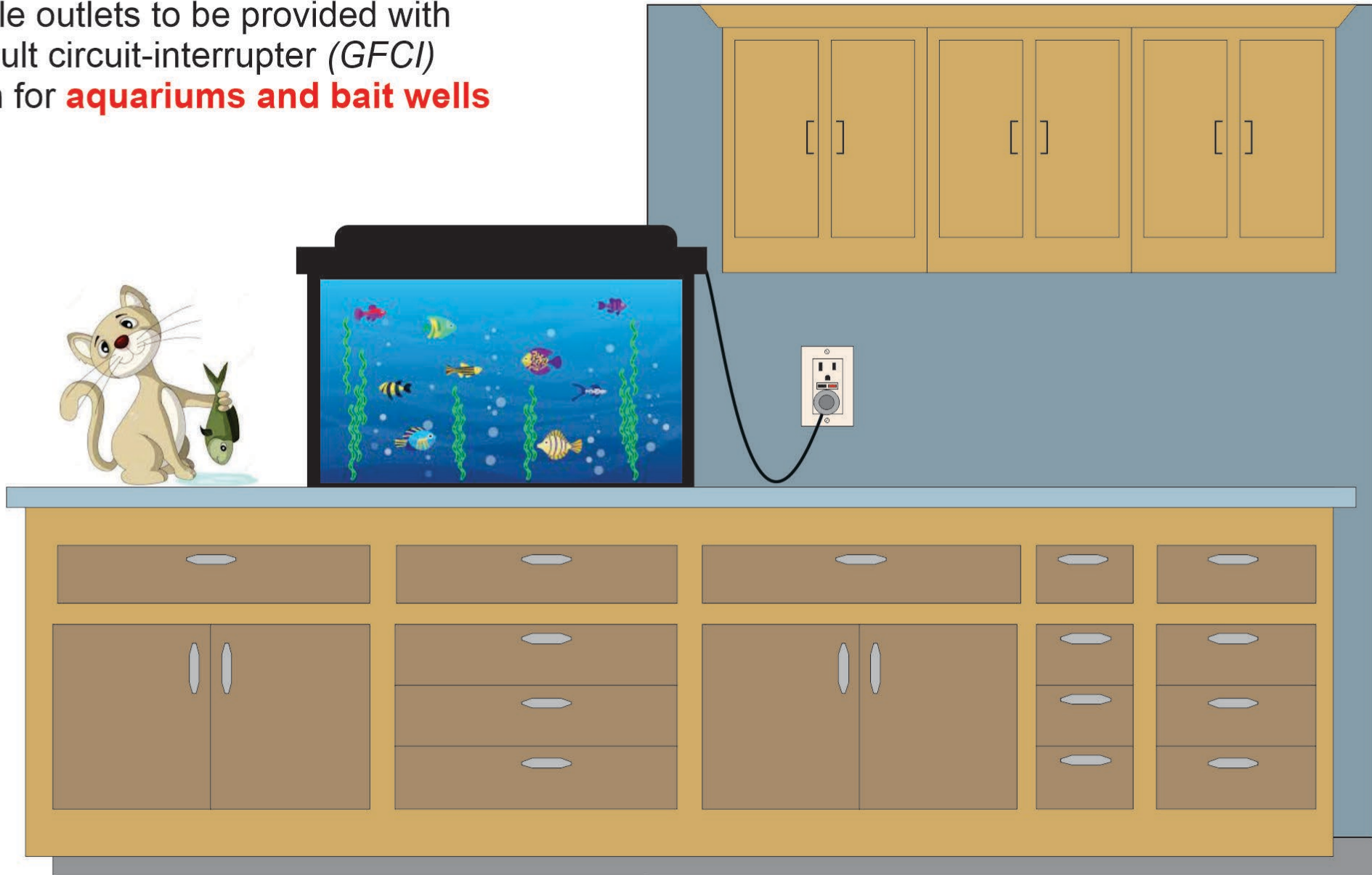
List item (13): Added for **aquariums and bait wells** in locations other than dwelling units

- ⚠ **Receptacles installed within 1.8 m (6 ft.)** of aquariums, bait wells, and similar open aquatic vessels or containers need to be provided with ground-fault circuit-interrupter (*GFCI*) protection
 - 🔧 Single-phase branch circuits rated 150 volts or less to ground, 50 amperes or less, 125-volt through 250-volt
 - 🔧 Supplied by three-phase branch circuits rated 150 volts or less to ground, 100 amperes or less
- ⚠ The areas around bait wells, aquariums, and the like tend to be wet-conductive locations where various types of electrical equipment are used
- ⚠ Examples are aerators, luminaires, and pump motors



210.8(B) Other Than Dwelling Units (*Aquariums and Bait Wells*)

Receptacle outlets to be provided with ground-fault circuit-interrupter (*GFCI*) protection for **aquariums and bait wells**





Challenge with this type of installation is presence during inspection (*Typically installed after occupying building*)

Photo courtesy of IAEL Archives

210.8(B) Other Than Dwelling Units (*Aquariums and Bait Wells*)



Examples:
Receptacle outlets to be provided with *GFCI* protection for **live minnow wells** used by fishing anglers





Photo courtesy of IAEI Archives



Accidents when **water and electricity** are used together have happened and GFCI protection for receptacles is now required

210.8 Ground-Fault Circuit-Interruption Protection for Personnel- (D) Specific Appliances

The appliances (*cord-and-plug and hard-wired*) requiring ground-fault circuit-interrupter (*GFCI*) protection were placed into a list format for easier use

- ⚠️ GFCI protection will apply to **outlets** supplied by a branch circuit of 150 volts or less to ground and 60 amperes or less in a single-phase system
- ⚠️ **New appliances** appear in **red text**:

- 🔌 Automotive vacuum machines
- 🔌 Drinking water coolers and bottle fill stations
- 🔌 High-pressure spray washing machines
- 🔌 Tire inflation machines
- 🔌 Vending machines
- 🔌 Sump pumps
- 🔌 Dishwashers
- 🔌 **Electric ranges**
- 🔌 **Wall-mounted ovens**
- 🔌 **Counter-mounted cooking units**
- 🔌 **Clothes dryers**
- 🔌 **Microwave ovens**



210.8(D) Specific Appliances (GFCI Protection)

The appliances (*cord-and-plug and hard-wired*) requiring ground-fault circuit-interrupter (GFCI) protection were placed into a list format for easier use (*dwelling and other than dwelling unit locations*)



GFCI protection applies to **outlets supplied by a branch circuit** of **150 volts or less to ground** and **60 amperes or less** in a **single-phase system**

New list items include:

- electric ranges
- wall-mounted ovens
- counter-mounted cooking units
- clothes dryers
- microwave ovens

New appliances include:

- electric ranges
- wall-mounted ovens
- counter-mounted cooking units
- clothes dryers
- microwave ovens



Photo courtesy of IAEI Archives

210.8 Ground-Fault Circuit-Interruption Protection for Personnel- (F) Outdoor Outlets

Ground-fault circuit-interrupter (*GFCI*) protection is to be installed when the equipment supplied by an outlet covered under the requirements of this section is **replaced**

- ⚠ This addresses issues of **older existing outlets** that are **not GFCI protected**
- ⚠ Will require GFCI protection for dwelling outdoor outlets when the electrical equipment is replaced that receives power from that older existing outlet
- ⚠ This change will increase the overall level of safety by providing the same level of protection

Notice: TIA 23-3 (*TIA Log #1664*) created **Exception No. 2** stating that GFCI protection not required for listed HVAC equipment

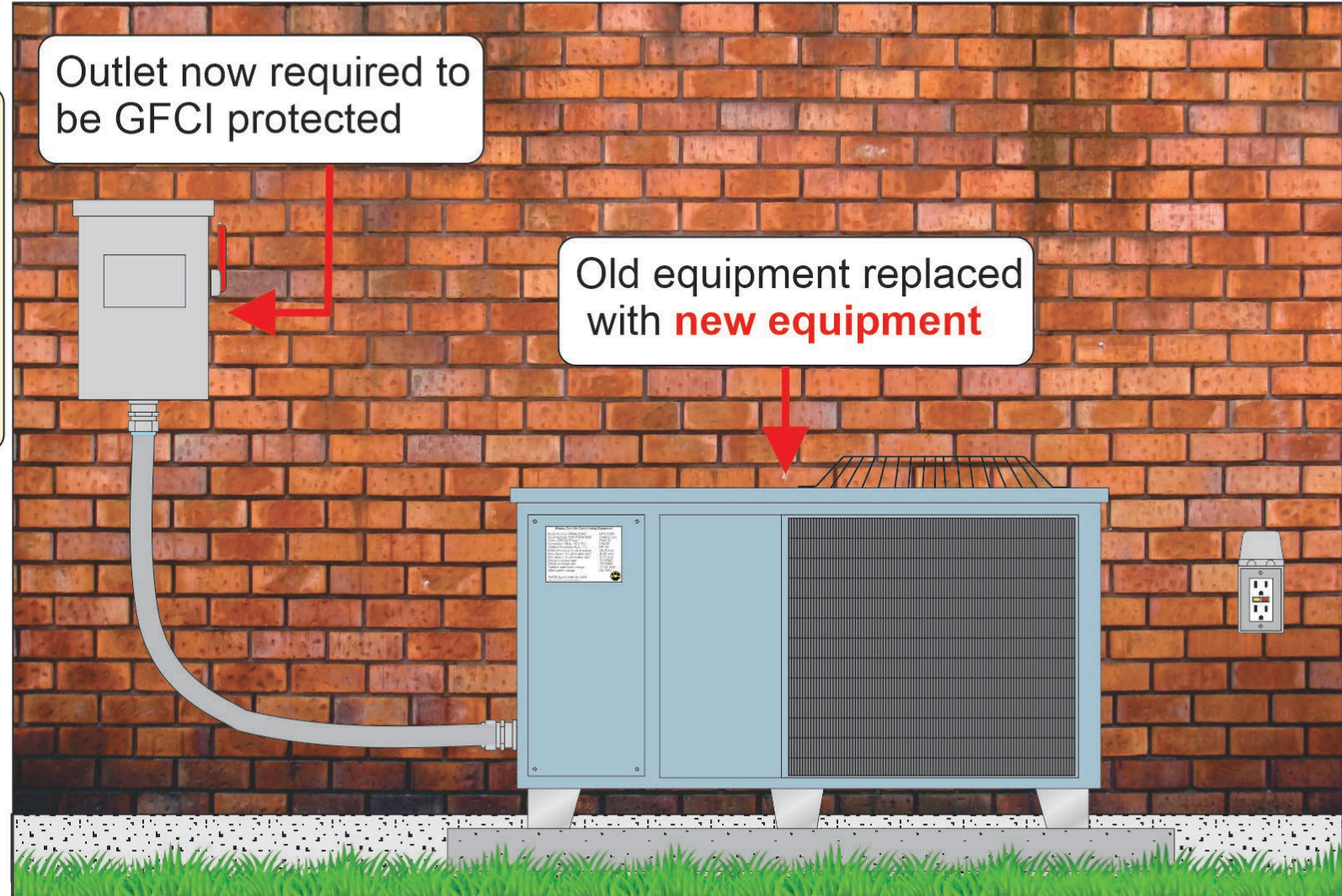
This exception will expire **September 1, 2026**

210.8(F) Outdoor Outlets (GFCI)

When **new electrical equipment** is installed, ground-fault circuit-interrupter (GFCI) protection method is required for the outlet serving the new equipment

Note from the Electrical Inspector:

NFPA has assigned a task group to look at interoperability issues between equipment and GFCI protection



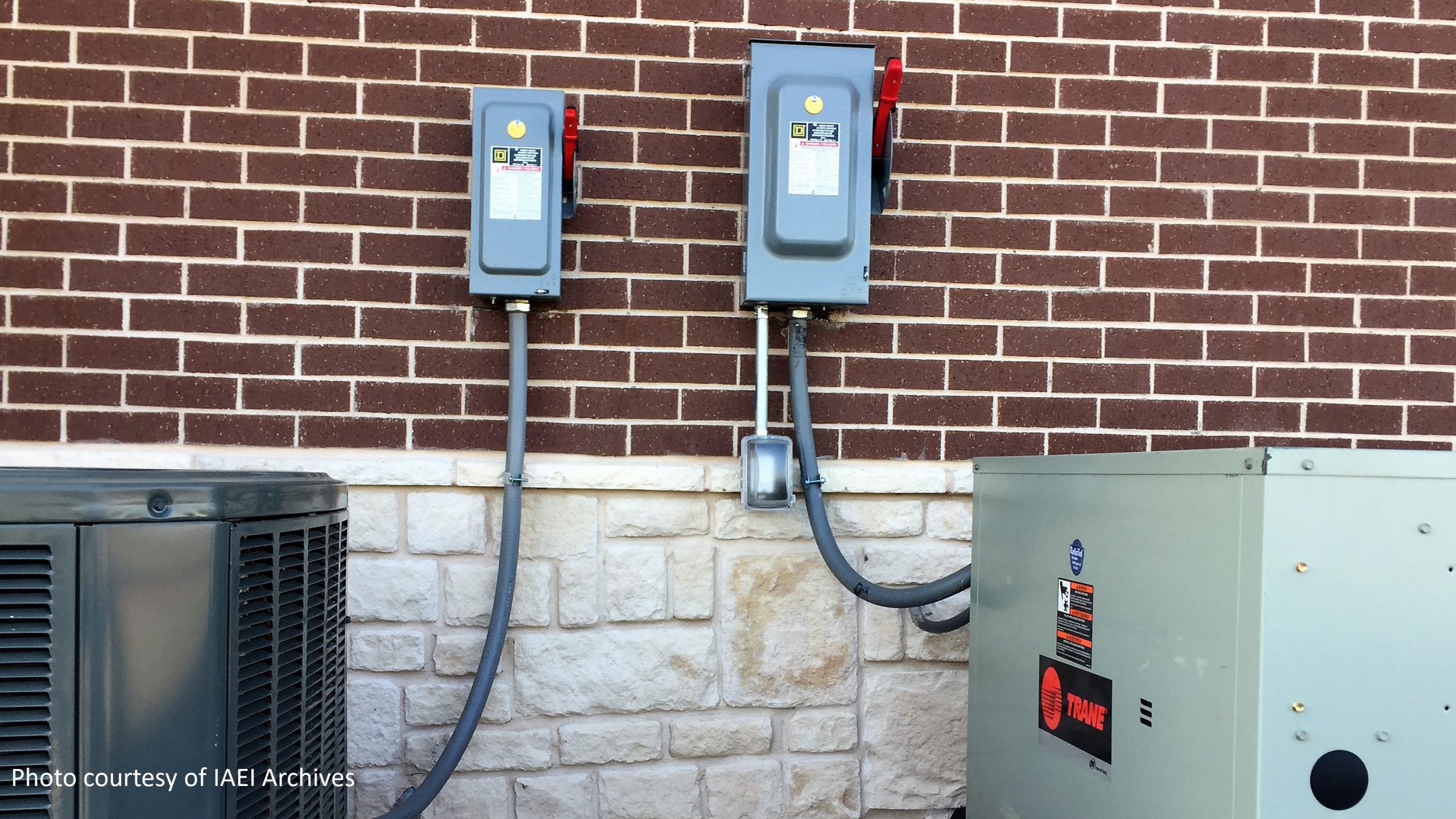


Photo courtesy of IAEL Archives



Photo courtesy of IAEI Archives

210.11 Branch Circuits Required

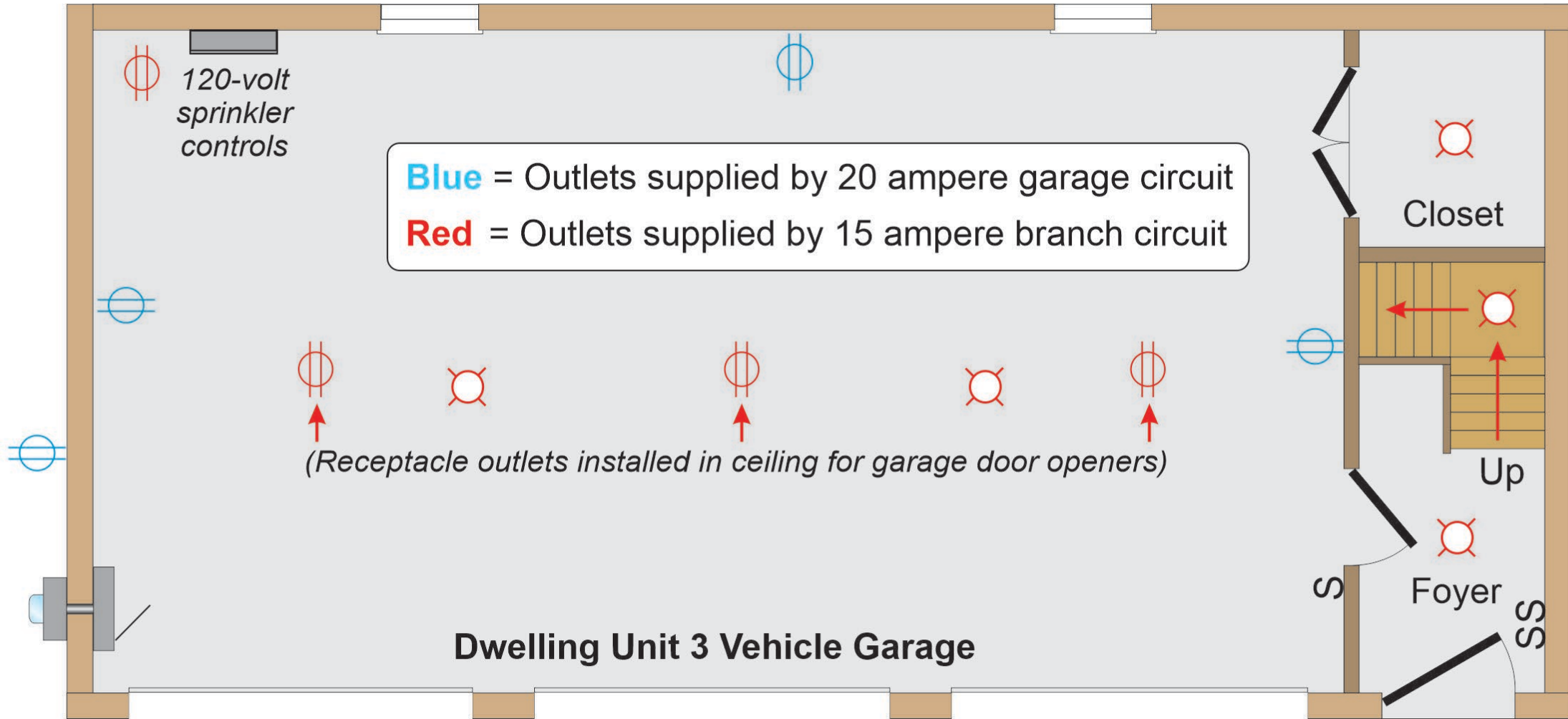
(C) Dwelling Units- (4) Garage Branch Circuits

The text was clarified so that 15-ampere branch circuits are permitted to serve receptacle outlets installed in a dwelling unit garage

- ⚠️ If a 15-ampere branch circuit(s) is installed, it would be in addition to the 20-ampere circuit supplying the required garage receptacles
- ⚠️ This would not diminish the required 20-ampere circuit requirement found at 210.52(G)(1)
- ⚠️ Applies to garages of any size (*1,2,3,4, etc., vehicle bays*)
- ⚠️ Equipment such as a central vacuum unit or garage door opener is allowed to be supplied by a branch circuit that limits ampacity to 15 amperes
- ⚠️ This change will alleviate any confusion about garage branch circuit requirements



210.11(C)(4) Dwelling Unit Garage Branch Circuits



Dwelling Unit 3 Vehicle Garage

If a 15-ampere branch circuit(s) is installed, it would be in addition to the 20-ampere circuit supplying the garage receptacles required by 210.52(G)(1)

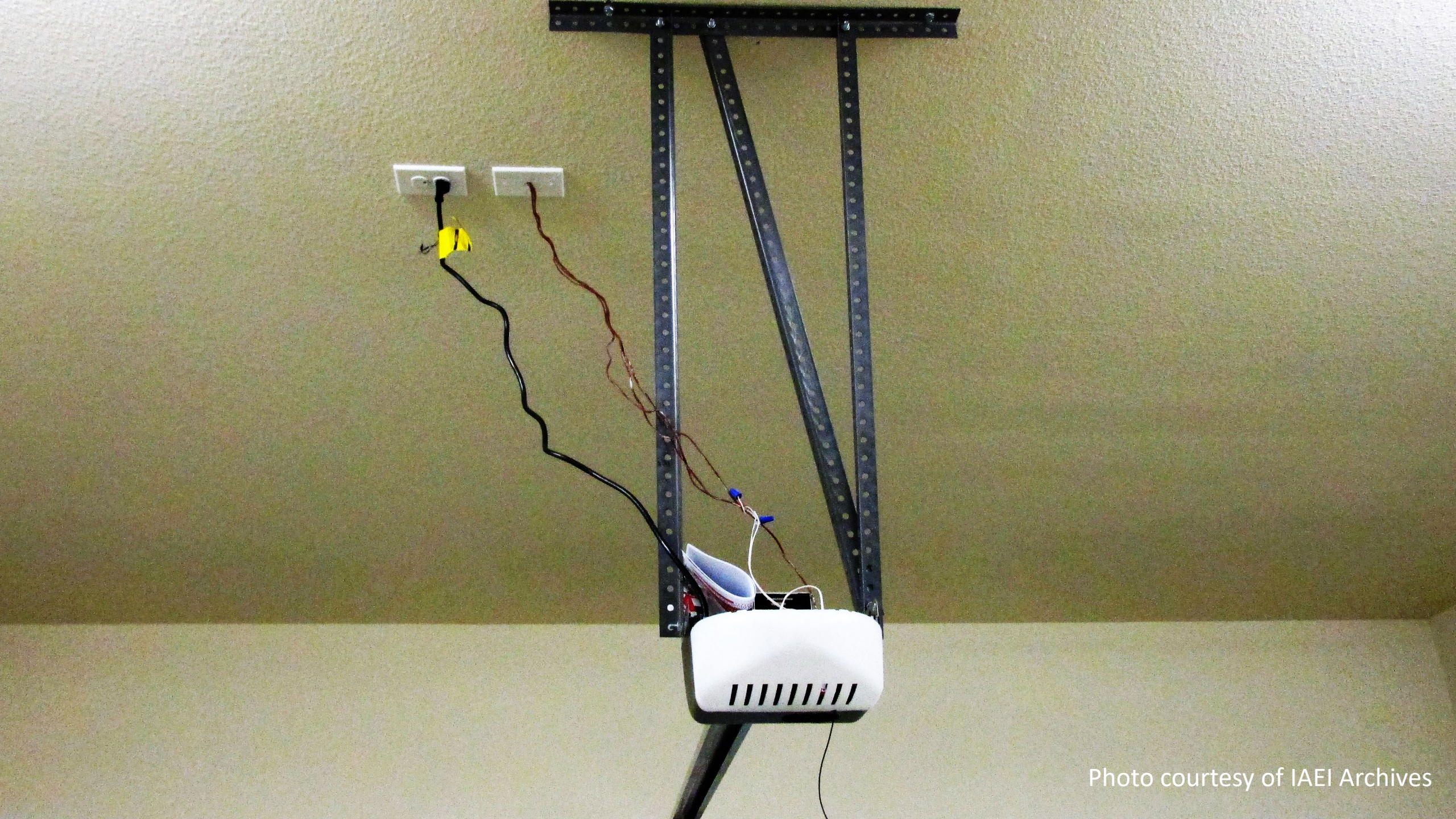


Photo courtesy of IAEI Archives

210.11 Branch Circuits Required

(C) Dwelling Units- (4) Garage Branch Circuits

New Exception No. (2): Added to permit the 20-ampere branch circuit supplying a single vehicle bay garage to supply other equipment in accordance with requirements in 210.23(A)(1) and (A)(2)

- ⚠️ A single-bay garage is only mandated to be provided with one receptacle outlet on the 20-ampere branch circuit
- ⚠️ The branch circuit will provide adequate circuit capacity to supply other loads
- ⚠️ These loads are likely to be limited in number due to the reduced space availability in the garage



210.11(C)(4) Dwelling Unit Garage Branch Circuits

20-ampere circuit supplying the dwelling unit single vehicle bay garage receptacles as permitted by new Exception No. 4

Note from the Electrical Inspector:

The 20-ampere circuit will provide adequate capacity as the loads are limited due to the space of the garage

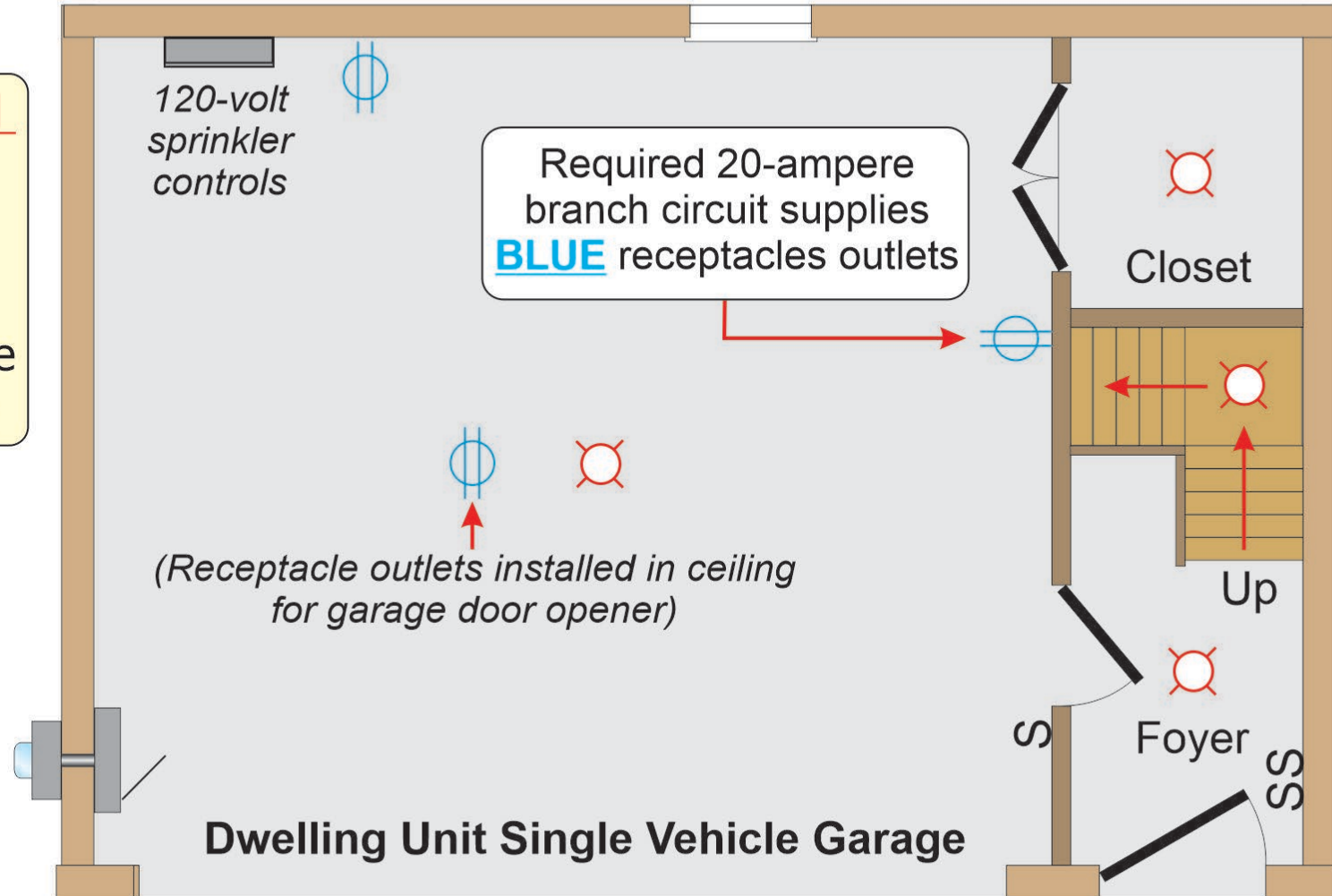


Photo shows a residential irrigation control panel that is allowed to be placed on a 15-ampere branch circuit (*still requires GFCI protection*)



210.12 Arc-Fault Circuit-Interrupter Protection (AFCI)

Reformatted for clarity making it easier to understand requirements

⚠ The **10-ampere branch circuit** was added to the branch circuit sizes allowed for these locations, and subdivisions were renamed

- 🔧 **(A) Means of Protection:** Now lists the protection methods available
- 🔧 **(B) Dwelling Units:** Includes the list of areas of the dwelling unit
- 🔧 **(C) Dormitory Units:** Specific requirements for dormitory units
- 🔧 **(D) Other Occupancies:** Includes expanded areas for AFCI protection
- 🔧 **(E) Branch Circuit Wiring Extensions, Modifications, or Replacements:**
Clarity changes included this cycle



210.12 Arc-Fault Circuit-Interrupter Protection (AFCI)

This section was **reformatted** making it easier to reference and utilize the requirements and a **10-ampere branch circuit added** to allowable branch circuit sizes

Section was reformatted for easier use:

- **Subdivision (A)**, Means of Protection
- **Subdivision (B)**, Dwelling Units
- **Subdivision (C)**, Dormitory Units
- **Subdivision (D)**, Other Occupancies
- **Subdivision (E)**, Branch Circuit Wiring Extensions/Modifications/Replacements

*Cut Away
AFCI Circuit
Breaker*



Photo courtesy of Eaton

*AFCI System
Combination
Rated Device*

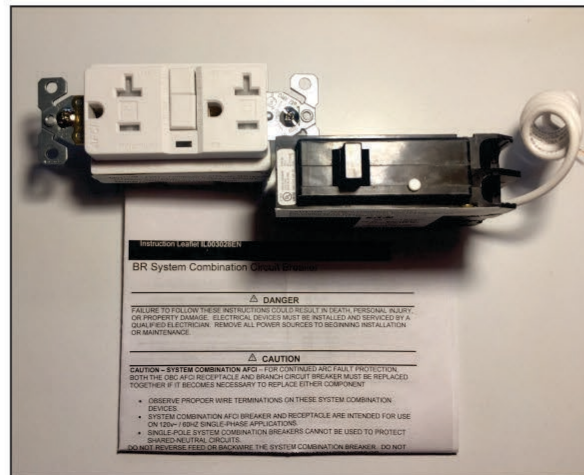


Photo courtesy of Eaton

*Dual function
AFCI/GFCI
Device*

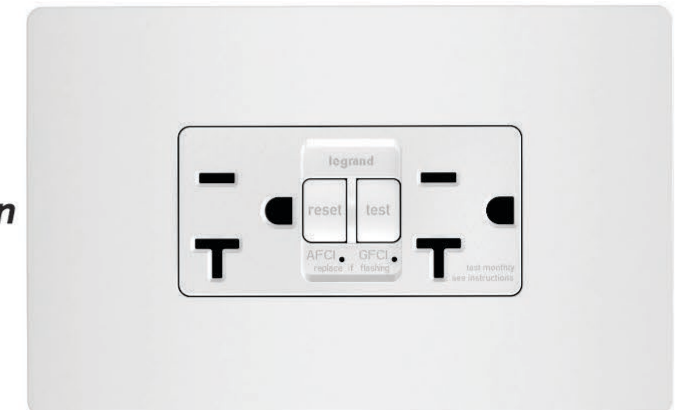


Photo courtesy of Legrand

210.12 Arc-Fault Circuit-Interrupter Protection (AFCI)

(D) Other Occupancies

New List Item (3): Rooms designed exclusively as sleeping rooms in places such as firehouses, rescue squads, police departments, and similar locations are to be protected by one of the methods in 210.12(A)(1) through (A)(6)

- ⚠ All 120-volt single-phase, 10, 15, and 20-ampere branch circuits supplying devices or outlets for these rooms are now required to be provided with arc-fault circuit-interrupter (AFCI) protection
- ⚠ These rooms are occupied in much the same way as bedrooms of dwellings or as guest rooms of hotels and motels and should be provided with the same level of safety
- ⚠ **Note:** Two new subsections were added in 210.12, and many existing subsections were modified for clarity and useability
 - ✎ In some cases, list items replaced long lines of text that detailed locations requiring AFCI protection



210.12(D)(3) Other Occupancies (*AFCI Protection*)

All 120-volt single-phase, 10, 15, and 20-ampere branch circuits supplying devices or outlets for the following locations required to be provided with arc-fault circuit-interrupter (*AFCI*) protection

In **sleeping quarters**
in places such as:

- firehouses
- ambulance stations
- rescue squads
- police departments
- ranger stations
- and similar locations



Photo courtesy of Bentonville Arkansas Fire Department

210.17 Guest Rooms and Guest Suites

Assisted living facilities were added to the existing list of locations requiring their branch circuits to be installed per the requirements for dwelling units if a permanent means for cooking exists

- ⚠ Assisted living facilities were seen as having the same characteristics as a guest room and guest suite, which were addressed in the 2020 *NEC*
- ⚠ If was felt that they should observe the same branch circuit requirements as dwelling units
- ⚠ The previous locations in this section were placed into a list format for added clarity
- ⚠ Informational notes were also included for guidance with:
 - ✎ laundry branch circuits and
 - ✎ direction towards the ***Life Safety Code*** for the definition of an assisted living facility



210.17 Guest Rooms and Guest Suites

Assisted living facilities were added to the existing list of locations requiring their branch circuits to be installed per the requirements for dwelling units **if a permanent means for cooking exists**

Assisted living facilities were seen as having the same characteristics as a guest room and guest suite which were addressed in the 2020 *NEC*

These locations should observe the **same branch circuit requirements as dwelling units**



Guest Room or Guest Suite
(added in 2020 NEC)

Assisted Living Center *(added in 2023 NEC)*



210.17 Guest Rooms and Guest Suites

Some assisted living facilities are very similar to a dwelling unit

When provided with permanent means for cooking, **the branch circuits at these locations are required to be installed** the same as for dwelling units



210.19 Conductors- Minimum Ampacity and Size

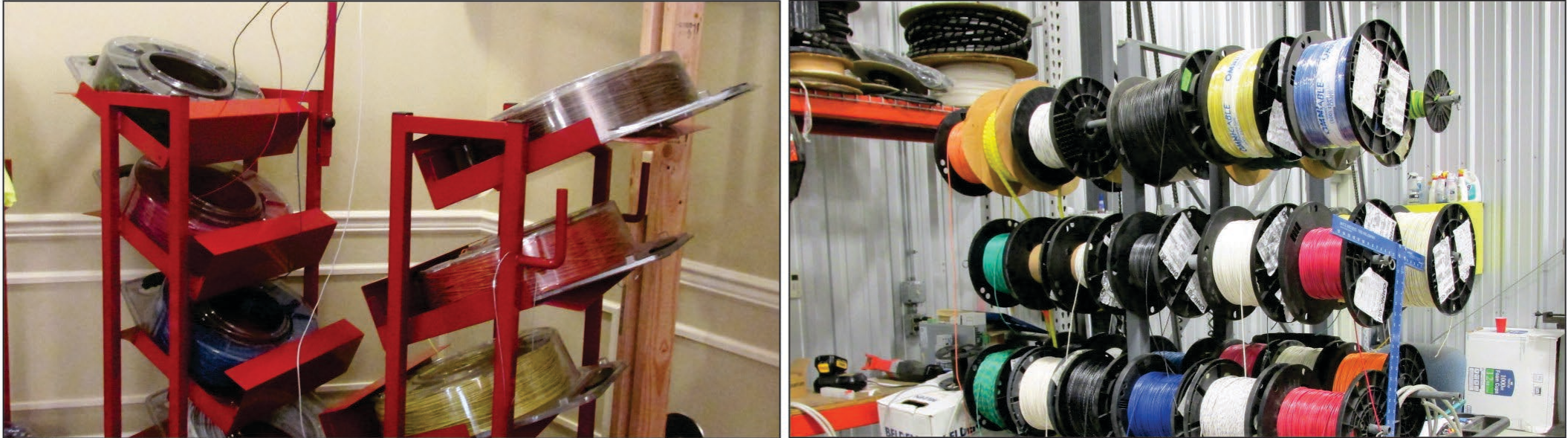
Revised to clarify that the voltage limitation should apply to the circuit, not the conductor insulation rating, and to specify this section applies to branch circuits not exceeding 1000 volts ac or 1500 volts dc

- ⚠ There was confusion as to if the voltage limitation applied to the circuit or if it applied to the insulation rating of the conductor
- ⚠ This has been clarified by the action of the code making panel
- ⚠ Due to the creation of new Article 235, language was added at 210.19 stating that this section applies to **“not more than 1000 volts ac or 1500 volts dc”**
- ⚠ Article 235 entitled ***Branch Circuits, Feeders and Services Over 1000 Volts ac, 1500 Volts dc, Nominal*** is intended to apply to **voltages over 1000 volts ac and 1500-volt dc**



210.19 Conductors- Minimum Ampacity and Size

Clarifies that **the voltage limitation should apply to the circuit**, not the conductor insulation rating and specifies this applies to branch circuits "not exceeding 1000 volts ac or 1500 volts dc"



Photos courtesy of IAEI Archives

These conductors in the photos are rated not over 1000 volts ac and would be covered by Article 210

Article 235 will cover voltages that exceed 1000 volts ac or 1500 volts dc

**Article 235 is entitled
Branch Circuits,
Feeders and Services
Over 1000 Volts ac,
1500 Volts dc, Nominal**

210.23 Permissible Loads

Permissible Loads, Multiple-Outlet Branch Circuits 10 Ampere Branch Circuits

- ⚠ This change covers permitted and non-permitted use of a 10-ampere branch circuit
- ⚠ Installation requirements were necessary for the use of a 10-ampere branch circuit if the installer chose to do so
- ⚠ Advantages include lower cost due to smaller conductors with loads such as increased LED lighting installations
- ⚠ A **10-ampere branch circuit can supply loads for** lighting outlets, lighting circuits for bathroom and laundry area exhaust fans within dwelling units, and a gas fireplace unit served by an individual branch circuit
- ⚠ A **10-ampere branch circuit cannot supply loads for** receptacle outlets, fixed appliances (*except as permitted for individual branch circuits*), garage door openers, or laundry equipment



210.23 Permissible Loads

10 ampere branch circuits are now addressed in the *NEC*

A 10-ampere branch circuit can supply loads for:

- lighting outlets
- lighting circuits for bathroom and laundry area exhaust fans within dwelling units
- gas fireplace unit served by an individual branch circuit

A 10-ampere branch circuit cannot supply loads for:

- receptacle outlets
- fixed appliances (except as permitted for individual branch circuits)
- garage door openers
- laundry equipment

Installation requirements were necessary for the use of 10-ampere branch circuits if the installer chose to do so

Note: A 10-ampere receptacle configuration does not currently exist

A 10-ampere branch circuit can supply loads for lighting outlets



Photo courtesy of IAEI Archives

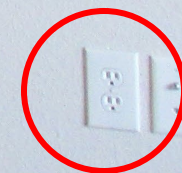
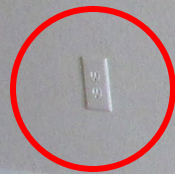
An individual 10-ampere branch circuit can supply electrical needs to a gas fireplace unit



Photo courtesy of IAEI Archives

A 10-ampere branch circuit cannot supply loads for receptacle outlets


10 ampere receptacle configurations currently do not exist



A 10-ampere branch circuit cannot supply loads for laundry equipment



Photo courtesy of IAEI Archives



A 10-ampere branch circuit cannot supply loads for garage door openers

210.52 Dwelling Unit Receptacle Outlets

(C) Countertops and Work Surfaces

(2) Island and Peninsular Countertops and Work Surfaces

The requirement for receptacles serving the countertop or work surface of an island or peninsula has been **made optional**, but guidance for their location has been maintained when they are provided

- ⚠ Data compiled by the Consumer Products Safety Commission (CPSC) document 45 reports of burns or other injuries between January 1991 and 2020
- ⚠ An estimated 9,700 burns or other injuries were treated in U.S. hospital emergency rooms
- ⚠ Most injuries were the result of hot contents being spilled from countertop cooking appliances on children who pulled the appliance cord



210.52 Dwelling Unit Receptacle Outlets

(C) Countertops and Work Surfaces

(2) Island and Peninsular Countertops and Work Surfaces

- ⚠ In the event a receptacle outlet is not provided, the electrical contractor must provide a method to the island or peninsula for the future addition of a receptacle outlet
- ⚠ Some examples may include:
 - 🔧 NM or UF cable in a box with cover
 - 🔧 Unfinished basement access to below the island or peninsula



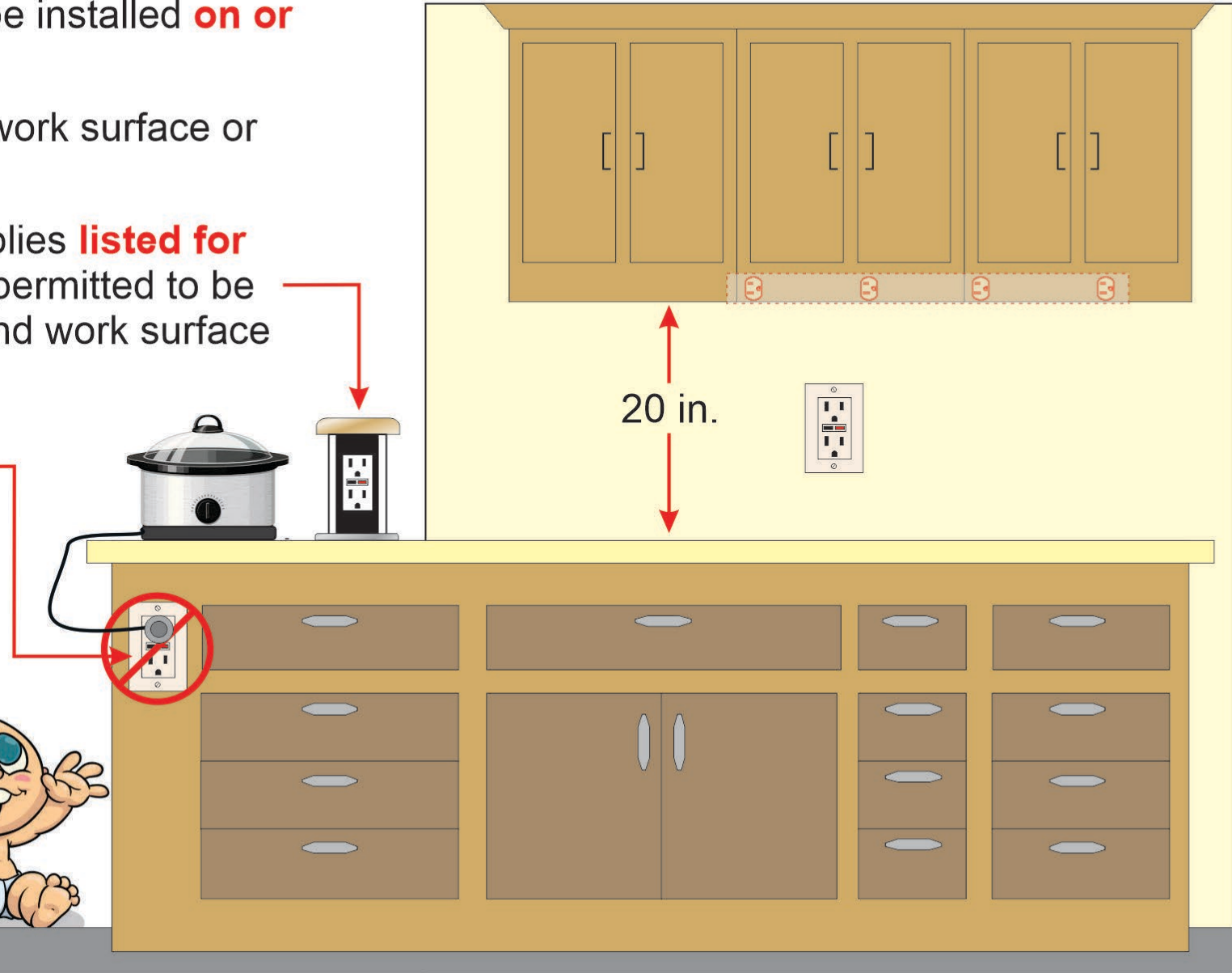
210.52(C) Islands and Peninsular Receptacles- Dwelling Units

Receptacle outlets shall be installed **on or above** the countertops

Not permitted face-up in work surface or countertop [406.5(G)(1)]

Receptacle outlet assemblies **listed for the application** shall be permitted to be installed in countertops and work surface

Receptacle outlet **no longer allowed** to be installed below the countertop



NEC History of Countertop Receptacle Placement

Before 1990 there was **no guidance or requirement** for receptacle placement for kitchen island and peninsular locations

This proposal to NFPA shows **IAEI was opposed to the receptacles being installed below countertops** due to possible accidents that are now well documented

Note: Jim Carpenter was a previous IAEI International Office CEO serving on CMP-2

2-222- (210-52(c)): Reject

SUBMITTER: Marlene Avigliano, IAEI

RECOMMENDATION: (Add) Receptacles required to service peninsular and island countertops shall not be located below the level of the countertop.

SUBSTANTIATION: Electrical cords from kitchen appliances extending over the end of a countertop expose children to a hazardous condition. Children pulling on a cord can pull hot coffee pots, skillets, etc., over the counter edge and onto themselves.

PANEL ACTION: Reject.

PANEL STATEMENT: Too restrictive. Incomplete technical substantiation to support the proposed change.


VOTE ON PANEL ACTION:

AFFIRMATIVE: 11

NEGATIVE: Carpenter

EXPLANATION OF VOTE:

CARPENTER: Many manufacturers of kitchen appliances have included warnings on their products or in their literature concerning the hazards of placing an appliance too close to the counter edge letting the cord extend over the counter edge because of the hazard described in this proposal. Permitting receptacles below the level of the countertop promotes the misuse of these appliances.




Receptacle outlets
will now be
optional for kitchen
islands and
peninsular locations

Photo courtesy of IAEI Archives

Receptacle outlets are optional, but provisions need to be provided to add later. *(when the homeowner request)*

They cannot be installed on the side of the cabinet but can be installed on the countertop surface.



When a receptacle is provided it must be located to prevent cords from hanging over the edge

Photo courtesy of IAEI Archives



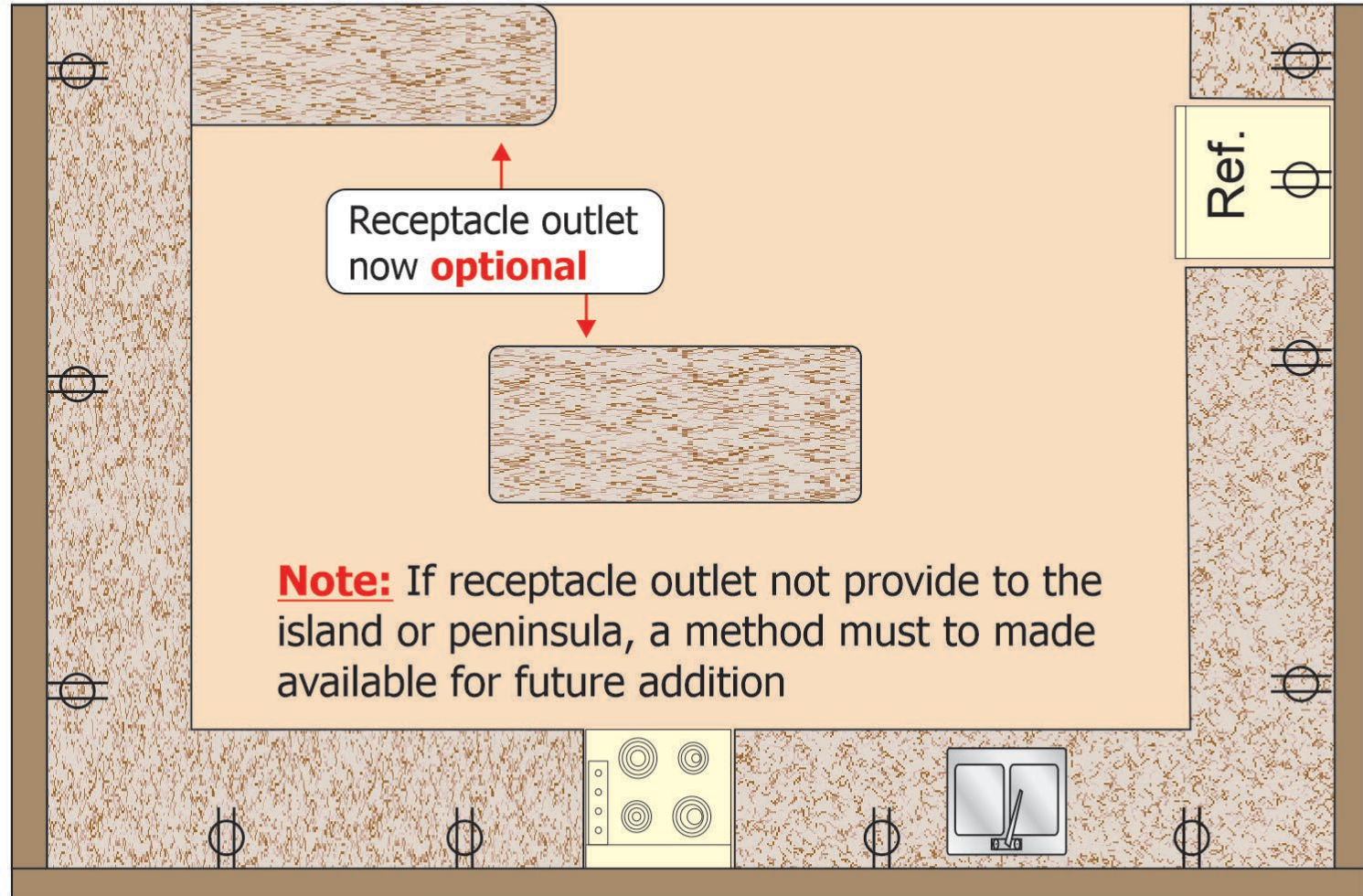
Photo courtesy of IAEI Archives

210.52(C) Island and Peninsular Countertops and Work Surfaces

Receptacles serving the countertop or work surface of an island or peninsula are **optional**, but guidance for their location has been maintained when they are provided

An estimated 9,700 burns or other injuries were treated in U.S. hospital emergency rooms from Jan. 1991-2020

Children pull cords and appliances fall from kitchen countertops

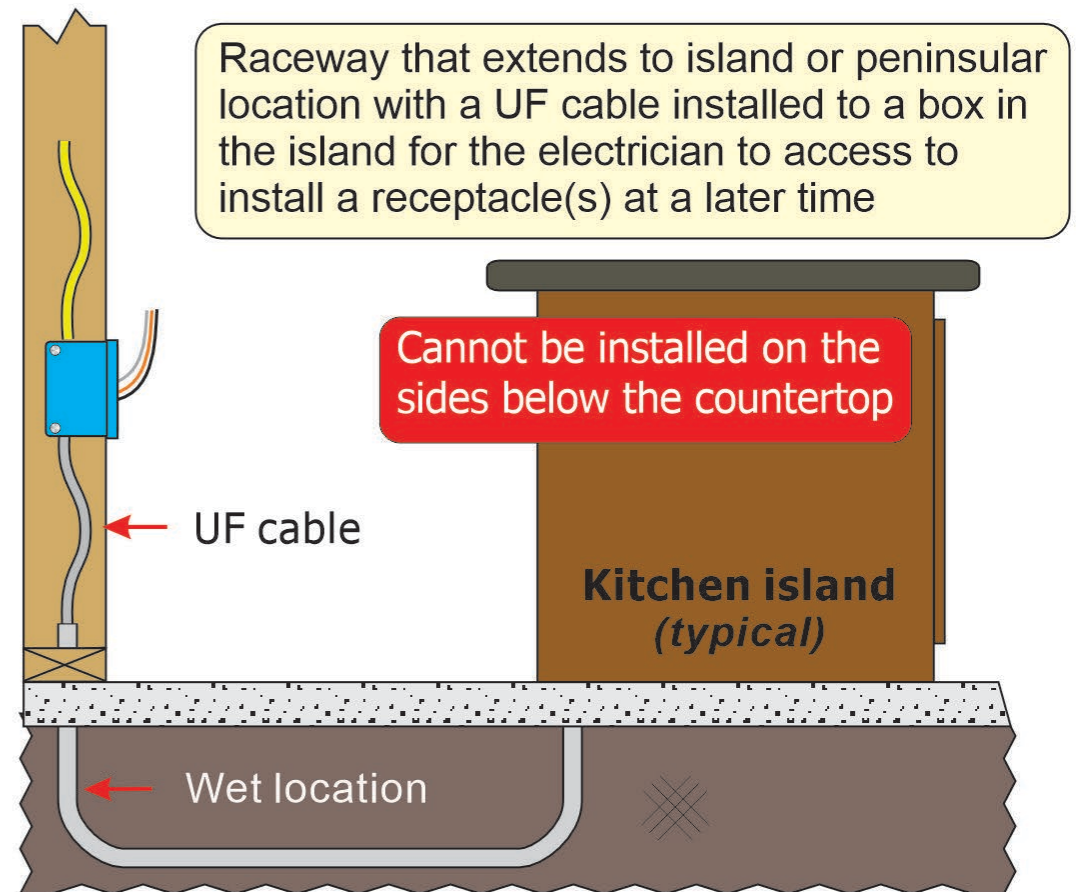


210.52(C) Island and Peninsular Countertops and Work Surfaces

Receptacles serving the countertop or work surface of an island or peninsula are **optional**, but guidance for their location has been maintained when they are provided

If a receptacle outlet is not provided, a method must be made available for future addition

Note: Below are two options to meet this requirement (*other options may be acceptable to the AHJ*)

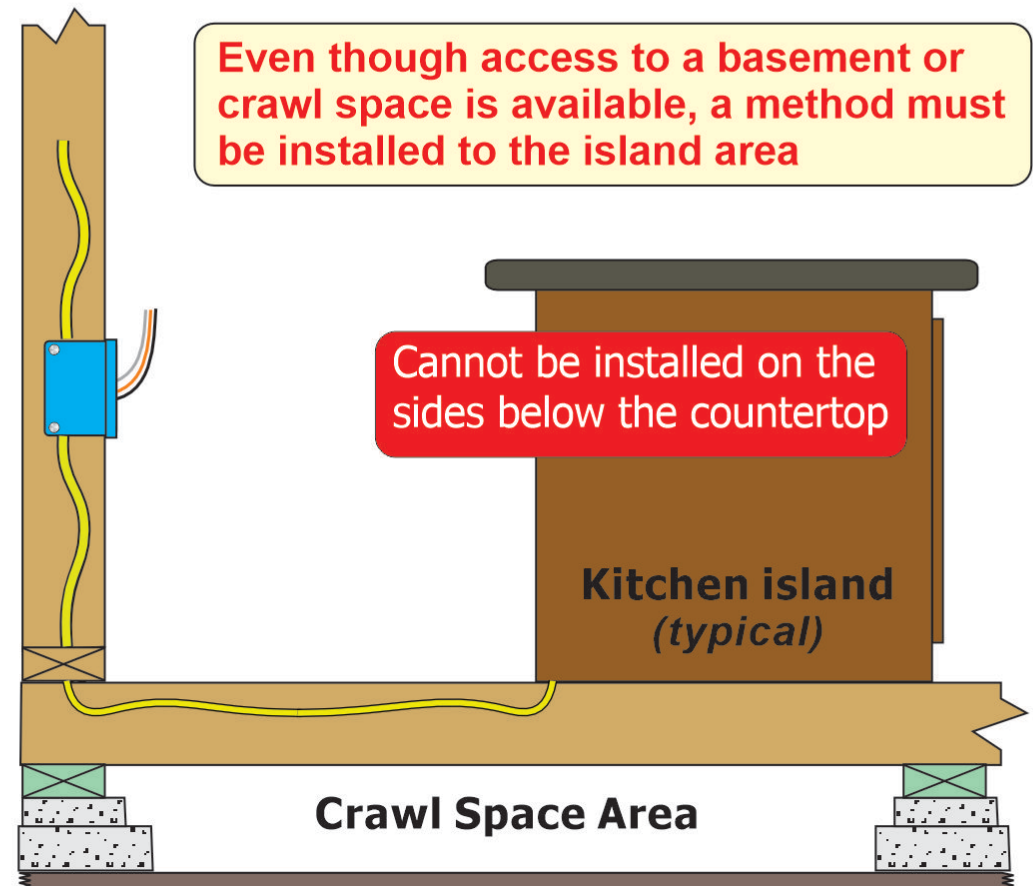
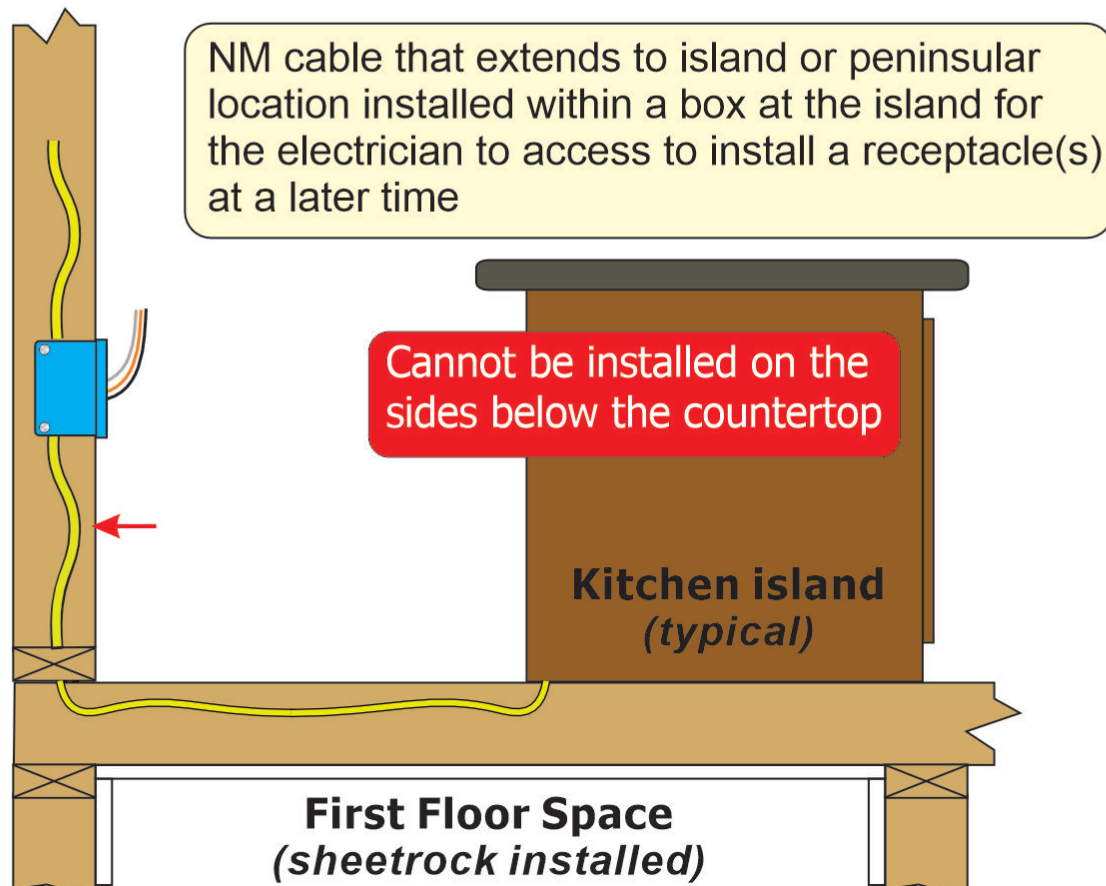


210.52(C) Island and Peninsular Countertops and Work Surfaces

Receptacles serving the countertop or work surface of an island or peninsula are **optional**, but guidance for their location has been maintained when they are provided

If a receptacle outlet is not provided, a method must be made available for future addition

Note: Below are two options to meet this requirement (*other options may be acceptable to the AHJ*)



210.52 Dwelling Unit Receptacle Outlets

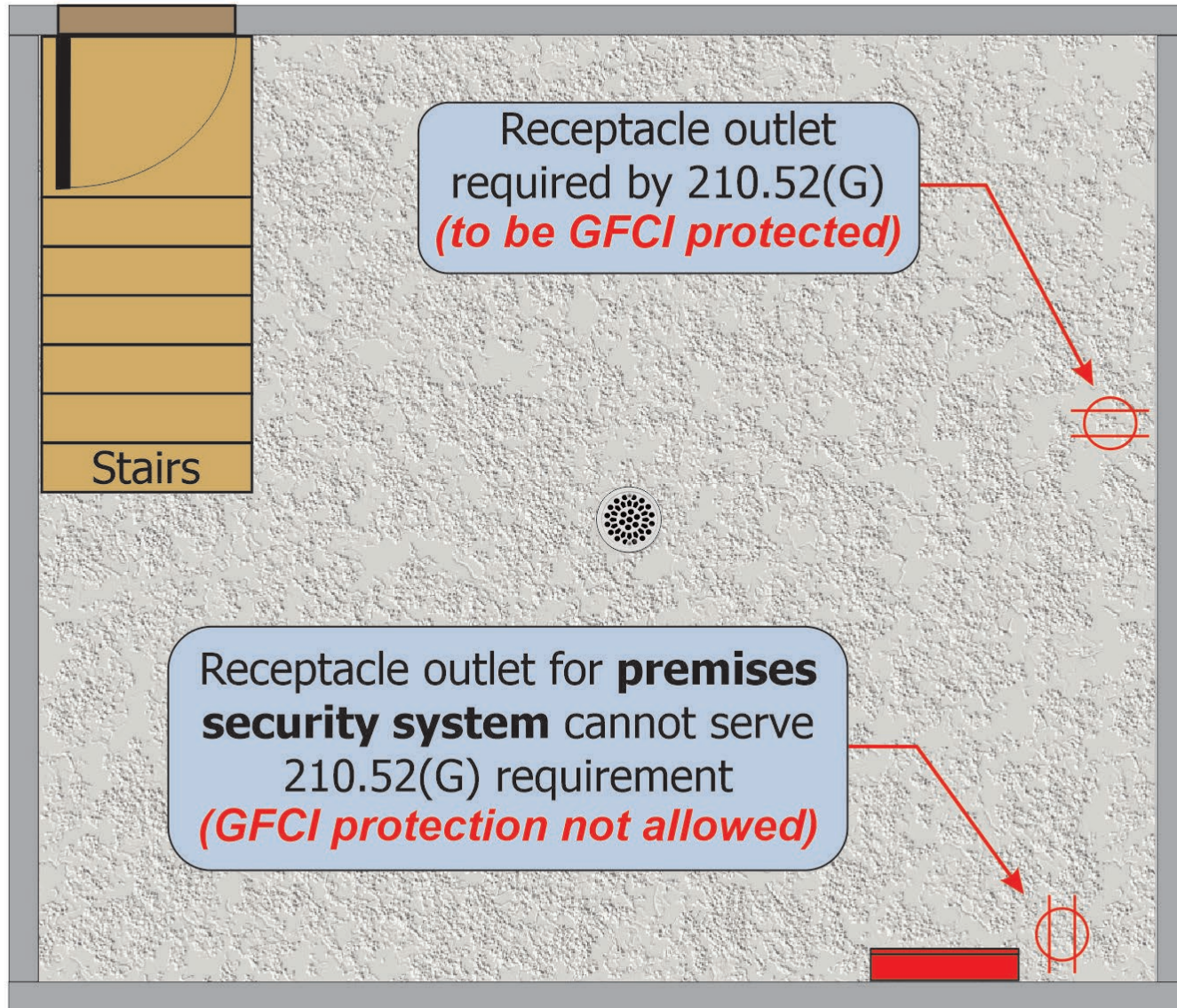
(G) Basements, Garages, and Accessory Buildings

It has been clarified that the receptacle provided for premises security systems does not meet the receptacle requirements of 210.52(G)

- ⚠ This will ensure that the required receptacle(s) for the basement, garage, or accessory building is provided with ground-fault circuit-interrupter (*GFCI*) protection
- ⚠ Confusion has arisen in the field concerning a receptacle that serves the premises security system that is not required to have GFCI protection also being used to meet the receptacle outlet required by 210.52(G)
- ⚠ This should reduce misunderstanding between installers and the authority having jurisdiction (*AHJ*) about the requirements for a GFCI receptacle outlet in the above locations that might also contain a premises security system



210.52(G) Basements, Garages, and Accessory Buildings



GFCI protected if receptacle is:

- 125-volt through 250-volt
- supplied by a single-phase branch circuit
- branch circuit rated 150 volts or less to ground



Goal: Reduce arguments between the inspector and the installer

210.62 Show Windows

This change clarified the intent of the receptacle outlets is for each show window location

- ⚠ There had been confusion by electrical professionals as to how the previous *Code* language was to be applied during electrical installations
- ⚠ New language makes this requirement easier to understand for both the installer and the inspection authority (*AHJ*)

This change was not included in the IAEI Analysis of Changes book



210.62 Show Windows

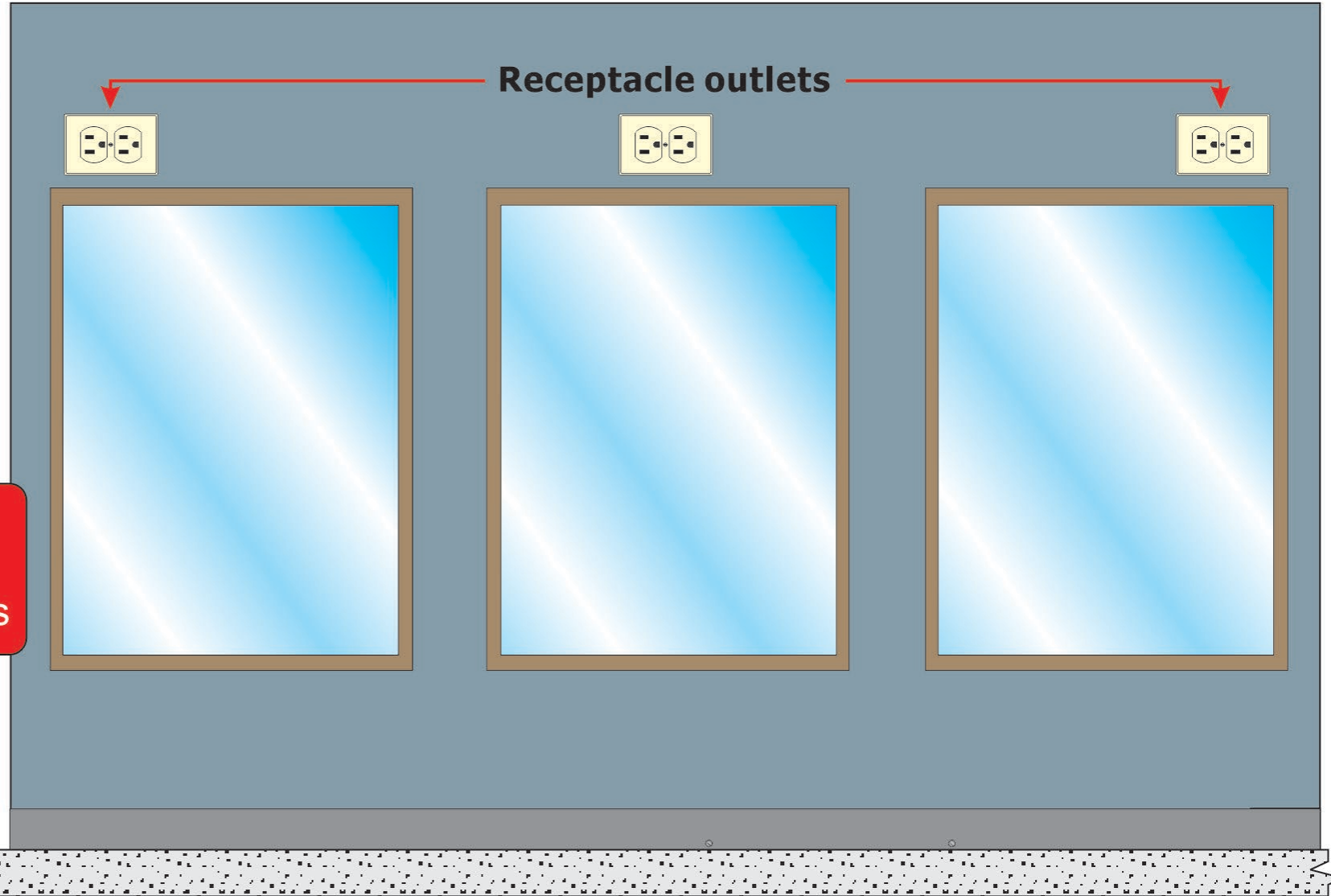
Requires receptacle outlets rated 15- or 20-amperes (125-volt, single phase)

0

Installed within 18 inches
of the top of **each window**

No point along top of
window farther than 6 feet
from receptacle outlet

Helps with installation
and enforcement by
clarifying requirements



210.70 Lighting Outlets Required

Laundry areas have been added to the existing list of locations in 210.70(A)(1), requiring a listed wall-mounted control device to be installed for the lighting outlet

- ⚠ Prohibits the switch or wall-mounted control device from **relying solely on a battery** unless provided with a **means to energize lighting outlets upon failure**
- ⚠ This requirement only applies to dwelling unit locations in the following locations:
 - 🔌 every habitable room
 - 🔌 kitchen
 - 🔌 laundry area and
 - 🔌 bathroom
- ⚠ It should be noted that a wall-mounted control device controlling a receptacle(s) cannot be installed instead of a lighting outlet(s) in kitchens, laundry areas, and bathrooms



210.70 Lighting Outlets Required

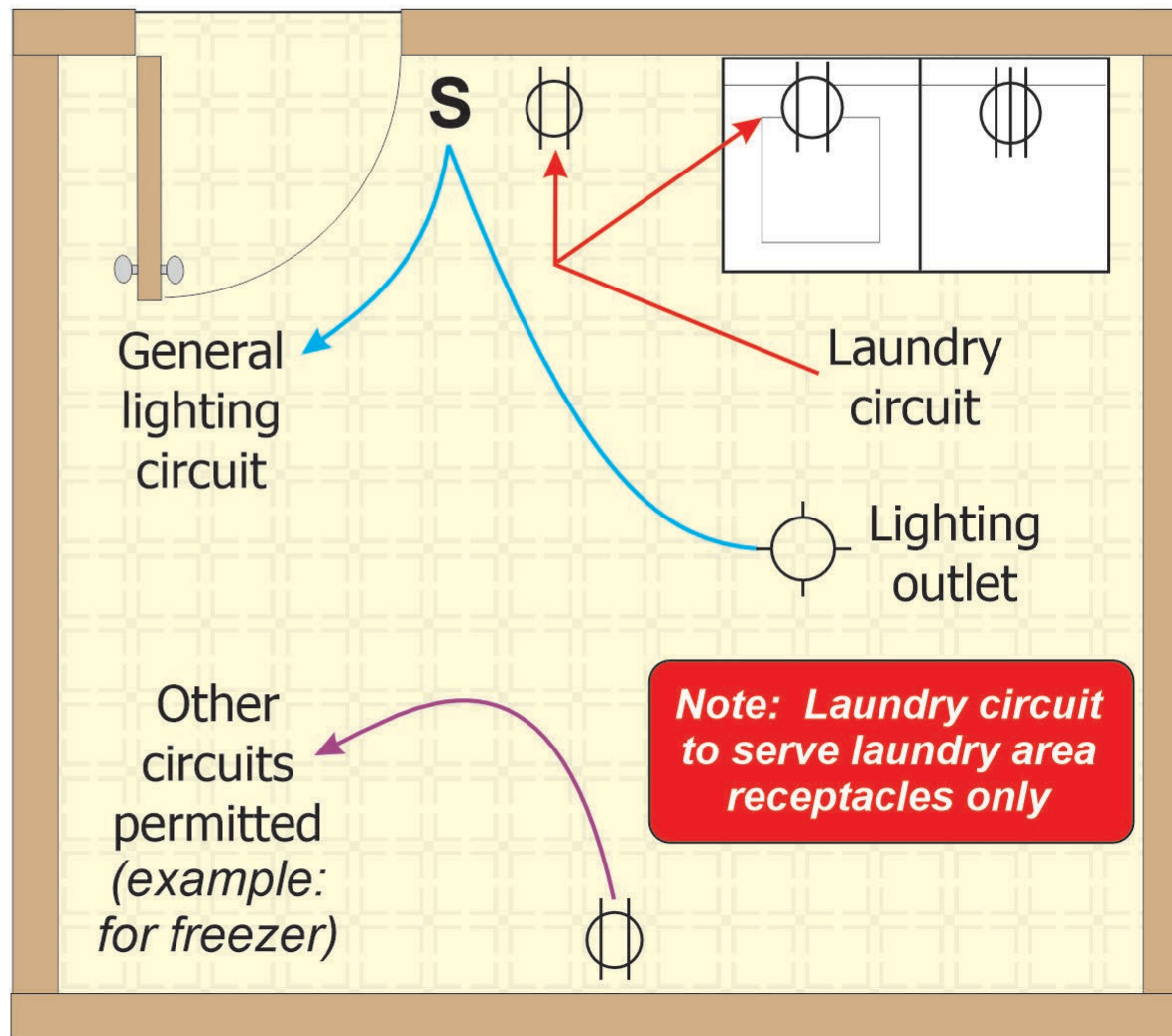
Laundry areas have been added to the existing list of locations in 210.70(A)(1), requiring a **listed wall-mounted control device** to be installed for the lighting outlet

Only applies to **dwelling unit** locations in the following locations:

- every habitable room
- kitchen
- **laundry area** and
- bathroom

Note:

A wall-mounted control device controlling a receptacle(s) cannot be installed instead of a lighting outlet(s) in kitchens, laundry areas, and bathrooms



Wall mounted control device
installed at the
entrance of the
laundry area



Article 215 Feeders



215.15 Barriers

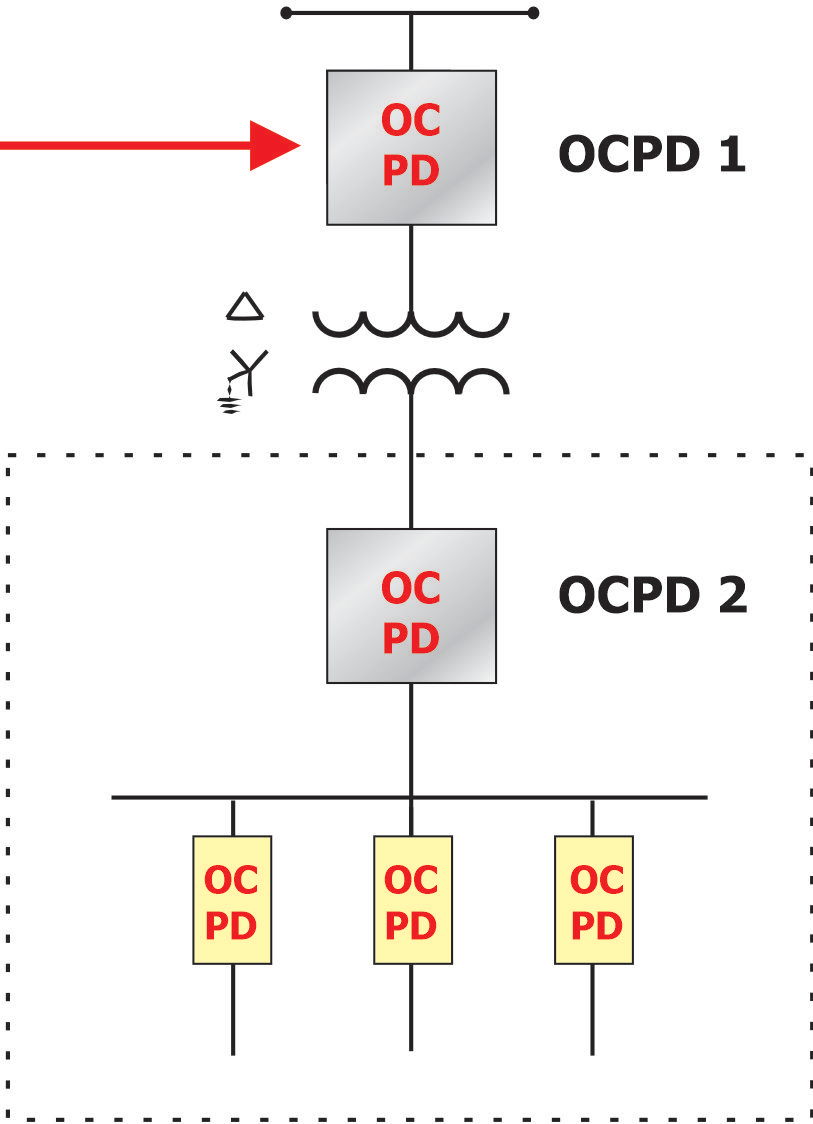
When feeder taps or transformer secondary conductors supply panelboards, switchboards, switchgear, or motor control centers, there must be barriers installed at load terminations when such terminations remain energized when the disconnect for the taps (*or transformer secondary conductors*) is in the off (*open*) position

- ⚠ When feeder taps or transformer secondary wiring feed a panelboard, for example, the line terminal lugs to a main breaker for the panelboard would remain energized even when the main breaker is turned off
- ⚠ Would add safety to the installation by requiring covers or barriers over the line terminals to the main breaker
- ⚠ Will provide additional safety for electrical workers



215.15 Barriers

Primary OCPD increased in size to address inrush of transformer causing initial delay increasing energy on secondary supplied equipment



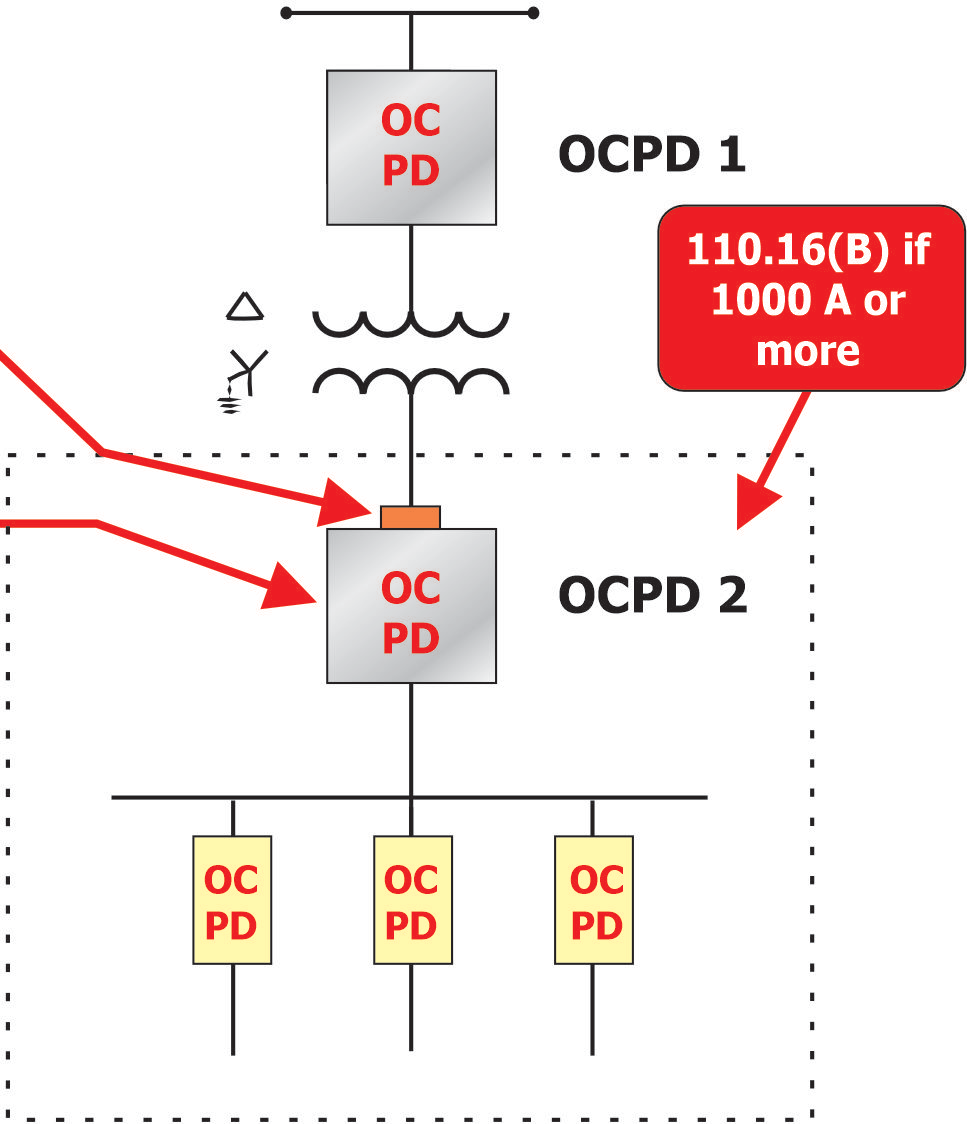
Severity
Risk is increased due to high incident energy at the first equipment on the load side of a transformer because of increased clearing time of the primary OCPD

215.15 Barriers

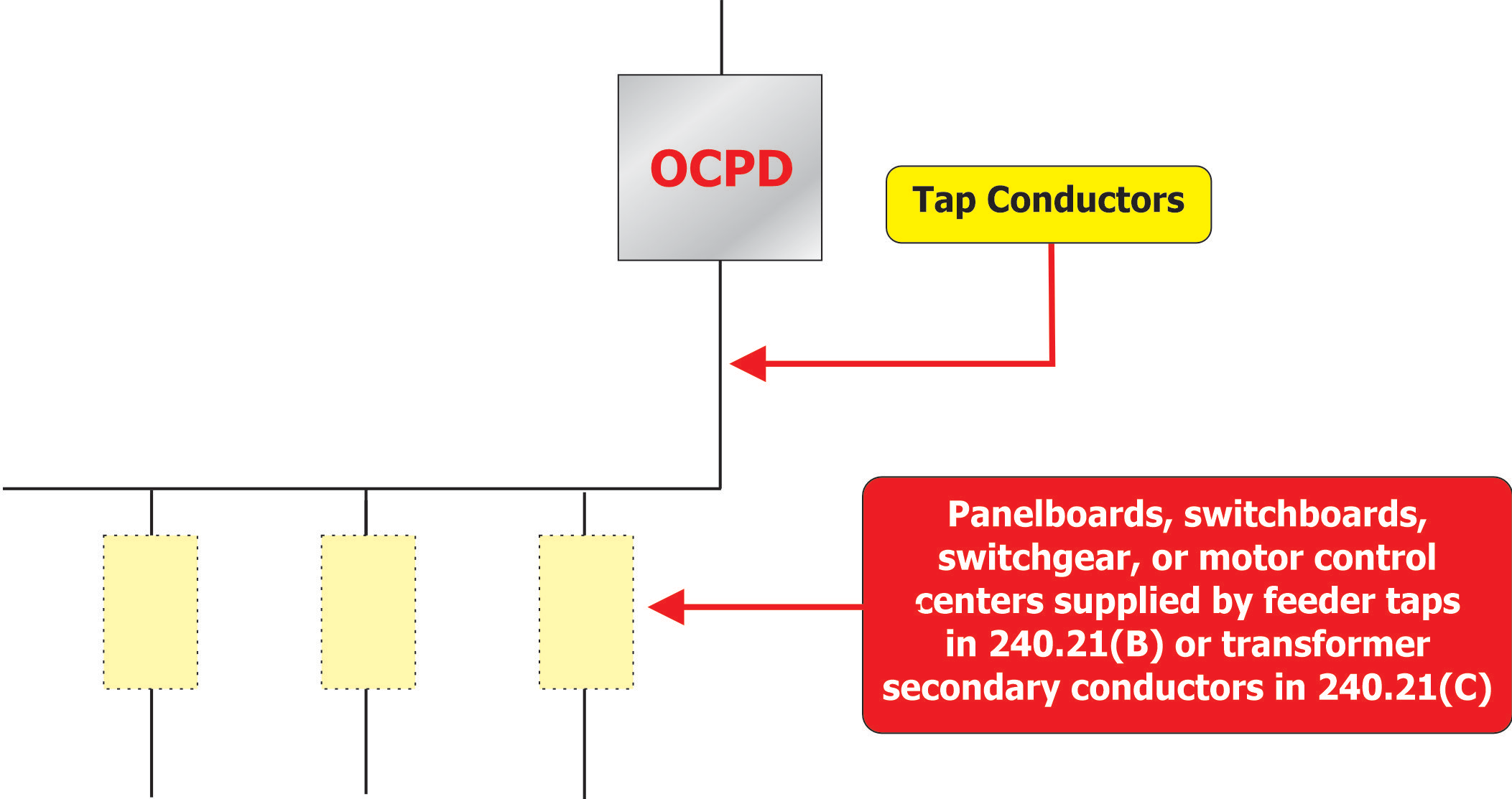
Barriers required as part of 215.15 and if service equipment as part of 230.62

Transformer secondary conductors for this panelboard must terminate on a main OCPD *[cannot use the 6-disconnect rule (408.36)]*

Mark the available fault current and the date the calculation was performed (408.6)

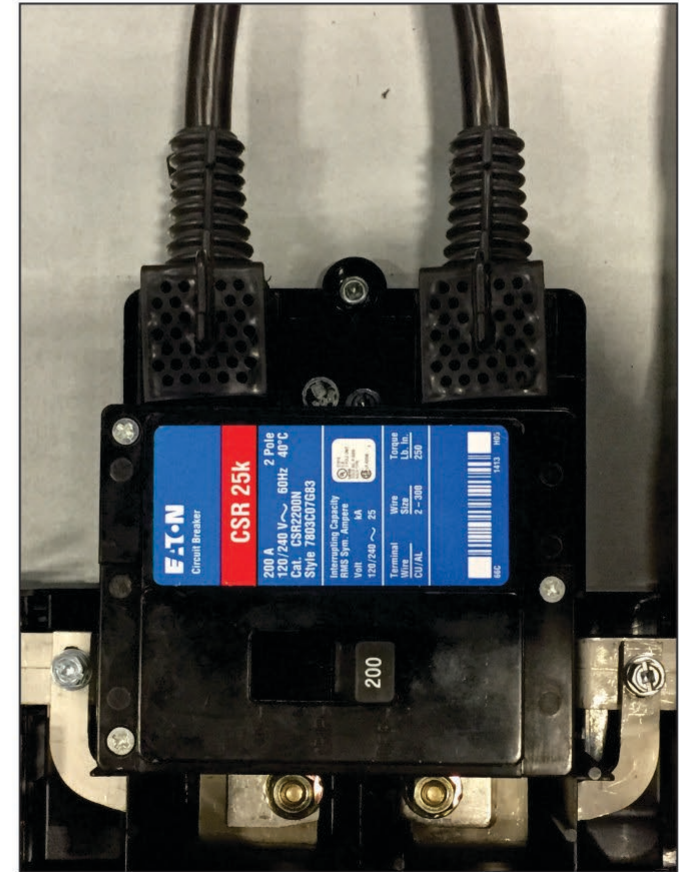
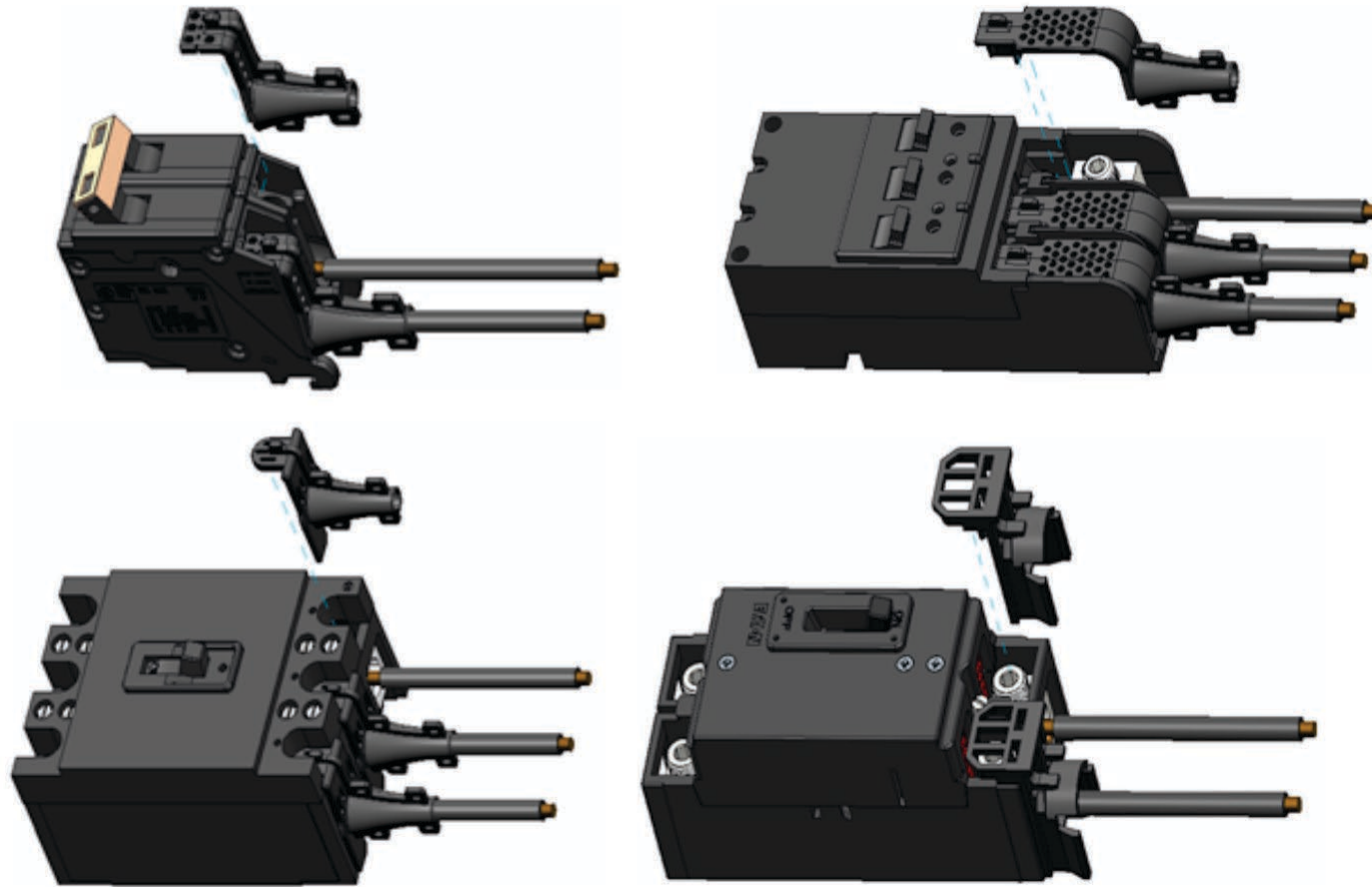


215.15 Barriers



215.15 Barriers (Feeders)

When **feeder taps or transformer secondary conductors** supply **panelboards, switchboards, switchgear, or motor control centers**, there must be barriers installed at load terminations when such terminations remain energized when the disconnect for the taps (or transformer secondary conductors) is in the off (open) position



Photos courtesy of Eaton

215.18 Surge Protection

New Section requires **Type 1 or 2 SPDs** when a service or feeder supplies a dwelling unit, dormitory unit, guest rooms of hotels and motels, and sleeping rooms/areas of nursing homes and limited-care facilities

- ⚠ Voltage surges can damage important sensitive equipment, such as smoke alarms, AFCIs, and GFCIs
- ⚠ These devices are very important in areas where people sleep
- ⚠ Rules have been expanded to ensure that SPDs are also required for feeders supplying other occupancies or areas used for sleeping purposes
- ⚠ Requirements specify SPD's must have a nominal discharge rating not less than 10kA
- ⚠ Note new requirements located for SPDs at 225.42 and 230.67



215.18 Surge Protection (Feeders)

Type 1 or 2 SPDs required when a **service or feeder supplies** a dwelling unit, dormitory unit, guest rooms of hotels and motels, and sleeping rooms/areas of nursing homes and limited-care facilities

Voltage surges can damage important sensitive equipment, such as smoke alarms, AFCIs, GFCIs, and electronic equipment



Courtesy of Leviton



Courtesy of Eaton



Photo courtesy of IAEI Archives



Photo courtesy of IAEI Archives



Article 220

Branch-Circuit, Feeder, and Service Load Calculations

Article 220 Restructuring

It was recognized that a few sections were not in the correct places within this Article. The following changes shifted the requirements into the correct buckets:

- ⚠ Section and Table 220.12 in part II for branch circuits is not used for calculating loads on branch circuits (*This section was appropriately relocated to Part III*)
- ⚠ Section 220.14 is titled “Other Loads – All Occupancies” yet this section included first level subdivisions dedicated to “Occupancy types”
- ⚠ The following were moved into their own sections found in part III
 - ✂ 220.14(J) Dwelling Units moved to 220.41 “Dwelling Units, Minimum Unit Load”
 - ✂ 220.14(K) Office Buildings moved to 220.43 with same name
 - ✂ 220.14(M) Hotel and Motel Occupancies moved to 220.44 with same name



220.1 Scope

Information was added to the scope of Article 220 concerning calculation methods for health care facilities and marinas, boatyards, floating buildings, and commercial and noncommercial docking facilities

⚠ Two new parts were added to Article 220 and referenced in the scope

✎ Part VI addresses calculation methods for **health care facilities**

✎ Part VII addresses calculation methods for **marinas, boatyards, floating buildings, and commercial and noncommercial docking facilities**

⚠ The existing Figure Informational Note 220.1 was also revised



220.1 Scope (*Branch-Circuit, Feeder, and Service Load Calculations*)

Information added to the scope for calculation methods for **health care facilities** and **marinas, boatyards, floating buildings, and commercial and noncommercial docking facilities**

Two new parts were added to **Article 220** and referenced in the scope (*Article 220 was restructured*)

- **Part VI** addresses calculation methods for health care facilities
- **Part VII** addresses calculation methods for marinas, boatyards, floating buildings, and commercial and noncommercial docking facilities



Photos courtesy of IAEI Archives

220.5 Calculations

(C) Floor Areas

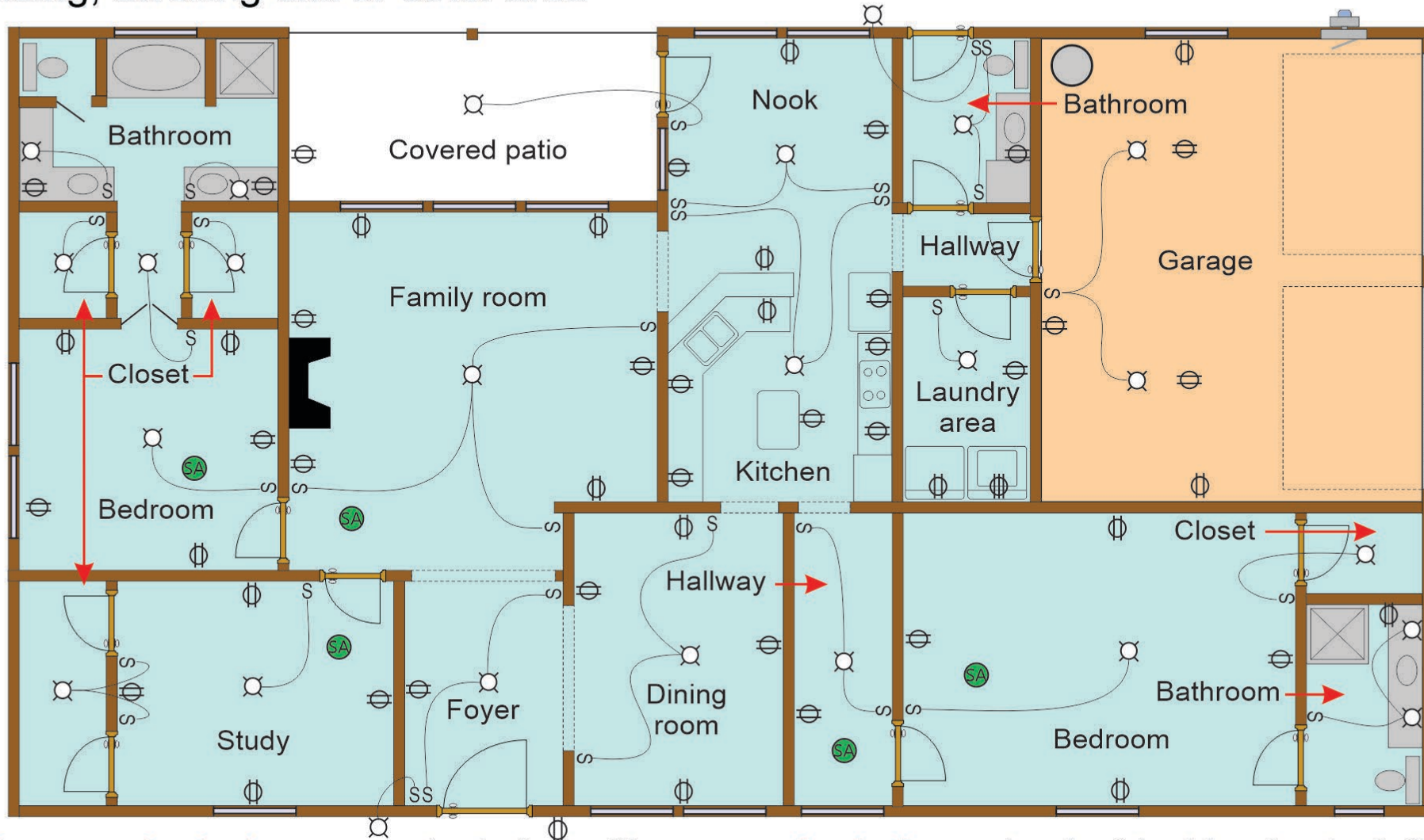
Areas such as **garages, or unfinished areas that can be adaptable for future use as a habitable room or occupiable space** are no longer excluded from the calculated floor area of the building, dwelling unit or other area

- ⚠️ A new subsection (C) was added to Section 220.5(C) entitled “Floor Areas”
- ⚠️ The previous text “**not adaptable for future use**” was considered subjective and reworded for clarity
- ⚠️ Garages and other spaces often are used as ancillary space to the habitable portions of the dwelling
- ⚠️ These spaces will now be included in dwelling, building, or other space square foot calculation



220.5(C) Floor Areas (Calculations)

Areas such as **garages, or unused or unfinished areas that can be adaptable for use as a habitable room or occupiable space** are no longer excluded from the calculated floor area of the building, dwelling unit or other area



Orange shaded area now included with **green shaded area** in electrical load calculation



NO
TRESPASSING
VIOLATORS
WILL BE SHOT

Photos courtesy of IAEI Archives

220.57 Electric Vehicle Supply Equipment (EVSE) Load

New Section 220.57 has been added to specify load calculations for Electric Vehicle Supply Equipment (EVSE)

- ⚠️ Electric Vehicle Supply Equipment (EVSE) is becoming more and more prevalent
- ⚠️ Charging infrastructure is necessary, and there was a need for the NEC to offer some direction as to load calculation requirements
- ⚠️ This language specifies the use of **7200 volt-amperes** or the **VA rating from the nameplate of the equipment**, whichever is the larger of the two
- ⚠️ A 7200 volt-ampere (VA) minimum requirement was chosen and is based on a 30 ampere, 240-volt, single-phase circuit



220.57 Electric Vehicle Supply Equipment (EVSE) Load

Section has been added to specify load calculations for Electric Vehicle Supply Equipment (EVSE)

This language specifies the use of **7200 volt-amperes** or the **VA rating from the nameplate** of the equipment, whichever is the larger of the two

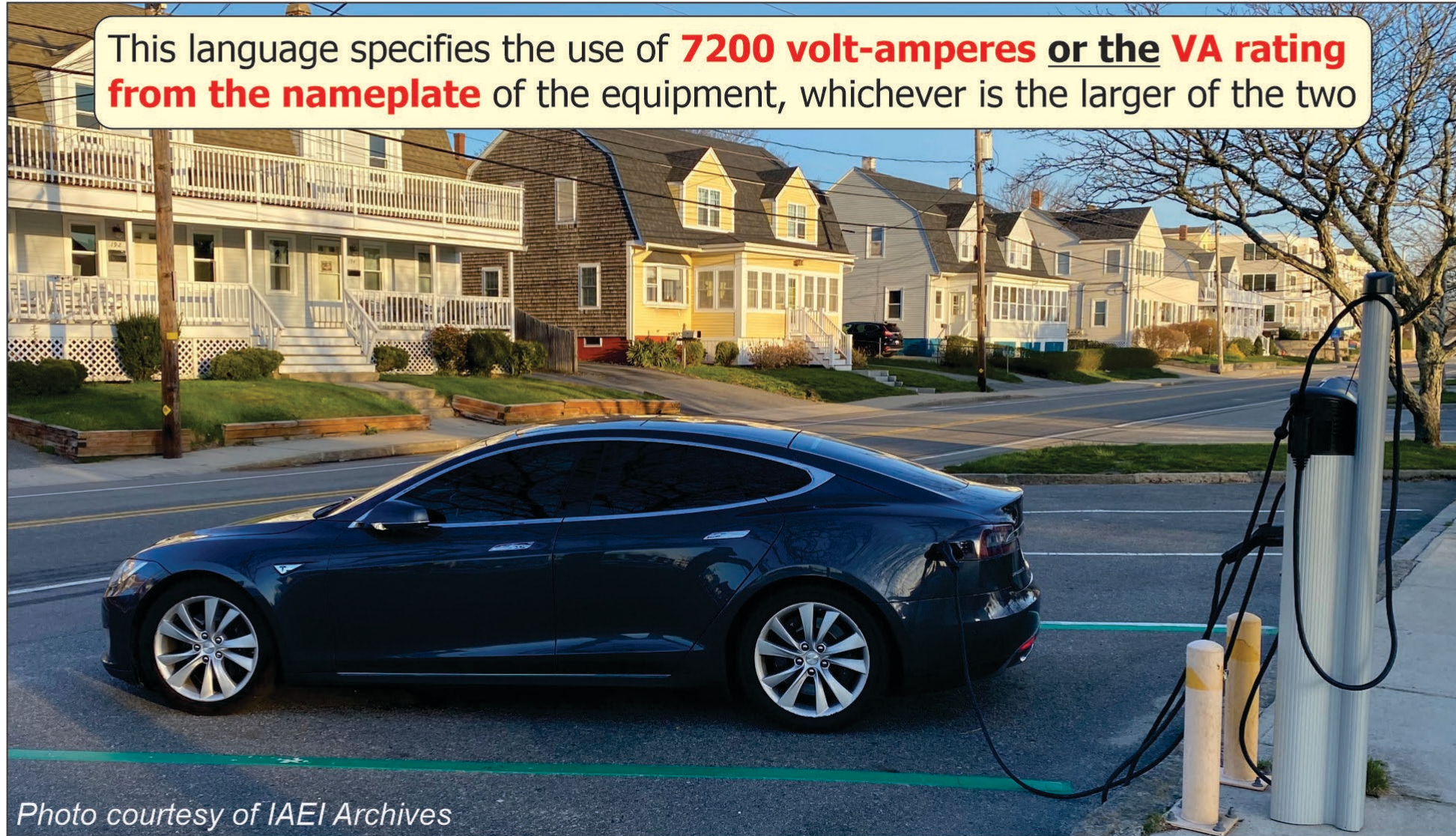


Photo courtesy of IAEI Archives

220.70 Energy Management Systems (*EMSs*)

A new section has been added to specify load calculations for Energy Management Systems (*EMSs*)

- ⚠ Resulted from a correlating committee task group focused on alternative energy requirements
- ⚠ Seeks to build upon specific allowances providing a **new option** for any load connected to a feeder or service conductor where these loads are controlled to a maximum limit that effectively restricts the total loads operated at one time
- ⚠ If an EMS is used in accordance with 750.30, requirements are provided concerning the maximum value setpoint
- ⚠ The option allows electric distribution systems to be utilized in a safe and effective manner
- ⚠ This will help property owners to pursue the use of EMS equipment without requiring extensive electrical system upgrades



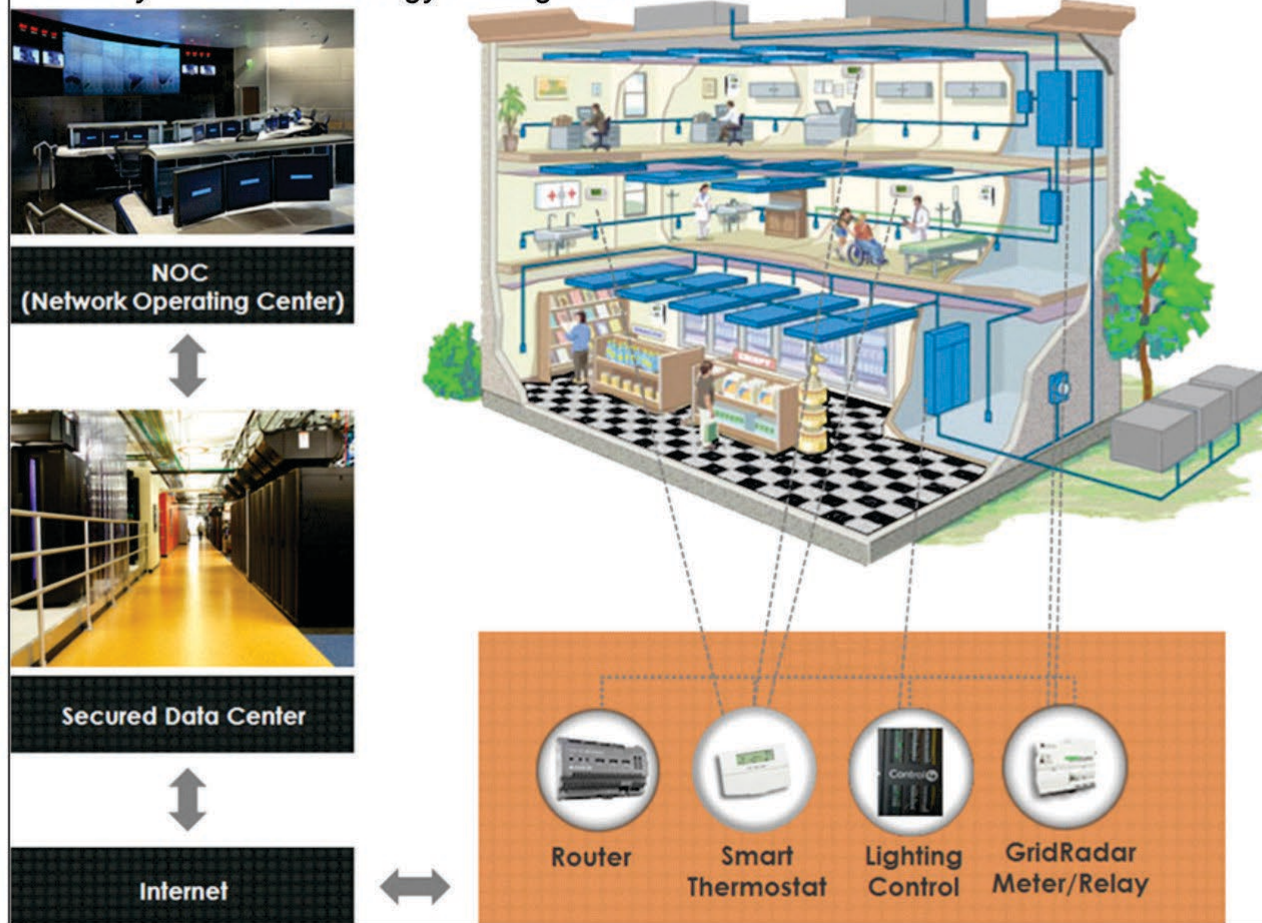
220.70 Energy Management Systems (Communication Circuits)

A new section has been added to specify load calculations for Energy Management Systems (EMSs)

Option allows electric distribution systems to be utilized in a safe and effective manner

Seeks to build upon specific allowances **providing a new option** for any load connected to a feeder or service conductor where these loads are controlled to a **maximum limit** that **effectively restricts the total loads operated at one time**

Courtesy of Sentinel Energy Management



220.70 Emergency Management Systems (EMSs)

An example of a product that is available to assist in load management for EV Charging

The DCC-12 has a NEMA 3R enclosure approved for indoor and outdoor installations

DCC allows the connection of any EV charger to a fully loaded panel by managing the energy available at any given time, whether in a home or in a condo

Ideal for the installation of EV chargers in single-family homes with a full electrical panel



Photo courtesy of DCC Electric

220.110 Receptacle Loads

New demand factors for receptacles added to Part VI, Health Care Facilities, for Category 1, 2, 3, and 4 patient care spaces

- ⚠ **Table 220.110(1)** Demand Factors for Receptacles Supplied by General-Purpose Branch Circuits in **Category 1 and Category 2** Patient Care Spaces
- ⚠ **Table 220.110(2)** Demand Factors for Receptacles Supplied by General-Purpose Branch Circuits in **Category 3 and Category 4** Patient Care Spaces
- ⚠ The Correlating Committee and the Standards Council determined that CMP-2 has responsibility for occupancy-based load calculations and demand factors (**Note: CC gave purview of this requirement to CMP-15 at CC Meeting**)
- ⚠ The focus was concerning the large number of receptacles required in Category 1 and Category 2 patient care spaces
- ⚠ New tables were developed, which included demand factor values to apply to receptacles used in a health care facility



Change driven by increased number of required receptacles in a hospital. Section 6.2 of NFPA 99 was revised increasing the number of receptacles required in operating rooms. NFPA 70 517.19(C) requires operating rooms to be provided with a minimum of 36 receptacles.



Photo courtesy of IAEL Archives



Photo courtesy of IAEI Archives



MAIN DIRECTORY
MICU
(Tower 1 Elevator to 2nd Floor)
SICU
Surgery Waiting
Administration
Tower 1
Harvey Jones Tower
Cafeteria
Prep Center

Photos courtesy of IAEI Archives

8000



Methodist

McKINNEY HOSPITAL

 **EMERGENCY**

SB

220.120 Receptacle Loads

Marinas, Boatyards, Floating Buildings, and Commercial and Noncommercial Docking Facilities

- ⚠ Requirements of Section 555.6 have been **relocated** to Part VII 220.120
- ⚠ This will not change the requirements for load calculations or demand factors
- ⚠ Article 220 entitled *Branch Circuit, Feeder, and Service Load Calculations*, is the logical place for users of the *Code* to find information concerning these calculations





Photo courtesy of IAEI Archives



Article 225

Outside Branch-Circuits and Feeders

Sections 225.5 and 225.7

Sections 225.5, *Size of Conductors 1000 Volts, Nominal, or Less*, and 225.7, *Lighting Equipment Installed Outdoors*, **were deleted**

- ⚠ Section 225.5 was redundant since such requirements can be found in Articles 215 and 220
- ⚠ Section 225.7 was also redundant since such requirements can be found in Articles 210 and 220



225.41 Emergency Disconnects

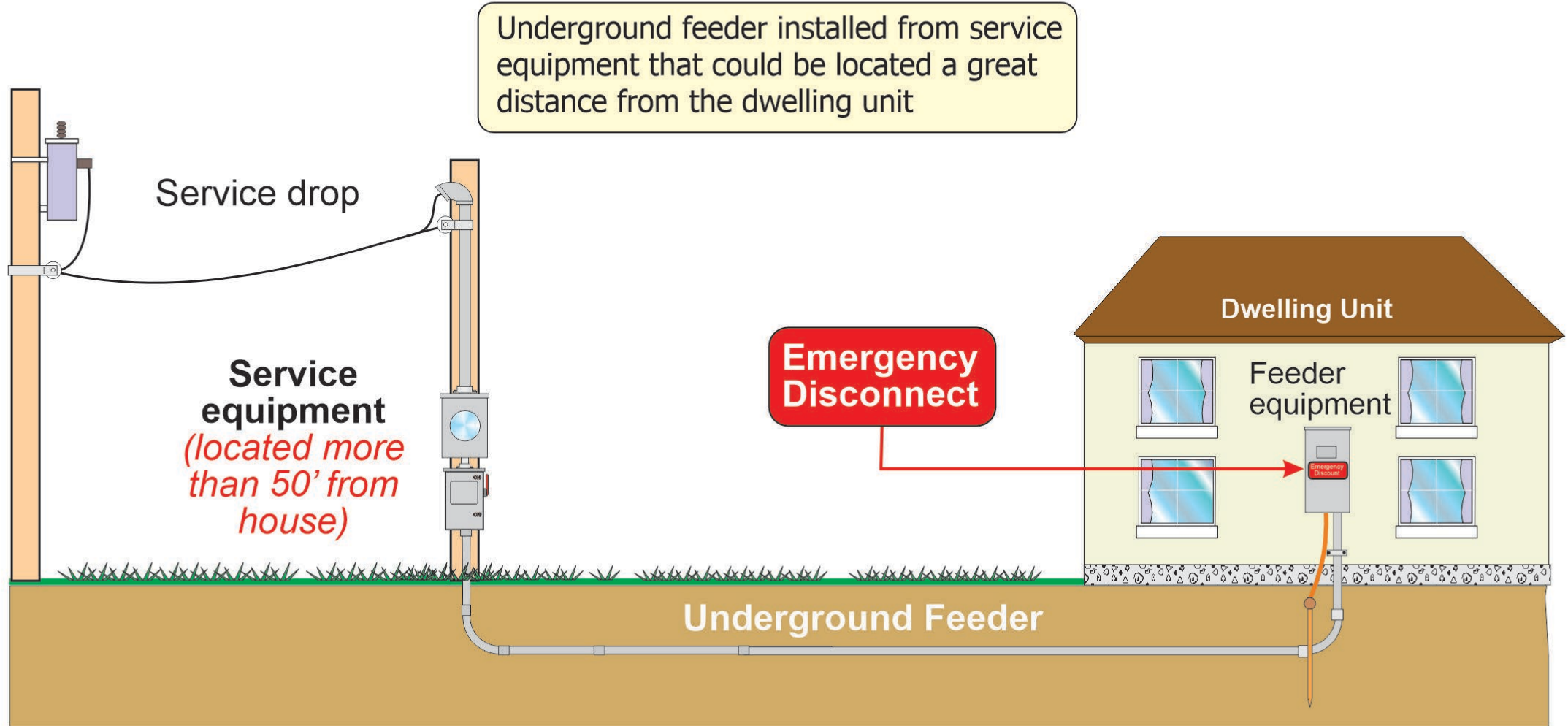
New requirements for an emergency disconnect at a readily accessible outdoor location for one-and two-family dwelling units that are served by feeders

- ⚠ One-and two-family dwelling unit are not always fed by a service but instead by an outdoor feeder
- ⚠ This ensures that all new one-and two-family dwelling units are provided with an emergency disconnect located at a **readily accessible outdoor location** on or **within sight of the dwelling unit** (see definition of *Within Sight* in Article 100)
- ⚠ This disconnect to be marked as **“EMERGENCY DISCONNECT”**
- ⚠ Plaque, or directory must also be provided adjacent to the emergency disconnect identifying the location(s) of any other energy source disconnect on the premises
- ⚠ The disconnect must be on or within sight of the dwelling unit



225.41 Emergency Disconnects

Requires an **emergency disconnect** at a readily accessible outdoor location for one-and two-family dwelling units that are **served by feeders**



Article 230

Services



230.62 Service Equipment- Enclosed or Guarded

(C) Barriers

Clarifies the requirements for barrier installation in service equipment **when the service disconnect is in the open position**

- ⚠ Installed in such a way that no uninsulated, ungrounded busbars or terminals are exposed to inadvertent contact while load terminations are being serviced when the service disconnect is in the open position
- ⚠ Main point of the barrier requirement is to provide insulation to busbars or terminals while load terminations are being serviced
- ⚠ Barriers have proven to increase safety for electrical professionals working on service equipment



230.62(C) Barriers

Clarifies the requirements for barrier installation in service equipment

Ensure no uninsulated, ungrounded busbars or terminals are exposed to **inadvertent contact** while load terminations are being serviced when the service disconnect is in the open position

Barrier requirement is to provide insulation to busbars or terminals while load terminations are being serviced



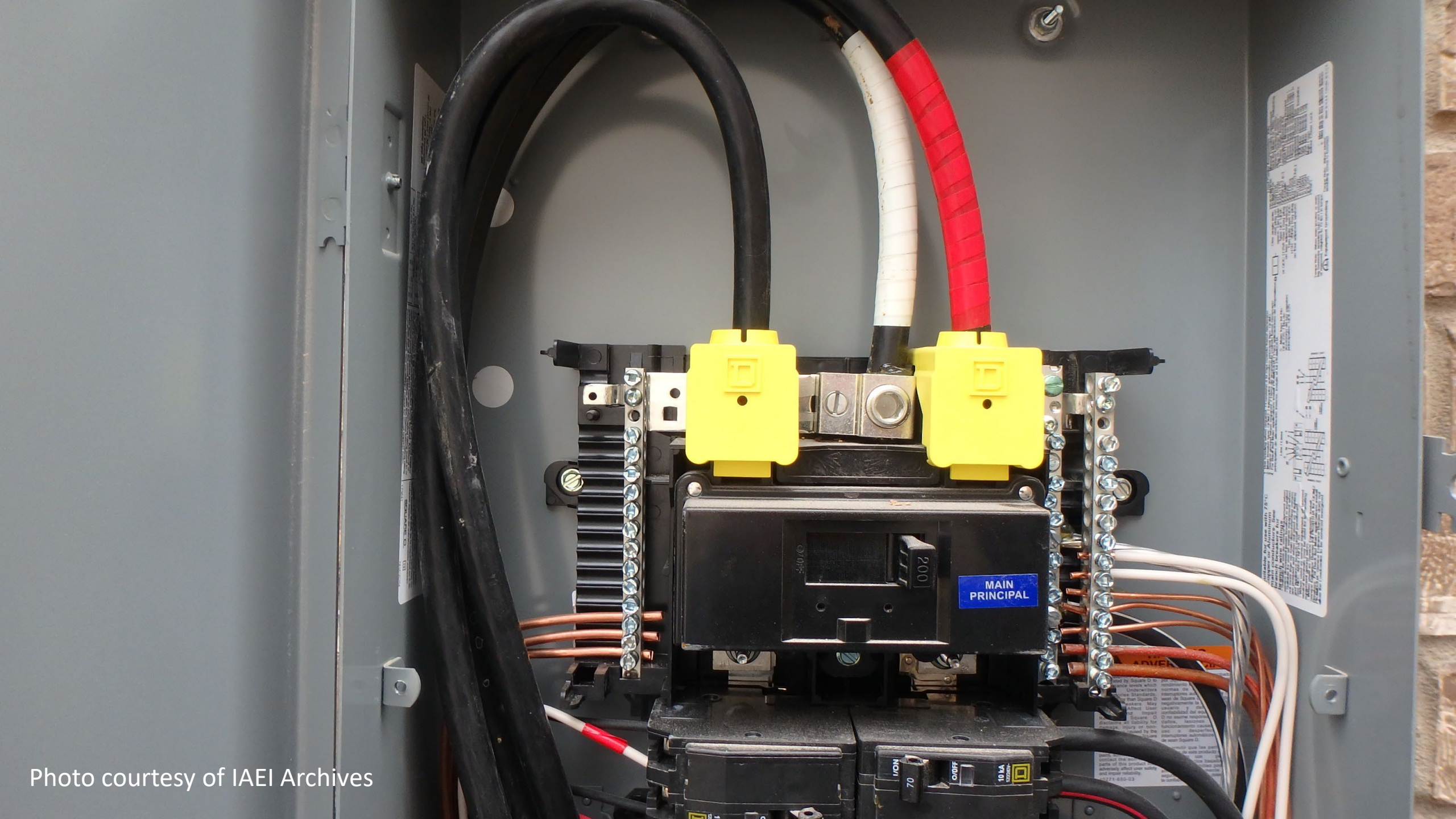


Photo courtesy of IAEI Archives

230.67 Surge Protection

(A) Surge-Protective Device

Existing term “dwelling units” changed to “the following occupancies” and added a list of additional locations that now require protection by a surge-protective device (*SPD*)

- ⚠ Service equipment can, at times, be subjected to surges that inflict damage on systems designed to provide life safety
- ⚠ Recognized industry authorities such as NEMA, IEEE, and UL, have collected data showing surges cause significant damage
- ⚠ Electronic life-saving equipment, such as fire alarm systems, GFCIs, AFCIs, and smoke alarms, could be rendered inoperable when a surge occurs (*Many times, this damage is undetected by the owner*)



230.67 Surge Protection (cont.)

(A) Surge-Protective Device (cont.)

Existing term “dwelling units” changed to “the following occupancies” and added a list of additional locations that now require protection by a surge-protective device (*SPD*)

⚠ Additional occupancies added include:

- ✎ dormitory units,
- ✎ guest rooms and guest suites of hotels and motels, and
- ✎ areas of nursing homes and limited-care facilities used exclusively as patient sleeping rooms



230.67(A) Surge-Protective Devices

Changed the existing term “dwelling units” to “the following occupancies” and added a list of additional locations that now require protection by a surge-protective device (SPD)

Additional occupancies now include:

- dormitory units
- guest rooms and guest suites of hotels and motels
- areas of nursing homes and limited-care facilities used exclusively as patient sleeping rooms

Electronic life-saving equipment such as fire alarm systems, GFCIs, AFCIs, and smoke alarms, could be rendered inoperable when a surge occurs

(Many times, this damage is undetected by the owner)



Photo courtesy of Eaton



Photo courtesy of Siemens

230.71 Maximum Number of Disconnects

(B) Two to Six Service Disconnecting Means

Transfer switches were added to clarify that they must be listed for and used as service equipment

- ⚠ Sections 230.71(B)(4) and (6) increase the ease of usability for the *Code* by adding these requirements to the existing list items
- ⚠ Motor control centers used as service equipment were also added with requirements limiting a maximum of two service disconnects per single motor control center and barriers required between each unit or compartment containing a service disconnect
- ⚠ Barrier provisions were added for additional types of service equipment to improve safety by reducing the likelihood of a person or maintenance equipment coming in contact with energized parts while servicing load terminations
- ⚠ Each service disconnect is to be provided in a separate compartment



230.71(B) Two to Six Service Disconnecting Means

Transfer switches were added to clarify that they must be listed for and used as service equipment

Transfer switch where each disconnect located in a separate compartment

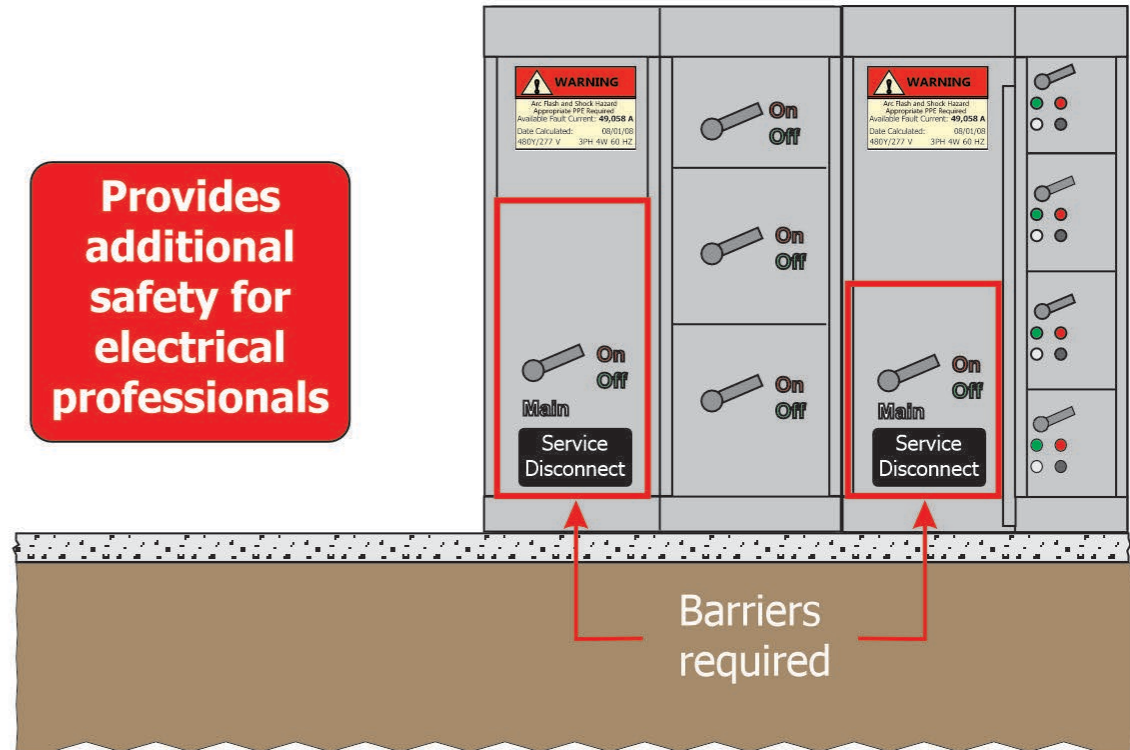


Photo courtesy of Eaton

Motor control centers used as service equipment limiting to a maximum of two service disconnects per single motor control center

Barriers required between each unit or compartment containing a service disconnect

Provides additional safety for electrical professionals



230.71 Maximum Number of Disconnects

(B) Two to Six Service Disconnecting Means

An exception was added to clarify that existing service equipment is not required to comply with the provisions of 230.71(B) when existing equipment was installed in compliance with previous editions of the *NEC*, allowing for up to six service disconnects in a single enclosure or compartment

- ⚠ Will aid in the enforcement of service equipment disconnecting means installed before this edition of the *Code*
- ⚠ Concern was expressed when an installer wanted to add a disconnect to existing service equipment that allowed for more than one disconnect means
- ⚠ Could be interpreted that the entire service equipment was required to be replaced
- ⚠ New exception clarifies that existing service equipment in compliance with previous editions of the *NEC* is not required to be upgraded



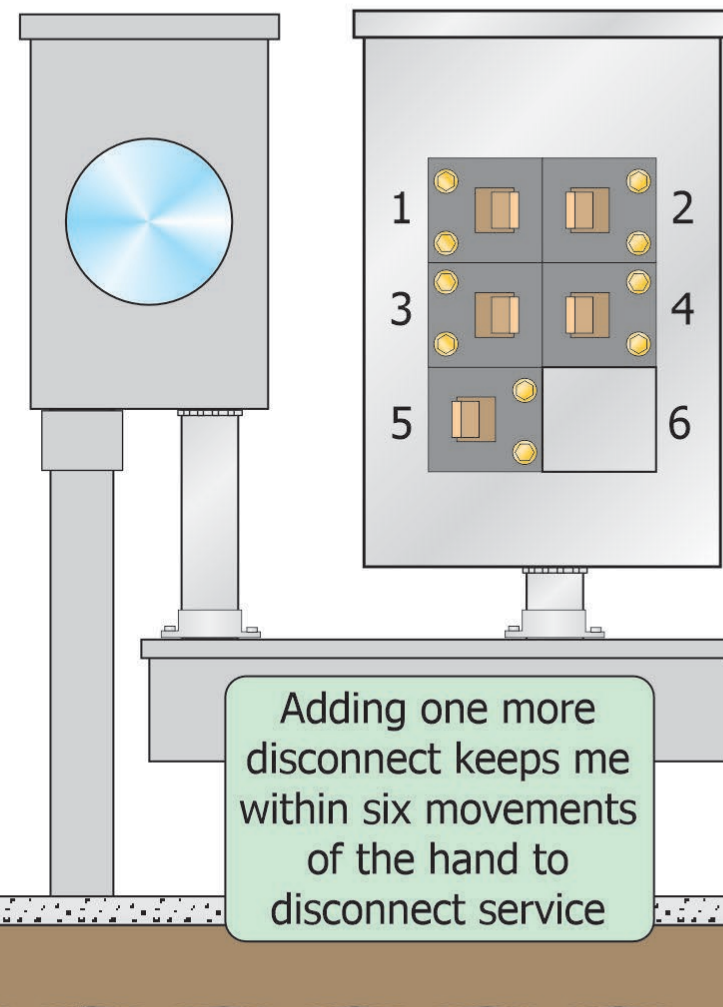
230.71(B) Two to Six Service Disconnecting Means

Existing service equipment is **not required to comply** with the provisions of 230.71(B)

When **existing equipment was installed in compliance with previous editions of the NEC** allowing for up to six service disconnects in a single enclosure or compartment

Existing service equipment with additional disconnecting means available *(no need to upgrade equipment)*

Will aid in the enforcement of service equipment disconnecting means





Service enclosure with
up to 6 disconnecting
means (*5 disconnects*)



230.85 Emergency Disconnects

Section 230.85 was reorganized into sub-sections with titles to better align with the formatting requirements of the *NEC Style Manual*

- ⚠ Clarifies that meter disconnects integral to meter mounting equipment or other listed disconnects used as the emergency disconnect cannot be marked as “suitable ONLY for use as service equipment”
- ⚠ This requirement does not apply to the regular service disconnect(s) for the one- and two-family dwelling [see 230.85(B)]
- ⚠ Section 230.85(C) was added to clarify that all of 230.85 applies to new (*or replaced*) service equipment
- ⚠ An exception was added to clarify that when only meter sockets, service conductors, service raceways, and/or fittings are replaced, 230.85 does not apply
- ⚠ Section 230.85(D) specifies that a plaque or directory be provided adjacent to the emergency disconnect identifying the location(s) of any other energy source disconnect on the premises



230.85 Emergency Disconnects (1 and 2 Family Dwelling Units)

Section was **reorganized into subdivisions with titles** to better align with the formatting requirements of the *NEC Style Manual*

Applies to new (or replaced) service equipment

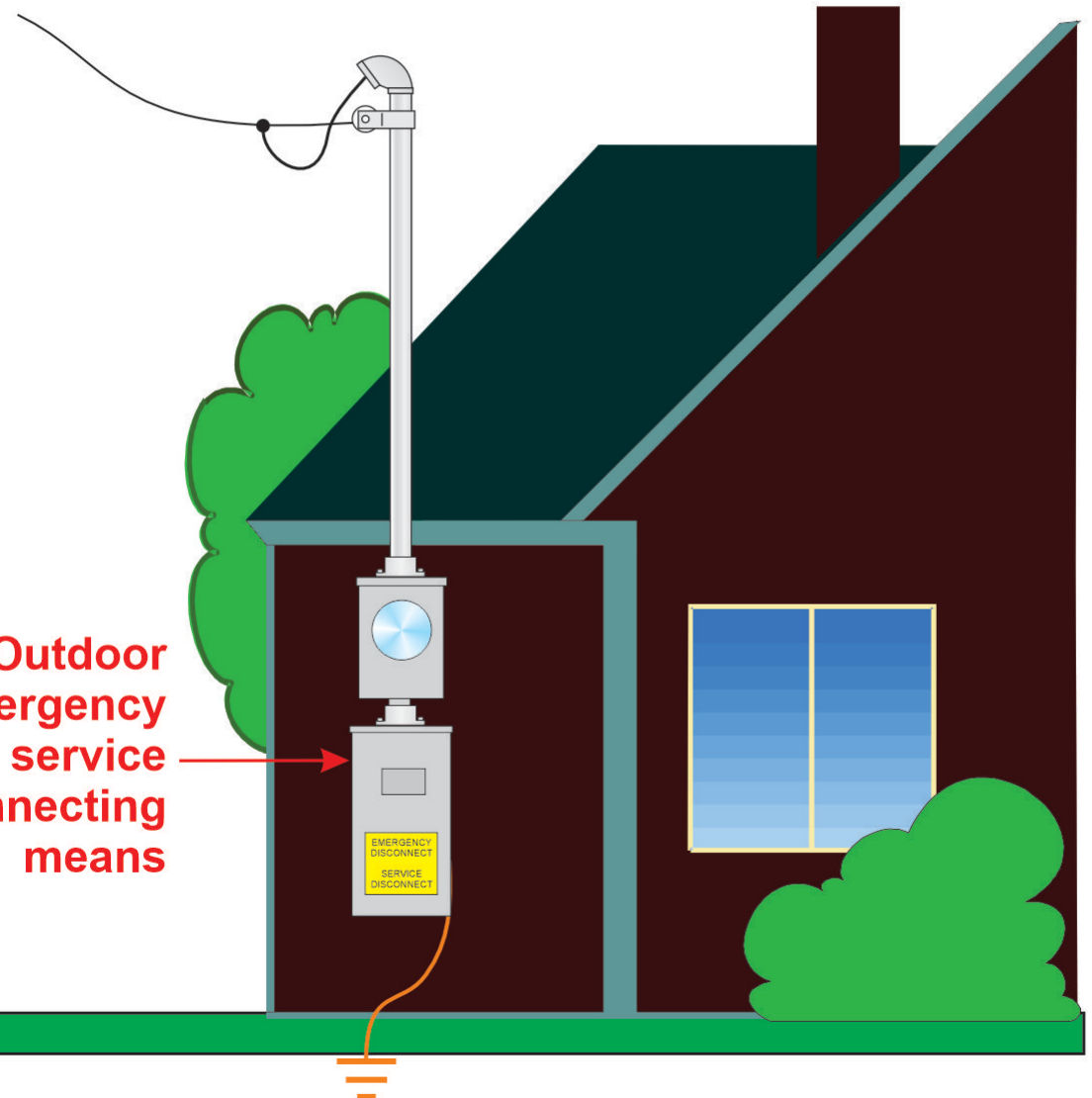
Does not apply when only meter sockets, service conductors, service raceways, and/or fittings are replaced

Requires a **plaque or directory** adjacent to the emergency disconnect identifying the location(s) of any **other energy source disconnect** on the premises

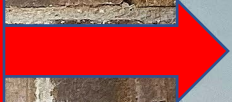
The layout of 230.85:

- General
 - Location
 - Rating
 - Grouping
- Disconnects
- Replacement
- Location of Other Isolation Disconnects
- Marking

Outdoor emergency service disconnecting means



Labeled as
Emergency
Disconnect



Listed and labeled as the Service Disconnect



Photo courtesy of IAEI Archives

Article 235

Branch Circuits, Feeders, and
Services Over 1000 Volts ac,
1500 Volts dc, Nominal

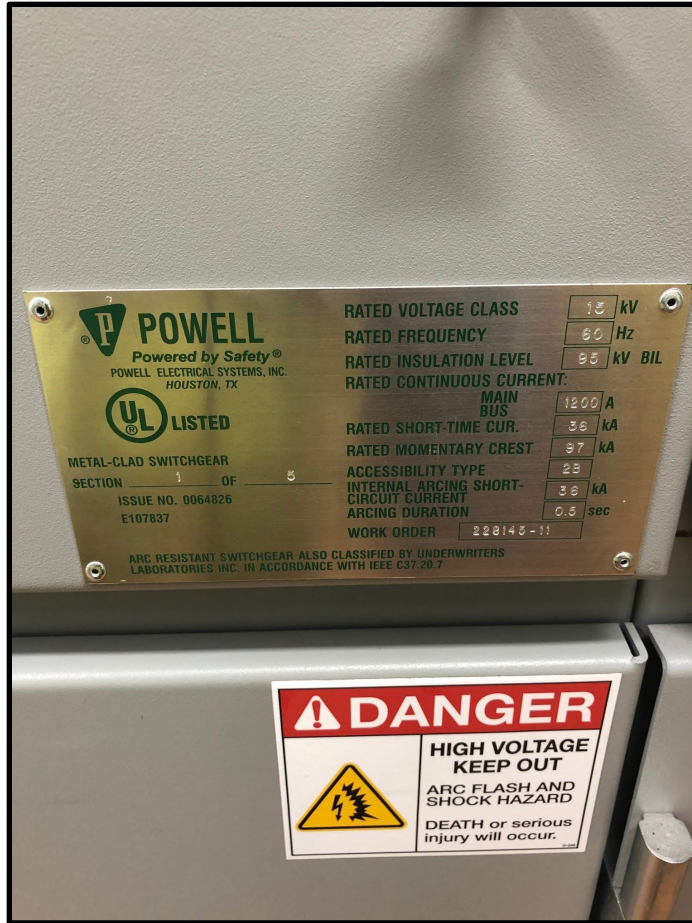
Article 235 Branch Circuits, Feeders and Services Over 1000 Volts ac, 1500 Volts dc, Nominal

New Article 235, entitled *Branch Circuits, Feeders and Services Over 1000 Volts ac, 1500 Volts dc, Nominal* has been created to govern **medium voltage branch circuits**

- ⚠ This new article will become the **placeholder** for information pertaining to medium voltage branch circuits, feeders and services
- ⚠ Previously, information for medium voltage branch circuits was located throughout the *NEC*
- ⚠ Requirements from Article 210 were reviewed for applicability to medium voltage branch circuits
- ⚠ Information from Article 210 that was applicable to these circuits have been copied and moved to this article
- ⚠ Some requirements were modified as necessary without making technical changes or modifying the existing requirement
- ⚠ **Note:** This was originally under the purview of CMP-2 but may be assigned to CMP-10 at the August 2022 Correlating Committee meeting



Article 235 Branch Circuits Over 1000 Volts ac, 1500 Volts dc



Photos courtesy of Chris Faucette, CMP-17



Photo courtesy of Scott Humphrey



WARNING
POTENTIAL ELECTRIC ARC
FLASH HAZARD
QUALIFIED PERSONS ONLY
A3717 1992 E02

B4

A4

C3

B3

A3

Photo courtesy of Scott Humphrey


Article 240

Overcurrent Protection

240.1 Scope

Article 240 now only applies for installations not more than 1000 volts, nominal (*Medium voltage requirements relocated to Article 245*)

Parts I through VII:

-  General requirements for overcurrent protection and overcurrent protective devices not more than 1000 volts, nominal

Part VIII:

-  Overcurrent protection for supervised industrial installations operating at voltages of not more than 1000 volts, nominal

Article 245:

-  Overcurrent Protection for Systems Rated Over 1000 Volts ac, 1500 Volts dc

240.2 Reconditioned Equipment

The reconditioning requirements previously located at 240.62 and 240.88 were relocated to Section 240.2

- ⚠ The xxx.2 sections have started becoming the placeholders for reconditioned equipment requirements
- ⚠ Restrictions on using reconditioned GFPE or GFCI devices were added
- ⚠ A new and listed device should be installed in its place upon failure of the device
- ⚠ This complies with Correlating Committee recommendations
- ⚠ Adds usability for the *NEC* user as this placeholder will be consistently located in each article



240.2 Reconditioned Equipment

Reconditioning requirements previously located at 240.62 and 240.88 were relocated here

Consistent placeholder in the *Code Restrictions* on using reconditioned GFPE or GFCI devices were added
New and listed device to be installed in place upon failure of the device

Reconditioning Permitted

Low Voltage Power Circuit Breakers

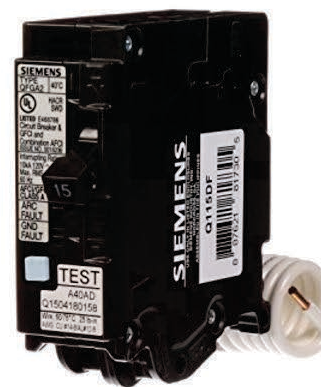
Electromechanical Relays and Current Transformers

Reconditioning Not Permitted



Courtesy of Pass & Seymour/Legrand

Courtesy of Eaton Corporation



Courtesy of Siemens Electric



Courtesy of Schneider Electric

240.4 Protection of Conductors

(B) Overcurrent Devices Rated 800 Amperes or Less

Adjustable trip overcurrent protective devices are permitted to have an ampacity value set that does not exceed the next higher standard overcurrent protection device ampacity value *[per Table 240.6(A)]* above the ampacity of the conductors being protected

- ⚠ Adjustable trip overcurrent devices are being used increasingly throughout the country
- ⚠ Requirements of 240.4(B)(1), 240.4(B)(2), and 240.4(B)(3) still apply
- ⚠ Adjustable trip overcurrent protective device must be provided with restricted access per 240.6(C)
- ⚠ Adds flexibility for designers and electrical professionals when choosing overcurrent protection devices for electrical systems



240.4(B) Overcurrent Devices Rated 800 Amperes or Less

Adjustable trip overcurrent protective devices (OCPD) are **permitted to have an ampacity value** set that **does not exceed** the next higher standard OCPD device ampacity value [per Table 240.6(A)] above the ampacity of the conductors being protected

Devices are **permitted to be adjusted** according to **240.4(B)**
Adjustable trip overcurrent protective device must be provided with **restricted access** per **240.6(C)**



Circuit breaker photos courtesy of Chad Kennedy, Schneider Electric

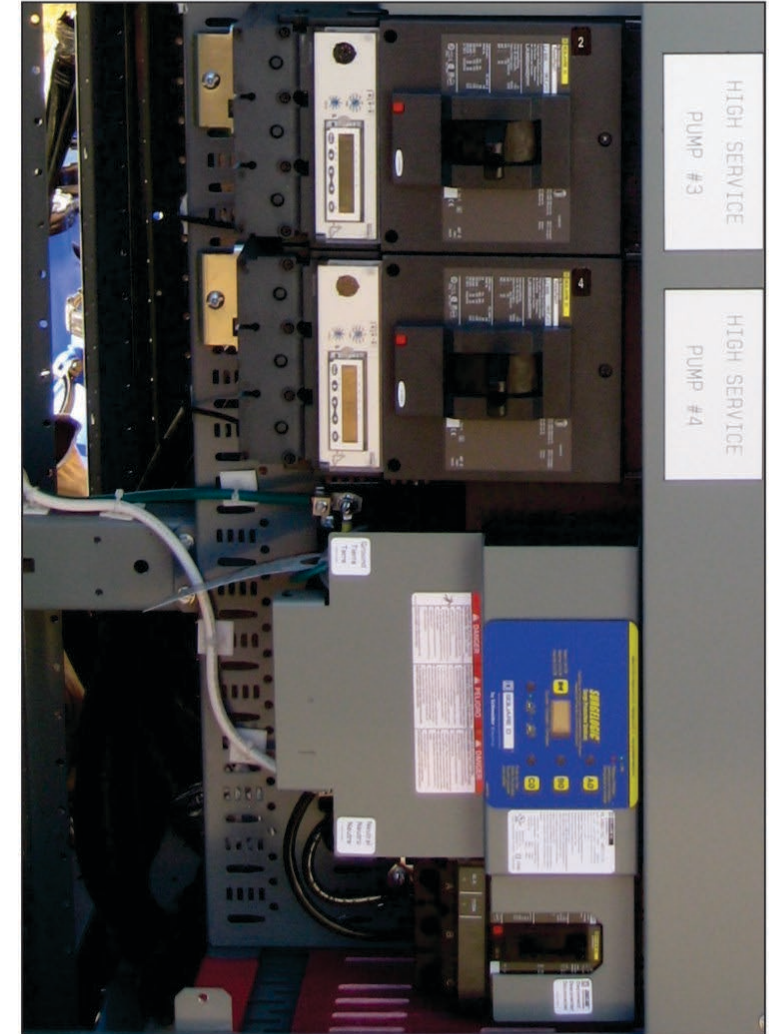


Photo courtesy of Jim Lefevre, Multi Craft Contracting

240.4 Protection of Conductors

(D) Small Conductors

(3) 14 AWG Copper-Clad Aluminum

New added list item to the list of permitted small conductors

- ⚠ Has been added to align with other small conductors permitted per 240.4(D)
- ⚠ **Overcurrent protection** device rating for the conductors **cannot exceed 10 amperes**, and the **maximum continuous load** on the circuit **cannot exceed 8 amperes**
- ⚠ Branch-circuit-rated breakers or fuses that the conductors connect to **must be listed and marked for use** with such conductors
- ⚠ Offers the electrical industry more flexibility when choosing types of conductors to install for certain circuits



240.4(D)(3) 14 AWG Copper-Clad Aluminum

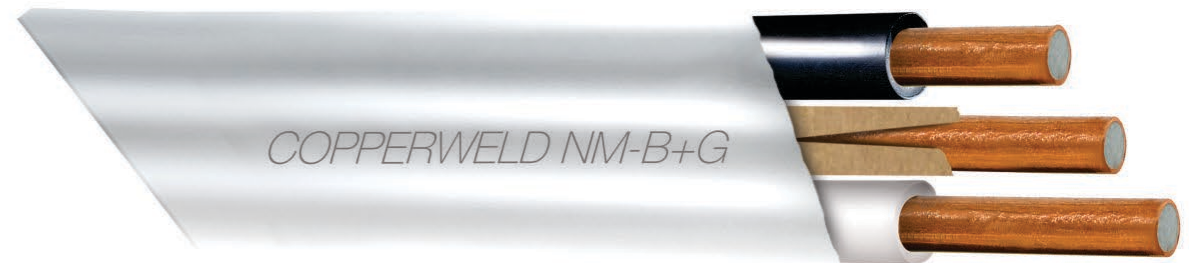
14 AWG copper-clad aluminum was added to the list of permitted small conductors

Branch-circuit-rated breakers or fuses that the conductors connect to **must be listed and marked** for use with such conductors



Photos courtesy of COPPERWELD Bimetallics, LLC.

Overcurrent protection device rating for the conductors **cannot exceed 10 amperes**, and the maximum continuous load on the circuit **cannot exceed 8 amperes**



240.6 Standard Ampere Ratings

(A) Fuses and Fixed-Trip Circuit Breakers

Table 240.6(A) Standard Ampere Ratings, **10 ampere was added** to the list of standard ratings of overcurrent protection devices

- ⚠️ 10 ampere rated fuses and circuit breakers are available and being used in the field
- ⚠️ Clarifies that such devices are permitted to be used
- ⚠️ Table listing of ampere ratings is more user friendly than the lines of text that appeared in previous editions of the *NEC*
- ⚠️ Offers more flexibility to the electrical industry when choosing overcurrent protection devices for certain circuits



Table 240.6(A) Standard Ampere Rating

10 ampere was added to the list of standard ratings of overcurrent protection devices

These 10- ampere fuses and circuit breakers are available and being used in the field

Table listing is more user friendly

Table type format showing the ampere ratings for fuses and circuit breakers (*10 ampere has been added*)

<u>10</u>	15	20	25	30
35	40	45	50	70
60	80	90	100	125
110	150	175	200	250
225	300	350	400	500
450	600	700	800	1200
1000	1600	2000	2500	4000
3000	5000	6000		

240.6 Standard Ampere Ratings

(D) Remotely Accessible Adjustable-Trip Circuit Breakers

Allows for remote access to adjustable-trip circuit breakers through a direct local nonnetworked interface or a networked interface connection

- ⚠ Due to SMART devices, provisions were needed to reduce likelihood of impact from cybersecurity attached for safety concerns
- ⚠ When the connection is through a networked interface:
 - 🔧 the circuit breaker and associated software must be evaluated for cybersecurity
 - 🔧 **OR** a cybersecurity assessment of the network is required to be completed, and documentation of such assessment must be provided to those authorized to inspect, operate, and maintain the system



240.6(D) Remotely Accessible Adjustable-Trip Circuit Breakers

Allows for remote access to adjustable-trip circuit breakers through a direct local nonnetworked interface or a networked interface connection

Enhances protection of remotely accessible adjustable-trip circuit breakers **from cyberattacks**

Can **remotely access** circuit breakers via wifi allowing user to access valuable information without making a trip to the electrical room or panelboard location



Photos courtesy of Eaton

240.7 Listing Requirements

New listing requirement requires branch-circuit overcurrent protective devices, relays, and circuit breakers that provide ground-fault protection of equipment (*GFPE*) and ground-fault circuit interrupter (*GFCI*) devices must be listed

- ⚠ Added to eliminate any confusion about whether or not such devices need to be listed
- ⚠ Provides jurisdictions a tool to require the listing of equipment as a basis to approve such devices
- ⚠ Only applies to overcurrent protective devices no more than 1000 Volts



Branch-circuit **overcurrent protective devices, relays, and circuit breakers** that provide ground-fault protection of equipment (*GFPE*) and ground-fault circuit interrupter (*GFCI*) devices **must be listed**



Type GHCGFEP
cable-in\cable-out
30 mA industrial
**ground-fault circuit
protector**



**Device equipped with
Ground Fault Protection**

Photos courtesy of Eaton

240.11 Selective Coordination

Clarifies that whenever the *NEC* requires a feeder overcurrent protective device to be selectively coordinated with a service overcurrent protective device, then **ALL feeder overcurrent devices** connected to such service **must be selectively coordinated** with the service overcurrent device

- ⚠ Closes any loopholes or gaps in the *Code*
- ⚠ Previously it could be interpreted that only certain feeder overcurrent protective devices needed to be included in the coordination study
- ⚠ All feeder overcurrent protective devices need to be included when such devices are fed by the same service overcurrent protective device in order to obtain proper selectivity
- ⚠ Ensures the service overcurrent protective device is less likely to open since all feeder overcurrent protective devices are included in the coordination study

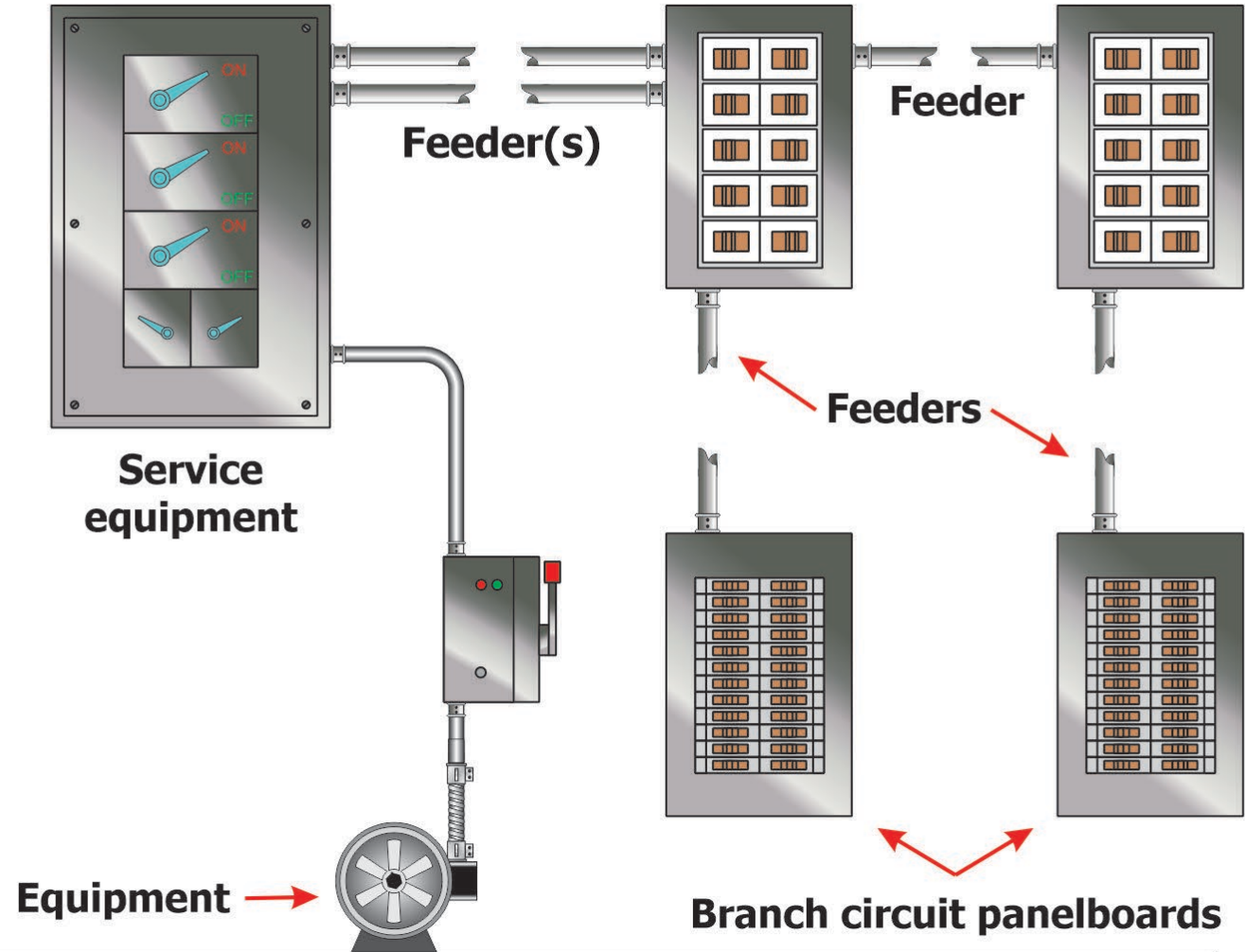


240.11 Selective Coordination

When a feeder overcurrent protective device to be selectively coordinated with a service overcurrent protective device, **ALL feeder overcurrent devices connected to the service** must be selectively coordinated with the service overcurrent device

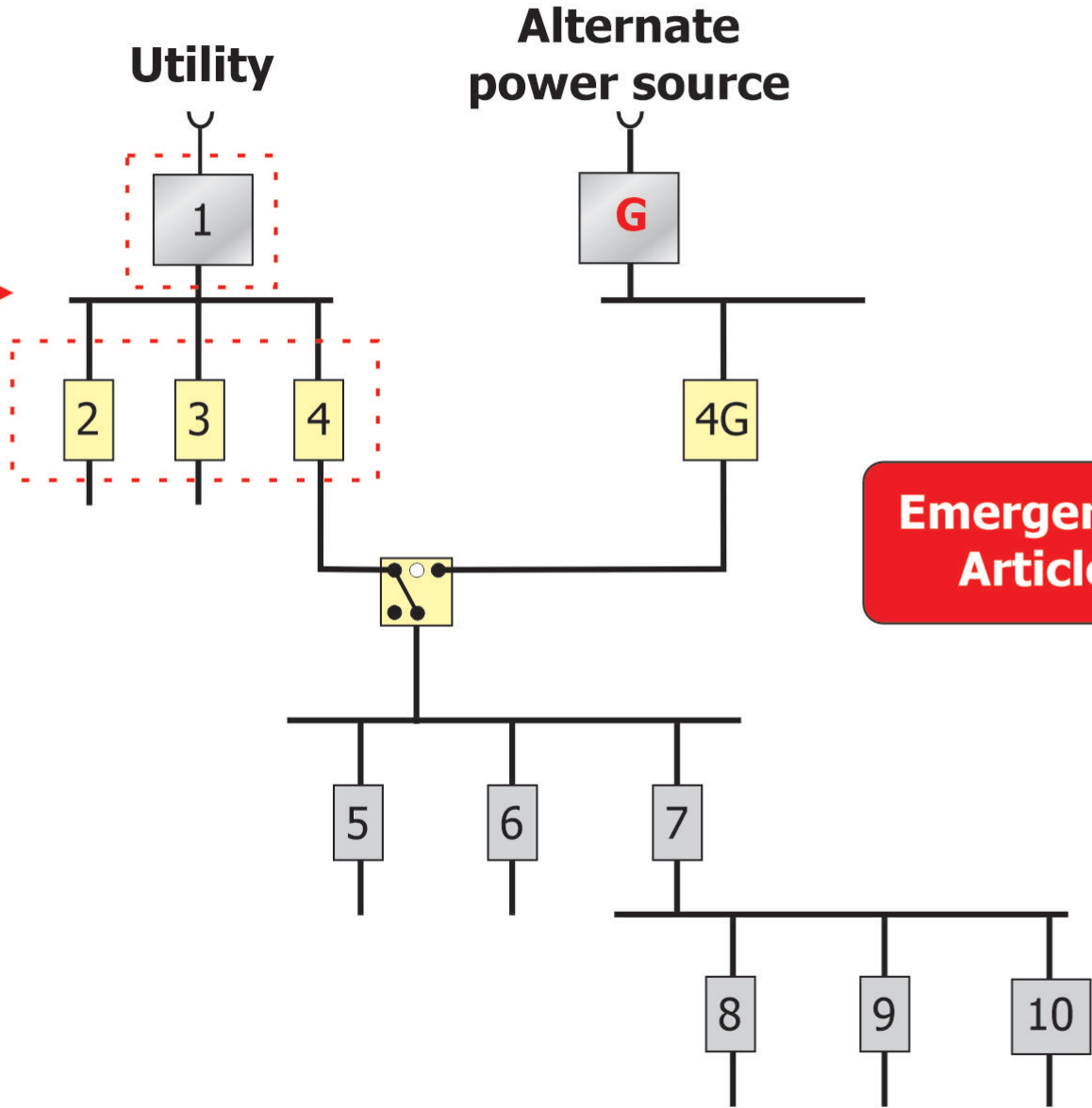
All feeder overcurrent protective devices need to be included when such devices are fed by the same service overcurrent protective device in order to obtain **proper selectivity**

Localization of overcurrent conditions to **restrict outages** to the equipment affected



240.11 Selective Coordination

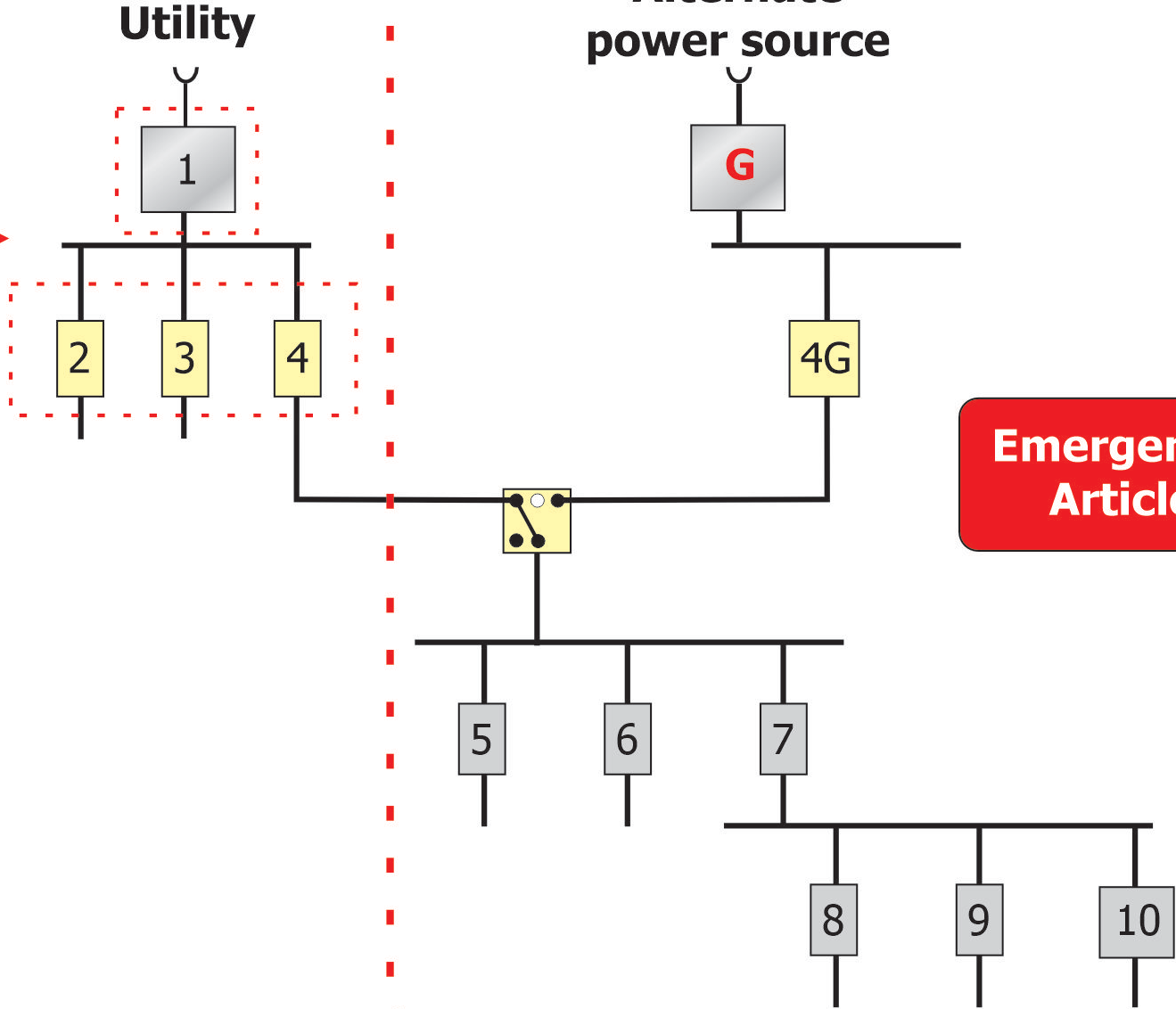
240.11 now requires 2, 3, and 4 to be selective with 1



Emergency Side Article 700

240.11 Selective Coordination

240.11 now requires 2, 3, and 4 to be selective with 1



Emergency Side
Article 700

240.11 Selective Coordination (cont.)

Whenever the *NEC* requires a feeder overcurrent protective device to be selectively coordinated with a service overcurrent protective device, the following sections apply:

NEC Section	System
620.62	Elevators (<i>multiple elevators on single feeder</i>)
645.27	Critical operations data systems
695.3(C)(3)	Multi-building campus-style complexes (<i>fire pumps</i>)
700.32	Emergency systems
701.27	Legally required standby systems
708.54	Critical operations power systems



240.16 Interrupting Ratings

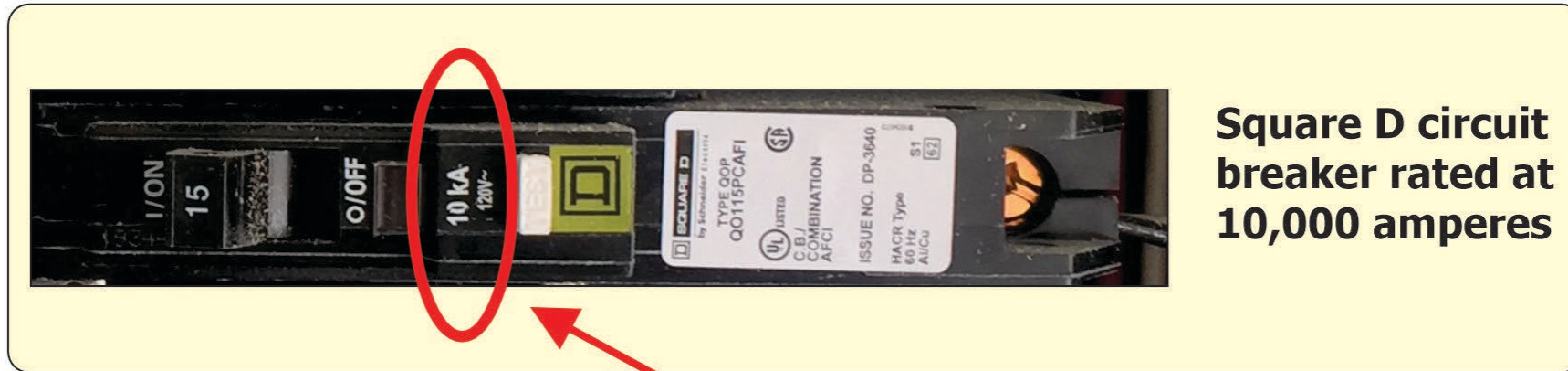
Now specifies that the minimum interrupting rating of a branch-circuit overcurrent protective device is 5,000 amperes

- ⚠ Previously found in the definition of Overcurrent Protective Device (*Branch-Circuit Overcurrent Protective Device*)
- ⚠ *NEC Style Manual* specifies that definitions are not permitted to contain requirements or recommendations
- ⚠ The 5,000-ampere interrupting rating requirement was moved from the definition to this section



240.16 Interrupting Rating

Specifies that the **minimum interrupting rating** of a branch-circuit overcurrent protective device is **5,000 amperes**



Note:

Always review the manufacturers instructions!

Overcurrent devices not marked with an interrupting rating have a minimum interrupting rating of 5000 amperes

240.24 Location in or on Premises

(A) Accessibility

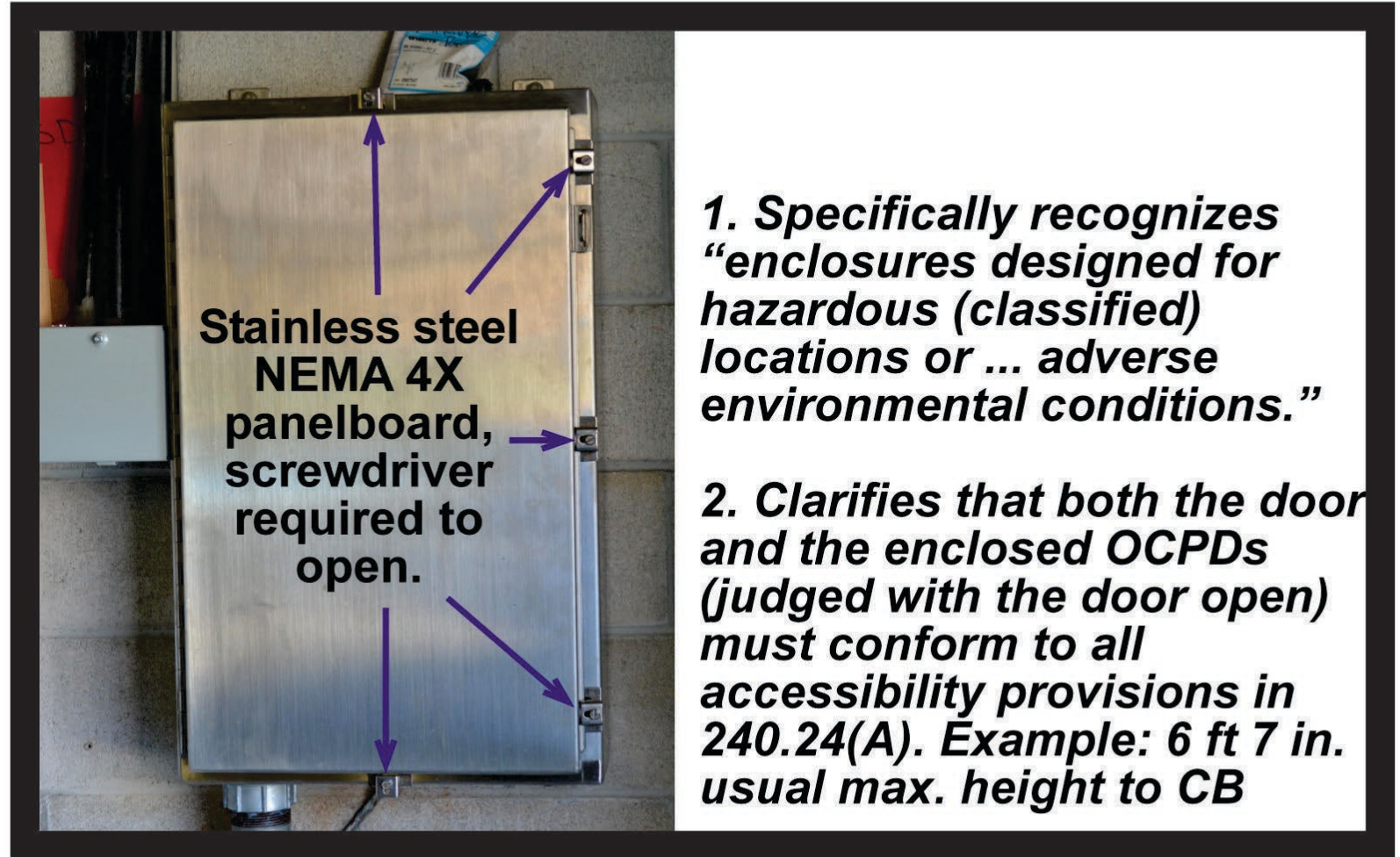
Revision replaces the words “similar enclosures” in the existing exception due to it being vague and not addressing many legitimate applications

- ⚠ Addresses a couple of issues that have caused enforcement problems due to the words “similar enclosures”
- ⚠ Consider the NEMA 4X stainless steel panel with bolted covers are designed with a series of bolts around the perimeter
- ⚠ This is not an industrial control panel, nor is it a “similar enclosure”
- ⚠ Revised exception clarifies that any readily accessible requirements that would normally apply to the overcurrent devices must still be applied to the enclosure itself
- ⚠ This includes any enclosed device(s) with the door or cover in the open position

240.24(A) Accessibility- Exception

Replaced the words “similar enclosures” in the existing exception due to the words being vague and in some cases causing issues for the enforcement community

This includes any enclosed device(s) with the door or cover in the open position



1. Specifically recognizes “enclosures designed for hazardous (classified) locations or ... adverse environmental conditions.”

2. Clarifies that both the door and the enclosed OCPDs (judged with the door open) must conform to all accessibility provisions in 240.24(A). Example: 6 ft 7 in. usual max. height to CB

Above drawing is courtesy of Fred Hartwell

240.24 Location in or on Premises

(E) Not Located in Bathrooms

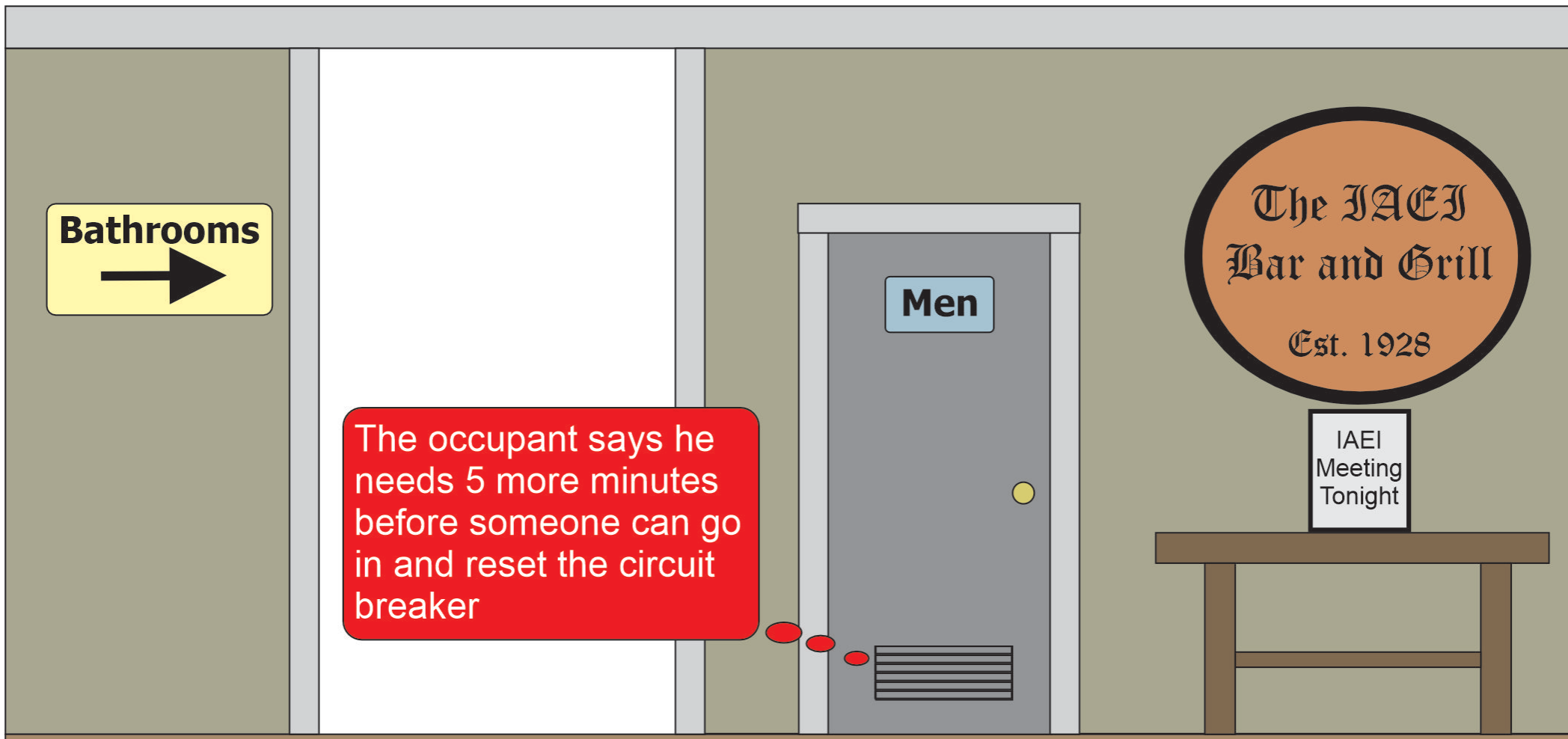
Overcurrent protective devices (*other than supplementary overcurrent devices*) are no longer allowed in **ANY** bathroom or in showering facilities or locker rooms having showering facilities

- ⚠ Addresses the difficulty of accessing a bathroom when such bathroom is occupied
- ⚠ No practical reason to continue with the permissive requirement of having overcurrent protective devices in bathrooms of any occupancy
- ⚠ Overcurrent protective devices are also no longer allowed in showering facilities or locker rooms having showering facilities since such areas present similar hazards as a bathroom
- ⚠ This will likely have the largest effect on facilities or occupancies having limited square footage
- ⚠ Office buildings are occupancies where electrical panels can be found in bathrooms



240.24(E) Not Located in Bathrooms

Overcurrent protective devices (*other than supplementary overcurrent devices*) are **no longer allowed in ANY bathroom** or in showering facilities or locker rooms having showering facilities



Article 242

Overvoltage Protection

242.2 Reconditioned Equipment

Surge protective devices (*SPDs*) and surge arresters cannot be reconditioned

- ⚠ SPDs are not dependent on the specific equipment they are connected to
- ⚠ When they reach the end of their usable life span, a new and listed SPD should be installed in its place
- ⚠ Will add safety to the electrical system



242.2 Reconditioned Equipment

Surge protective devices (SPDs) and surge arresters **can not be reconditioned**
(Replace when they have reached the end of their life)



Photo courtesy of Schieder Electric



Photo courtesy of Eaton



Photo courtesy of Siemens

242.9 Indicating

New requirement added requiring all **surge-protective devices (SPD)** to be provided with an **indication notification** to the occupant that the SPD is in working order

- ⚠ Occupants of offices and other occupancies spend a lot of time trying to figure out why equipment is not working that is plugged into an SPD
- ⚠ An indication of some type is needed for the end user to determine if the SPD is working properly
- ⚠ Now addressed by the *Code* so that building occupants can identify whether an SPD is functioning properly or if such device needs to be replaced



242.9 Indicating

Surge protective devices (SPDs) to have an indication that the **device is functioning properly**
(Replace when they have reached the end of their life)



Photo courtesy of Eaton

Photo courtesy of Siemens



Article 245

Overcurrent Protection for Systems Rated Over 1000 Volts ac, 1500 Volts dc

Article 245 Overcurrent Protection

Portions of Articles 215, 225, 230, and 240 dealing with conductors or systems operating at over 1,000 volts relocated to Article 245, Overcurrent Protection for Systems Rated Over 1000 Volts AC, 1500 Volts DC

- ⚠️ Help to increase the usability of the *NEC* by having requirements for systems operating over 1,000 volts be located in their own articles
- ⚠️ Enforcement community has expressed concerns regarding the lack of needed requirements in the *Code*
- ⚠️ Industry is experiencing an increasing installation of medium voltage systems by designers and installers



Article 245- Overcurrent Protection for Systems Rated Over 1000 Volts AC, 1500 Volts DC

Portions of Articles 215, 225, 230, and 240 dealing with conductors or systems operating at over 1,000 volts relocated to this article

Help to increase the usability of the *NEC*
There is an increase with installation of medium voltage systems by designers and installers



Medium voltage E rated fuses
courtesy of Eaton Bussman

Helps the enforcement community
and other electrical professionals



Photo courtesy of Rob Bowman, Denver Wastewater

Article 250

Grounding and Bonding

250.24 Grounding of Service-Supplied AC Systems

The panel added the word “shall” where necessary to clarify electrical professionals’ understanding of installing conductors connected in parallel

- ⚠️ Several changes were made to meet the requirements of the *NEC Style Manual*
- ⚠️ In the Exception to 250.24(2), “**The system**” was replaced with “**Impedance grounded system**” to clarify the exception helping to correlate with 250.36 and the changes made for that section
- ⚠️ Section 250.24(D)(2), *Connected in Parallel*, was relocated after “Conductors” and has been revised to a list format for additional clarity and useability



250.24 Grounding of Service-Supplied AC Systems



Photo courtesy of Scott Humphrey

250.24 Grounding of Service-Supplied AC Systems

(D) Grounded Conductor Brought to Service Equipment

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

- ⚠ Clarifies the requirements concerning grounded parallel conductors for service equipment found at:
 - 🔗 250.24 Grounding of Service-Supplied AC Systems
 - 🔗 (D) Grounded Conductor Brought to Service Equipment
- ⚠ When **paralleled grounded service conductors** in raceways and cables are connected in parallel, the size of the grounded conductor should be based upon the size of the ungrounded conductor in the raceway or cable
- ⚠ Previous language used the word “installed,” which was grammatically incorrect
- ⚠ The word “connected” has replaced the word “installed” adding clarity and usability to the *Code*



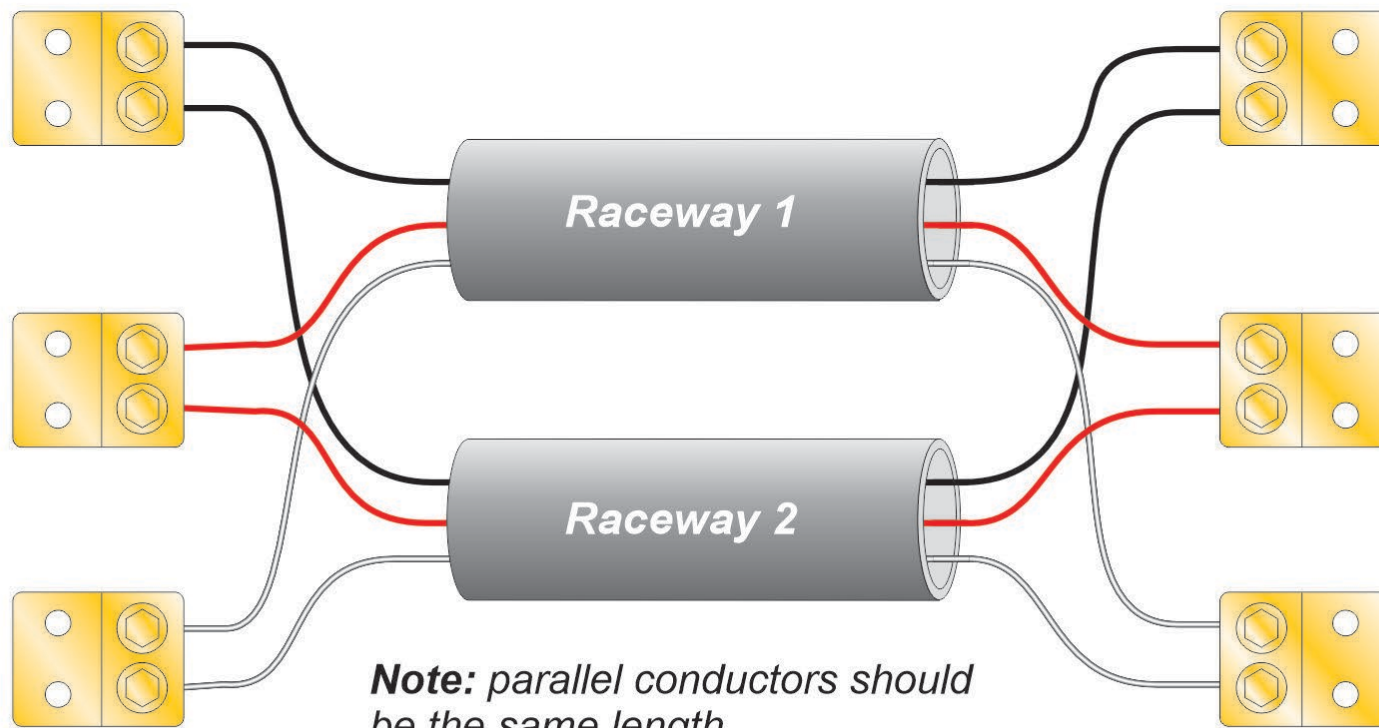
250.24 Grounding of Service-Supplied AC Systems

Clarifies the requirements concerning grounded parallel conductors for service equipment found at:

- **(D) Grounded Conductor Brought to Service Equipment**
- **(2) Conductors in Two or More Raceways or Cables Connected in Parallel**

When paralleled grounded service conductors in both raceways and cables are **connected in parallel**, the size of the grounded conductor should be based upon the size of the ungrounded conductor in the raceway or cable

The word **"connected"** has replaced the word **"installed"** adding clarity and usability to the *Code*



250.30 Outdoor Source

(C) Outdoor Source

Remove the word “neutral” from 250.30(C) to be consistent with other locations within the *NEC* and be consistent with language found at 250.36 and 250.187

- ⚠️ “Neutral” was removed from impedance grounded ~~neutral~~ systems because it was removed elsewhere in the code to comply with the *NEC Style Manual*
- ⚠️ Correlates with the new definition found in Article 100 for **Impedance Grounded System**
- ⚠️ When consistency in terminology can be achieved, the *Code* becomes more user-friendly



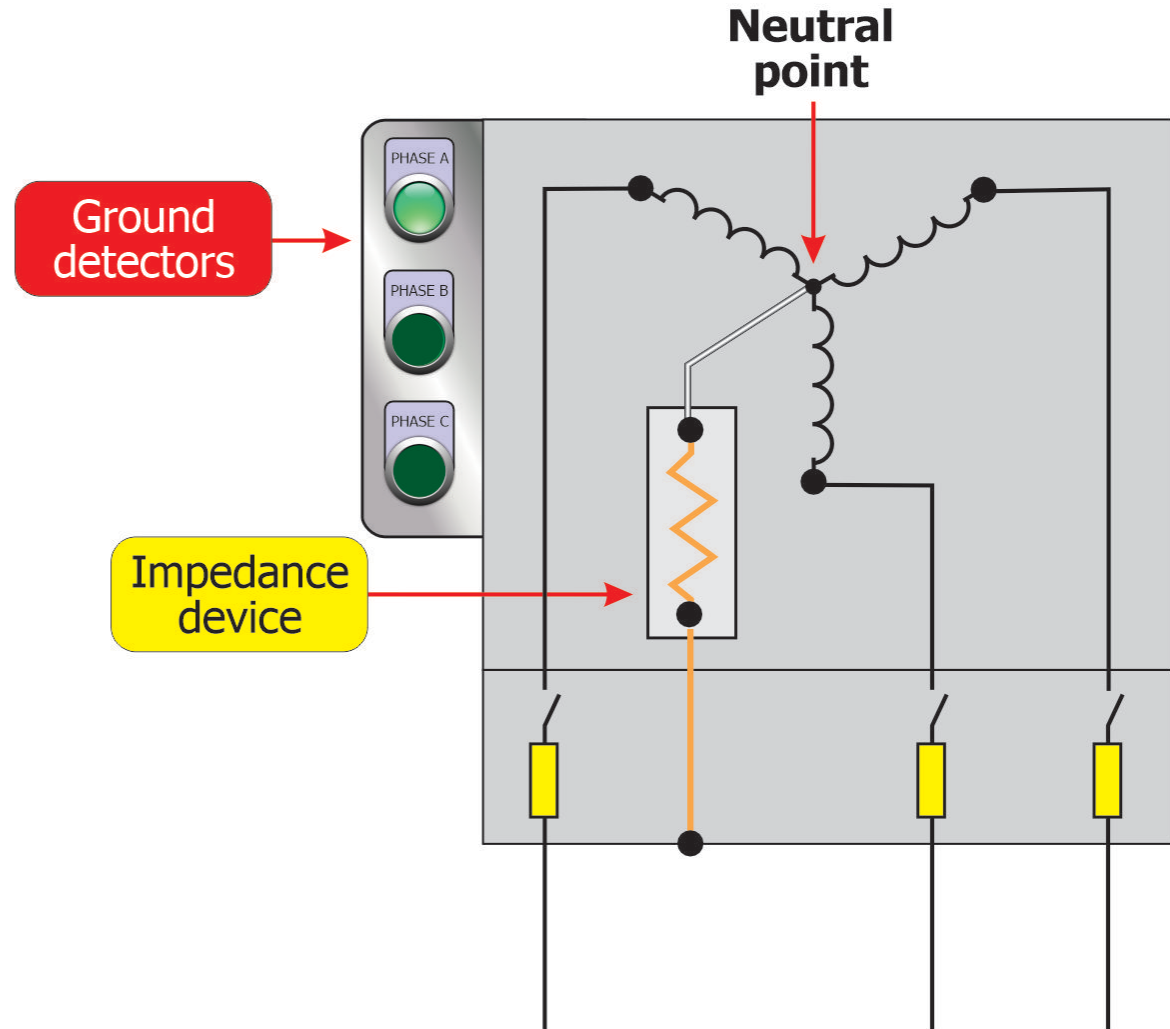
250.30(C) Outdoor Source, Exception (*Impedance Grounded System*)

“Neutral” was removed from **impedance grounded neutral systems** and elsewhere in the *Code* to comply with the *NEC Style Manual*

Correlates with the new definition found in Article 100 for Impedance Grounded System

Grounded **intentionally** from the neutral point **through an impedance device**

Is now **consistent with language** found at 250.36 and 250.187



250.36 Impedance Grounded Systems - 480 Volts to 1000 Volts

Removed the words “High” and “Neutral” from the title of Section 250.36, renaming the section to be **Impedance Grounded Systems** - 480 Volts to 1000 Volts

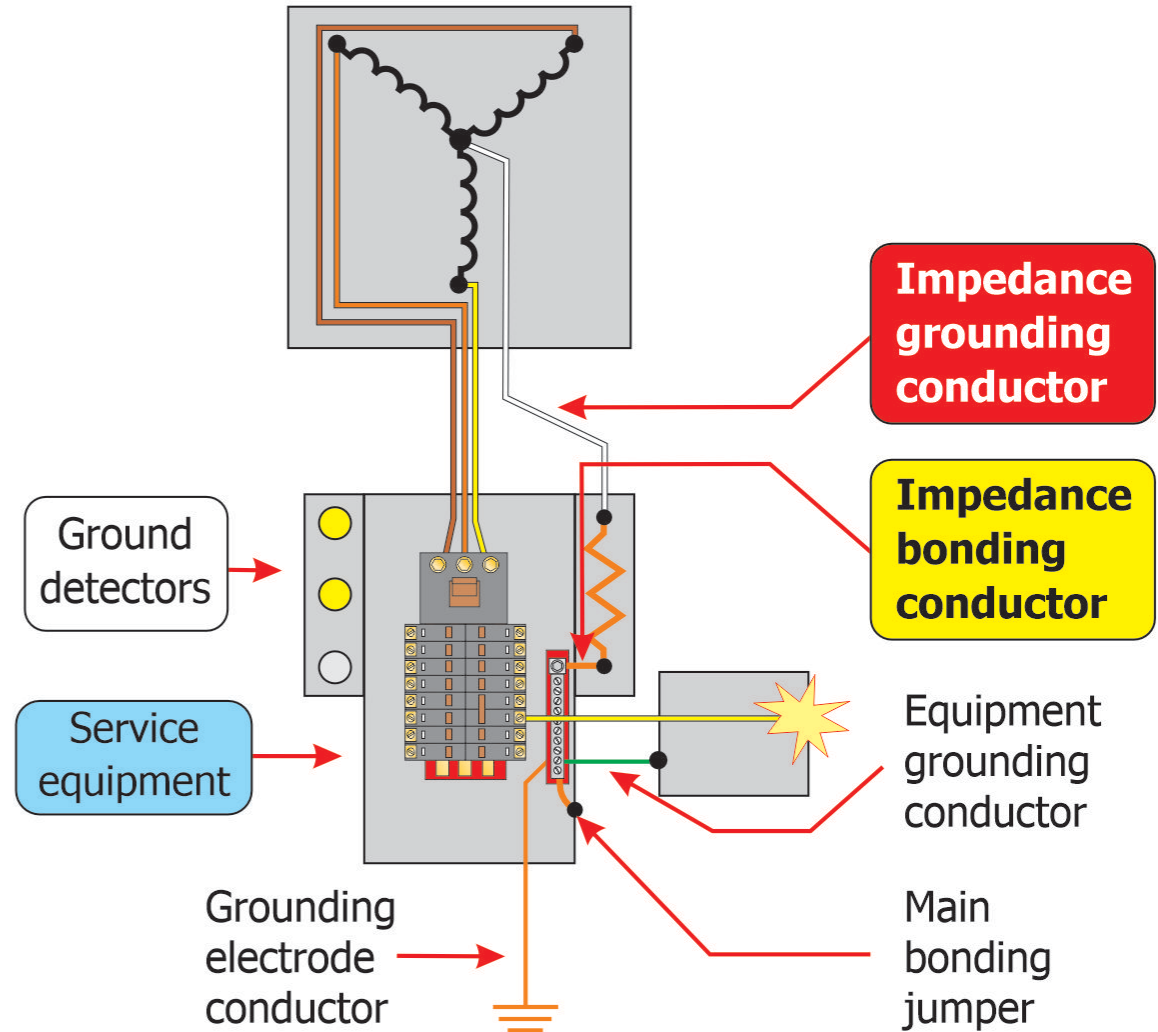
- ⚠ New definition for **“impedance grounding conductor”** was also created to replace the phrase “grounded system conductor”
- ⚠ Clarifies that the conductor that connects the neutral point to the impedance of an impedance grounded system does not meet the definition of a “grounded conductor” in Article 100
- ⚠ Another change was made by deleting the word “Equipment” and replacing it with “Impedance” for the definition of “Impedance Bonding Jumper”



250.36 Impedance Grounded System

New definition for "impedance grounding conductor" was created to replace the phrase "grounded system conductor"

Applies to 480 through 1000 volts
Impedance grounding conductor to be **fully insulated**
Ground detection alarm installed on the system
Not smaller than current rating of impedance device (*minimum 8 AWG copper or 6 AWG aluminum*)



250.36 Impedance Grounded Systems- 480 Volts to 1000 Volts

Photo shows the typical ground detection and alarm system associated with an impedance grounded system

Has visual as well as audible alarm features

Manufactured by Post Grover



Photo courtesy of Rob Bowman



250.50 Grounding Electrode System, 250.52(A)(3)(1) Concrete- Encased Electrode, 250.52(B)(3) Not Permitted for Use as Grounding Electrodes

The term “reinforcing steel or rods” was replaced with “rebar”

- ⚠️ Revision was done in all three sections of the *Code* for consistency
 - 🔧 250.50 Grounding Electrode System
 - 🔧 250.52(A)(3)(1) Concrete- Encased Electrode
 - 🔧 250.52(B)(3) Not Permitted for Use as Grounding Electrodes
- ⚠️ Makes it easy to understand and adds consistency in the field and the construction industry (*many use the term “rebar”*)
- ⚠️ Harmonizes the term to be consistent with the language preferred in 250.68(C)



Section 250.50, 250.52(A)(3)(1), and 250.52(B)(3)

The term "reinforcing steel or rods" has been replaced with "rebar"

Easy to understand and adds consistency with the trades in the construction industry

Applies to:

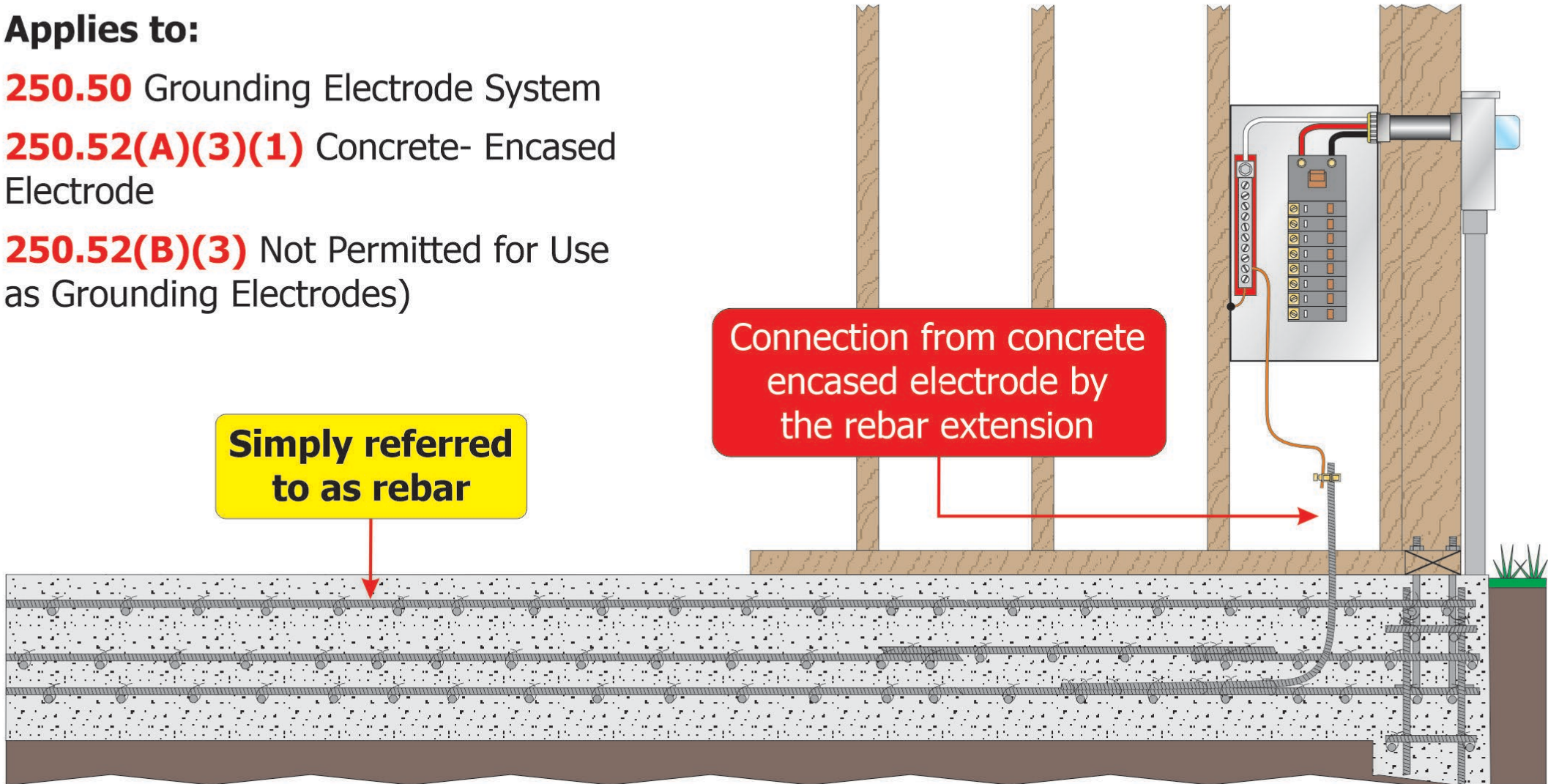
250.50 Grounding Electrode System

250.52(A)(3)(1) Concrete- Encased Electrode

250.52(B)(3) Not Permitted for Use as Grounding Electrodes)

Simply referred to as rebar

Connection from concrete encased electrode by the rebar extension



250.64 Grounding Electrode Conductor Installation

(G) Enclosures with Ventilation Openings

A new requirement now prohibits openings in enclosures intended for ventilation to be used to install the grounding electrode conductor

- ⚠️ Ventilation openings are provided to ensure that adequate cooling air is provided for safe operation of the equipment under normal and abnormal conditions
- ⚠️ Listing of the equipment is predicated on these openings not being obstructed, such as by the installation of raceways or conductors through the opening
- ⚠️ Using one or more of these opening to install conductors, such as a grounding electrode conductor block adequate ventilation
- ⚠️ A similar requirement was made for Transformers at 450.10 *Grounding and Bonding* in the 2020 NEC



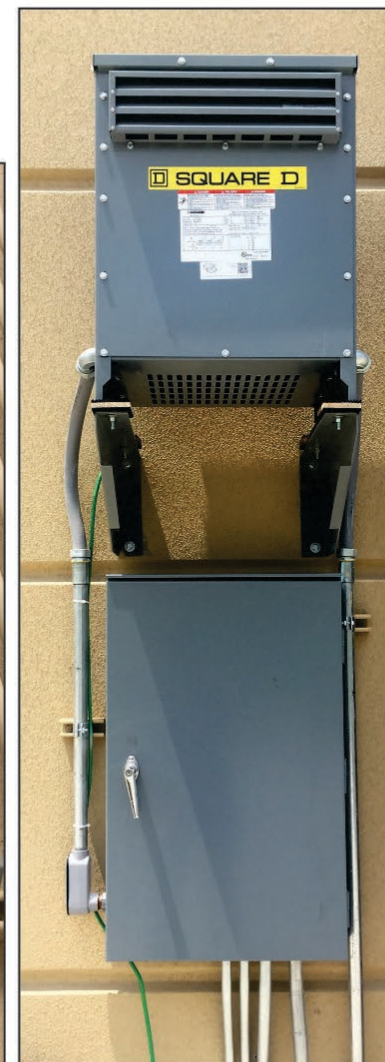
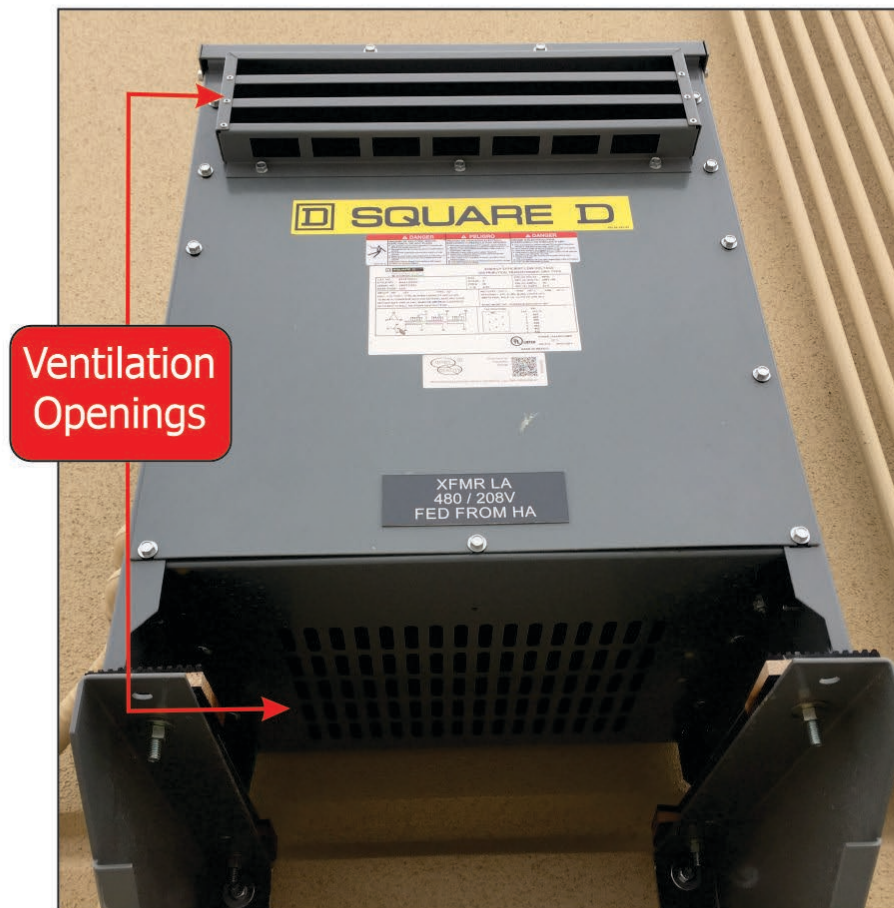
250.64(G) Enclosures with Ventilation Openings

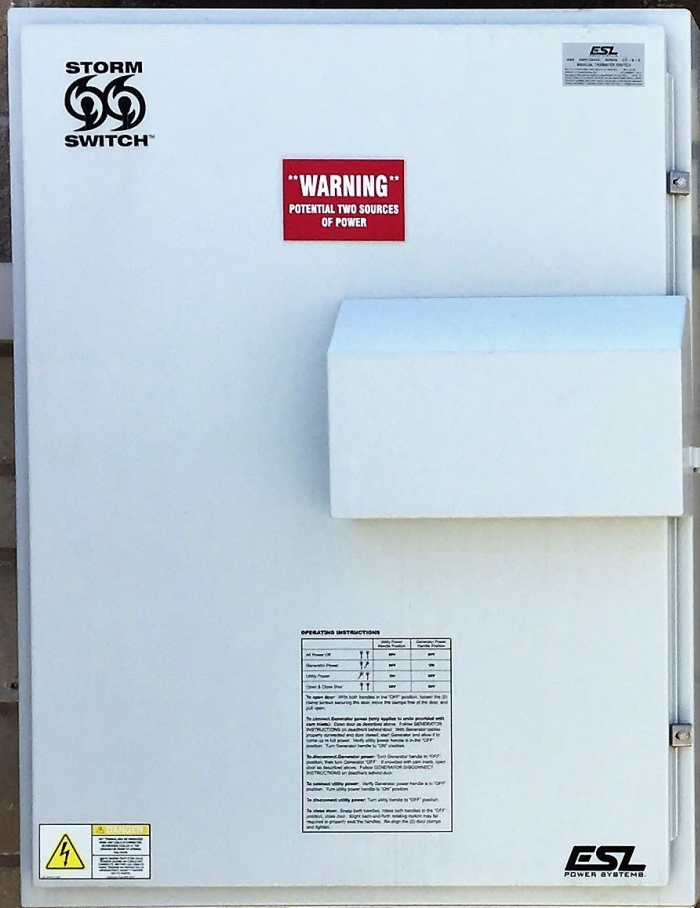
Prohibits openings in enclosures intended for ventilation to be used to install the grounding electrode conductor

Ventilation openings are provided to ensure that adequate cooling air is provided for safe operation of the equipment under normal and abnormal conditions

Now **applies to all electrical enclosures** and not just transformers
(2020 NEC added 450.10 Grounding and Bonding)

Photos courtesy of IAEI Archives





½ in. PVC raceway enclosing the grounding electrode conductor (GEC)

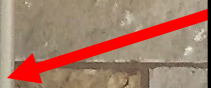


Photo courtesy of IAEI Archives

250.70 Methods of Grounding and Bonding Conductor Connection to Electrodes

The section has been divided into two new first level subdivisions (A) and (B)

⚠ The list of methods for connection to grounding electrodes has been eliminated

🔧 **(A) General**

🔧 **(B) Indoor Communications Systems**



250.70 Methods of Grounding and Bonding Conductor Connection to Electrodes

- ⚠ It was identified that there are no pipe fittings, pipe plugs or other device that screws into pipe that are suitable or identified for attaching a grounding electrode conductor and the list item has been removed
- ⚠ The list item for communications system has been moved to the new list item (B) as a permitted method
- ⚠ A new informational note was added to clarify to users that a connector or fitting that is listed as suitable for direct burial is also listed and suitable for concrete encasement
- ⚠ See UL 467, *Standard for Safety Grounding and Bonding Equipment*, for additional information

250.70 Methods of Grounding and Bonding Conductor Connection to Electrodes

The section has been divided into new subparts (A) and (B) and the **list of methods for connection to grounding electrodes has been eliminated**

New informational note was added to clarify that a connector or fitting that is listed as suitable for direct burial is also listed and suitable for concrete encasement



Photos courtesy of IAEI Archives

250.94 Bonding for Communications Systems

(A) Intersystem Bonding Termination Device

This now recognizes the Intersystem Bonding Termination Device (*IBT*) as the location “for” the grounding electrode conductor

- ⚠ The words “or to” were removed and replaced with “for” which clarifies that the IBT is the location “for” the grounding electrode conductor
- ⚠ Updated language at 250.94(A)(4) a and b helps to clarify this section for the electrical professional
- ⚠ Informational Note 1 was returned to the panel by the Correlating Committee to be addressed so it would comply with *NEC Style Manual*
- ⚠ The Informational Note was removed as the panel could not find a way to meet the requirements of the *NEC Style Manual*



250.94(A) Intersystem Bonding Termination Device

Recognizes the Intersystem Bonding Termination Device (*IBT*) is **to be securely mounted** and acts as a location “for” the grounding electrode conductor to terminate

Clarifies this section for the electrical professional
Informational Note was removed due to *NEC Style Manual* issues



250.106 Lightning Protection Systems

The edition date of the NFPA 780 standard was removed for Informational Note No.1 and updated for Informational Note No. 2

- ⚠ Revisions to 90.5(C) states that the reference is to be the **latest edition of the standard** unless the standard reference includes a date
- ⚠ Edits to the Informational Notes were made for clarity and compliance with the *NEC Style Manual*






YELLOWSTONE PARK FOUNDATION
OLD FAITHFUL HAYNES PHOTO SHOP

Photos courtesy of IAEI Archives

250.118 Types of Equipment Grounding Conductors

This section was reorganized into two first level subdivisions

(A) Permitted:

-  250.118(A)(5)(f) and 250.118(A)(6)(f) were added to **require a wire-type equipment grounding conductor or a bonding jumper** in accordance 250.102(E)(2) when flexible metal conduit or liquidtight flexible metal conduit with a stainless-steel core

(B) Not Permitted:

-  Relocated from 250.121 which prohibits the use of grounding electrode conductors or structural metal frames of building or structures as an equipment grounding conductors

250.118 Types of Equipment Grounding Conductors (cont.)

(A) Permitted

Recognition of stainless-steel flexible and liquidtight metal conduit and requires a wire-type equipment grounding conductor (*EGC*)

- ⚠ Acceptable wiring method for locations where high resistance to corrosion is encountered
- ⚠ The stainless-steel core provides higher resistivity than other metal types used with flexible conduits
- ⚠ A separate internal EGC or external bonding jumper is required to be installed to provide an effective ground-fault current path
- ⚠ Provides the electrical professional additional options where high resistance to a corrosive environment is required



250.118(A) Types of Equipment Grounding Conductors

Stainless-steel flexible conduit and **liquidtight metal conduit** is a recognized wiring method but require for a wire-type equipment grounding conductor (*EGC*)

Acceptable wiring method for locations where high resistance to **corrosion** is required

An **internal EGC** or **external bonding jumper** is required to be installed to provide an effective ground-fault current path



**Stainless-steel
flexible conduit**

Photo courtesy of FlexGlory

250.130 Equipment Grounding Conductor Connections

Replacement of snap switches without an equipment grounding terminal with snap switches with an equipment grounding terminal when the branch circuit does not have an equipment grounding conductor

- ⚠ See 250.130(C) for the 6 locations for a snap switch or receptacle to be connected to for their EGC requirements
- ⚠ An added informational note provides a link to the 404.9(B) requirements regarding the grounding of snap switches



250.130 Equipment Grounding Conductor Connections

Snap switches were added to the item (*previously only receptacle*) that must conform with requirements found at 250.130(C) for their equipment grounding conductor (*EGC*) connection

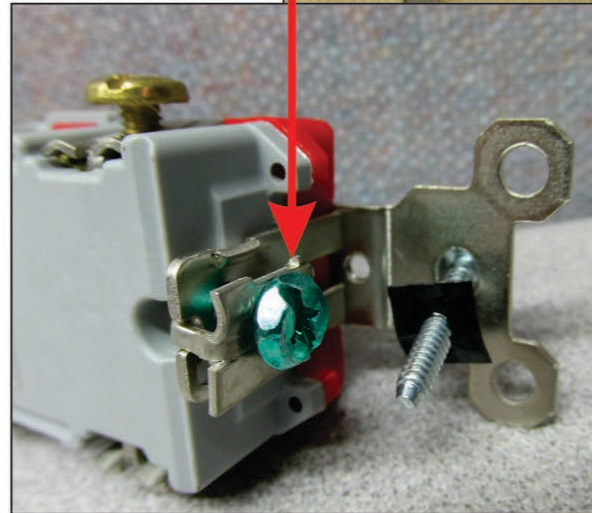
Replacement of snap switches **without an equipment grounding terminal** with snap switches with an equipment grounding terminal has been added at 250.130



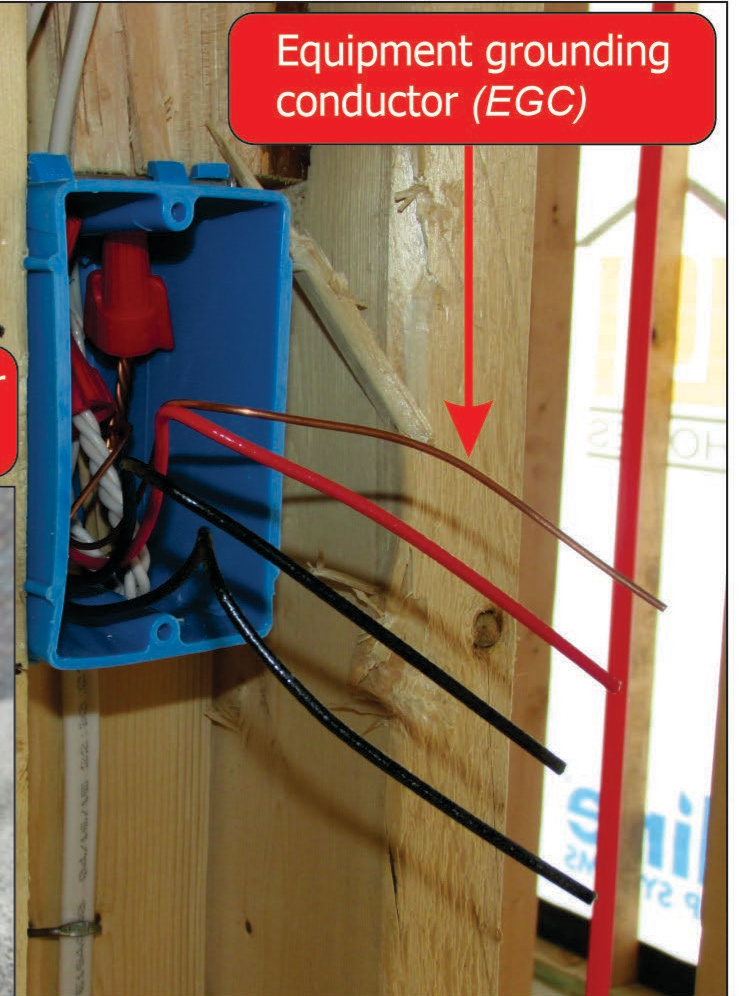
**Single-pole,
nongrounding
switch**

*Photo courtesy
of Leviton*

**Equipment grounding conductor
(EGC) connection**



**Equipment grounding
conductor (EGC)**



Photos courtesy of IAEI Archives

250.140 Frames of Ranges and Clothes Dryers

Section 250.140 was revised to include two first level subdivision

- ⚠️ 250.140(A) is existing text that was relocated from the parent text
- ⚠️ 250.140(B) was the existing exception that was written into positive text
- ⚠️ 250.140(B)(5) adds a new list item to address the hazard of having neutral current on the metal normally non-current carrying parts (*objectional current*)
- ⚠️ Adds copper-clad aluminum as a permitted conductor type

250.140(B)(5) Frames of Ranges and Clothes Dryers

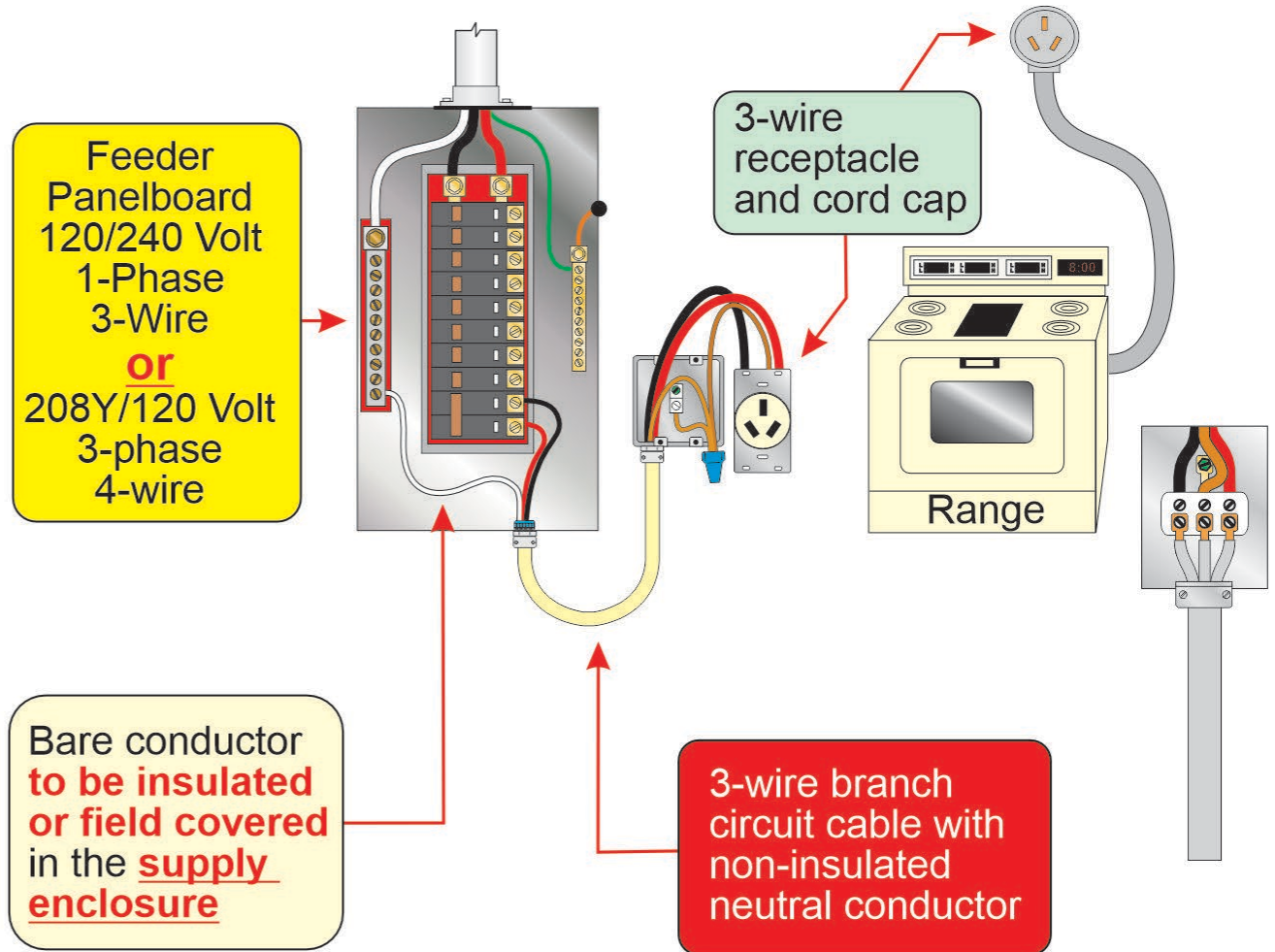
Grounded connector is to be **insulated or field covered** within the **supply enclosure** with a listed insulating material to prevent contact of an uninsulated conductor with any normally non-current carrying metal part of the equipment

Provides a safe alternative from having to replace existing 3-wire service entrance cables

Keeps current from getting on metal parts of equipment

In this scenario the bare conductor in the panelboard is wrapped with insulating tape

Reference 200.6(A) for marking options such as the use of white tape



Feeder Panelboard
120/240 Volt
1-Phase 3-Wire
or
208Y/120 Volt
3-phase 4-wire

Bare conductor to be insulated or field covered in the **supply enclosure**

3-wire receptacle and cord cap

3-wire branch circuit cable with non-insulated neutral conductor

Range

250.148 Continuity of EGCs and Attachment in Boxes

Modified subdivision (A) to specify that all equipment grounding conductors that are spliced or terminated within a box are required to be connected together regardless if they are for different circuits

- ⚠ Clarification was needed regarding wire-type equipment grounding conductors (EGCs) within boxes
- ⚠ There was spirited debate between installers and inspectors as to if all the EGCs within an electrical box were required to be connected together
- ⚠ Also, list item (C) was revised providing the sizing requirements for the bonding connection to the metal box by the EGC or the equipment bonding jumper
- ⚠ Size is based on Table 250.122 for the largest overcurrent device for any of the circuits entering the box

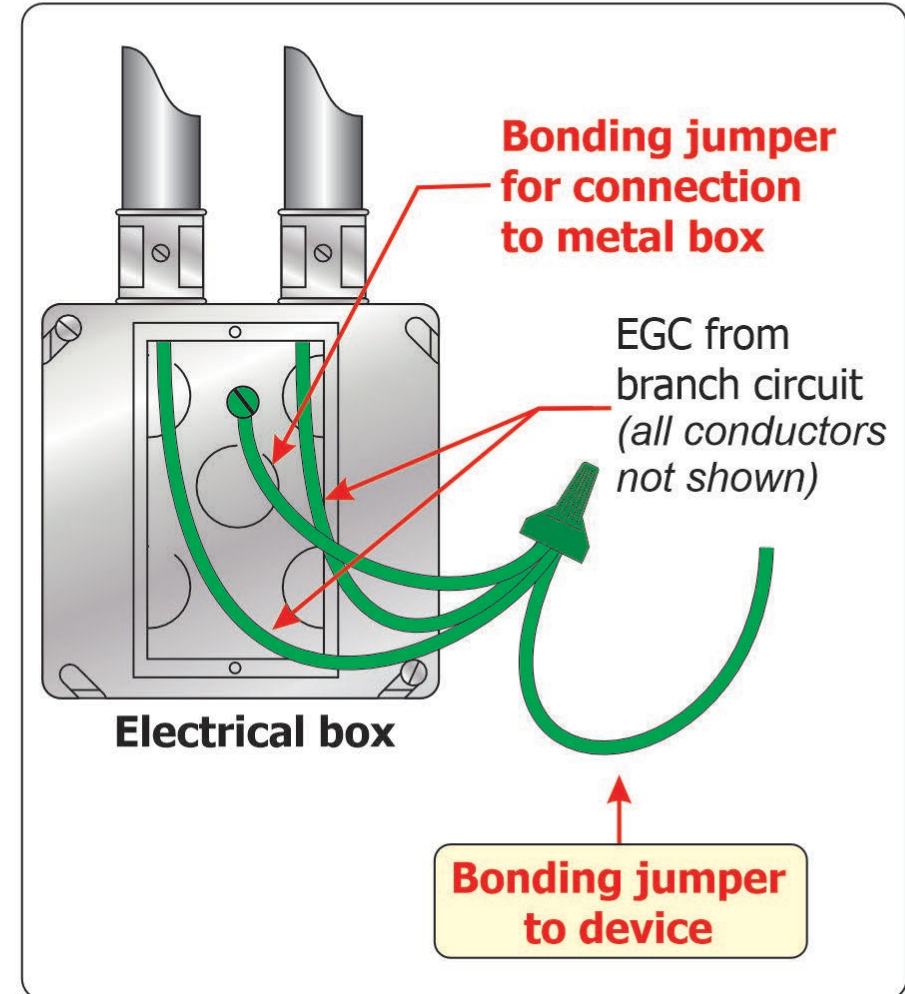
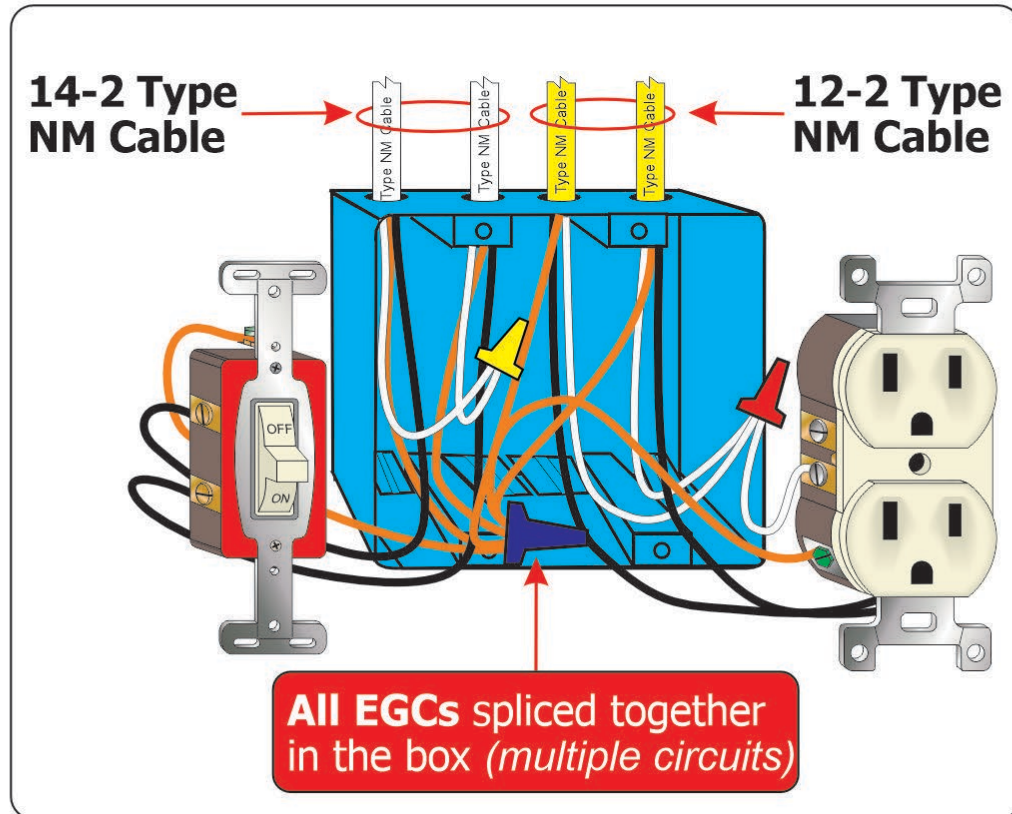


250.148 Continuity of EGCs and Attachment in Boxes

Modified subdivision (A) to specify that **ALL equipment grounding conductors (EGCs) spliced or terminated within a box** to be connected together **REGARDLESS** if they are for different circuits

Revised the **sizing requirements** for the bonding connection to the metal box by the EGC or the equipment bonding jumper

Size **based on Table 250.122** for the largest overcurrent device for any of the circuits entering the box **[250.148(C)]**



Chapter 3

Wiring Methods and Material

- Article 300
- Article 305
- Article 310
- Article 312
- Article 314
- Article 315
- Article 320
- Article 322
- Article 330
- Article 337
- Article 342
- Article 344
- Article 352
- Article 353
- Article 358
- Article 369
- Article 371
- Article 398

Various Chapter 3 Raceway Titles

Revised Articles 342, 344, 348, 350, 352, 353, 354, 355, 356, 358, 360, and 362 by removing the word “Types” from their titles

- ⚠ The word “Type” has been removed from the new definitions found in Article 100 for conduit and tubings
- ⚠ This editorial deletion correlates with the definition and clarifies the acronym for usability
- ⚠ This change was related to multiple public inputs that relocated all the xxx.2 definitions in the *NEC* to Article 100 to comply with the 2020 *NEC* Style Manual
- ⚠ The Correlating Committee established a Task Group to review the format of the wiring method articles regarding the use of acronyms and the use of the word “type” used with some acronyms

Chapter 3 Raceway Titles- Multiple Articles

Articles 342, 344, 348, 350, 352, 353, 354, 355, 356, 358, 360, and 362 were revised by **removing the word "Types"** from their titles

Raceway types involved in this change include:

Article 342- Intermediate Metal Conduit

Article 344- Rigid Metal Conduit

Article 348- Flexible Metal Conduit

Article 350- Liquidtight Flexible Metal Conduit

Article 352- Rigid Polyvinyl Chloride Conduit

Article 353- High Density Polyethylene Conduit

Article 354- Nonmetallic Underground Conduit

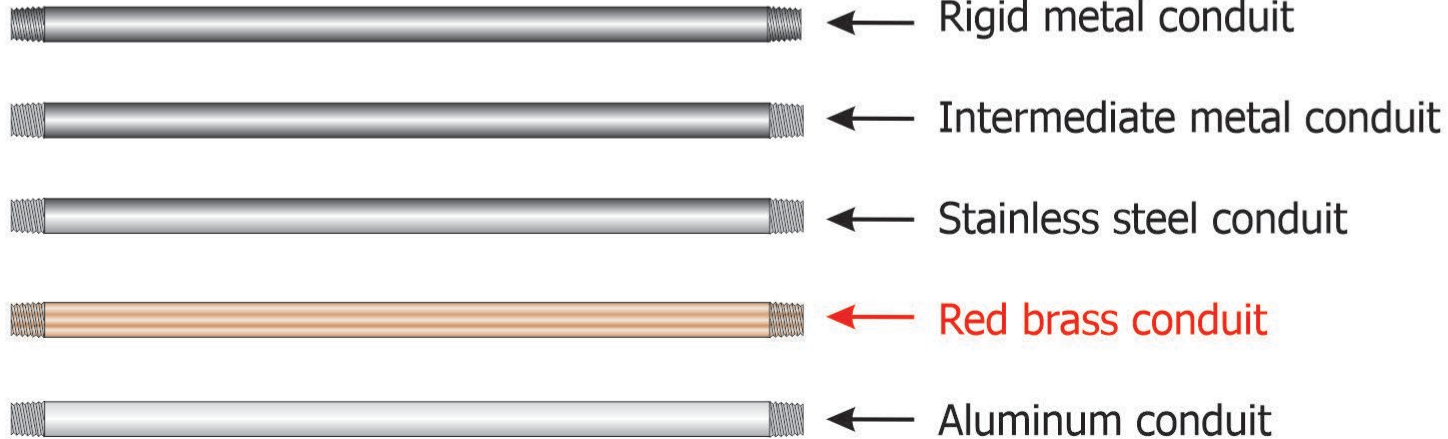
Article 355- Reinforced Thermosetting Resin Conduit

Article 356- Liquidtight Flexible Nonmetallic Conduit

Article 358- Electrical Metallic Tubing

Article 360- Flexible Metallic Tubing

Article 362- Electrical Nonmetallic Tubing



Reinforced Thermosetting Resin Conduit





Article 300

General Requirements for Wiring Methods and Materials

300.2 Limitations

(A) Voltage

Section was modified to add 1500 volts dc requirements in 2 locations

- ⚠ This allows for wiring methods located within Chapter 3 to be used for 1000 volts ac, 1500 volts dc, nominal, or less installations if not limited in other locations of the *NEC*
- ⚠ Medium voltage (*MV*) requirements have been relocated to new Article 305 to enhance usability



300.2 Voltage

This allows for wiring methods found within in Chapter 3 to be used for **1000 volts ac, 1500 volts dc, nominal**, or less installations *(if not limited in other locations of the NEC)*

Medium voltage (MV) requirements are being **reorganized**

MV is being installed by more and more electrical contractors

Installation of a motor control for over 1000 volts at the Denver Wastewater Facility



Photo courtesy of Rob Bowerman

300.4 Protection Against Physical Damage

(E) Cables, Raceways, or Boxes Installed in or Under Metal-Corrugated Roof Decking

A new **Exception No. 2** has been added which **recognizes poured concrete** on top of the metal roof decking as a means of physical protection for cables, raceways, or boxes installed in or under metal-corrugated roof decking

300.4 Protection Against Physical Damage (cont.)

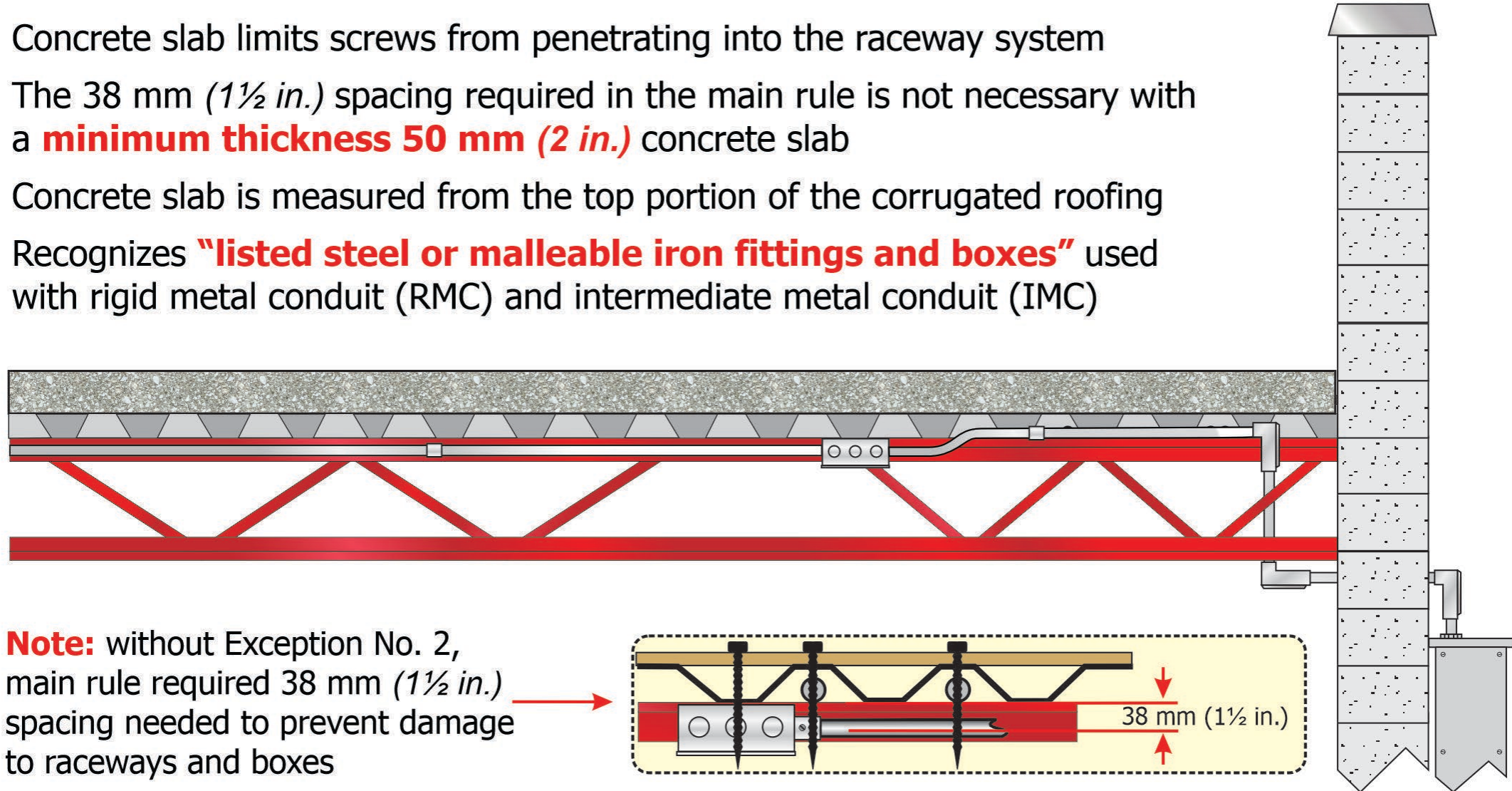
(E) Cables, Raceways, or Boxes Installed in or Under Metal-Corrugated Roof Decking (cont.)

- ⚠ Concrete limits screws from penetrating into the raceway system causing damage to the raceway and wiring
- ⚠ When the metal-corrugated sheet roof decking is covered with a **minimum thickness 50 mm (2 in.) concrete slab**, the 38 mm (1 ½ in.) spacing is not necessary
- ⚠ The concrete slab is measured from the top portion of the corrugated roofing
- ⚠ This also recognizes the addition of “**listed steel or malleable iron fittings and boxes**” for Exception No. 1 which are used with rigid metal conduit (*RMC*) and intermediate metal conduit (*IMC*)

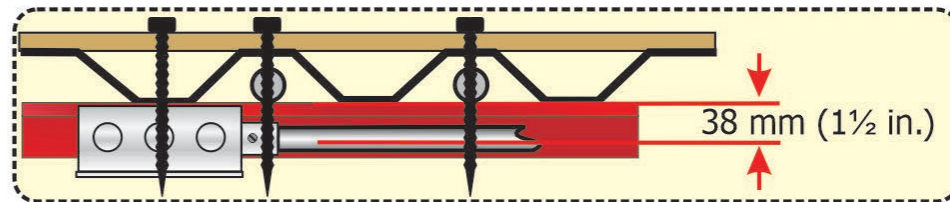


300.4(E) Cables, Raceways, or Boxes Installed in or Under Metal-Corrugated Roof Decking- Ex. No. 1 and 2

Concrete slab limits screws from penetrating into the raceway system
The 38 mm (1½ in.) spacing required in the main rule is not necessary with a **minimum thickness 50 mm (2 in.)** concrete slab
Concrete slab is measured from the top portion of the corrugated roofing
Recognizes **“listed steel or malleable iron fittings and boxes”** used with rigid metal conduit (RMC) and intermediate metal conduit (IMC)



Note: without Exception No. 2, main rule required 38 mm (1½ in.) spacing needed to prevent damage to raceways and boxes



300.4 Protection Against Physical Damage

(G) Fittings

New language has been added requiring that protective fittings be installed to fittings “prior to the installation of conductors”

- ⚠ The protective fitting needs to be in place before the installation of the conductors in order to provide protections to these conductors
- ⚠ Installing this fitting after the conductors have been installed allows possible damage to occur to conductors being pulled into the raceway
- ⚠ Determining if this fitting was installed before the installation of conductors may be hard for an AHJ to determine during an inspection (*sometimes there is no visible conductor damage*)
- ⚠ There are fittings available on the market that are designed to be installed after the conductors have been installed



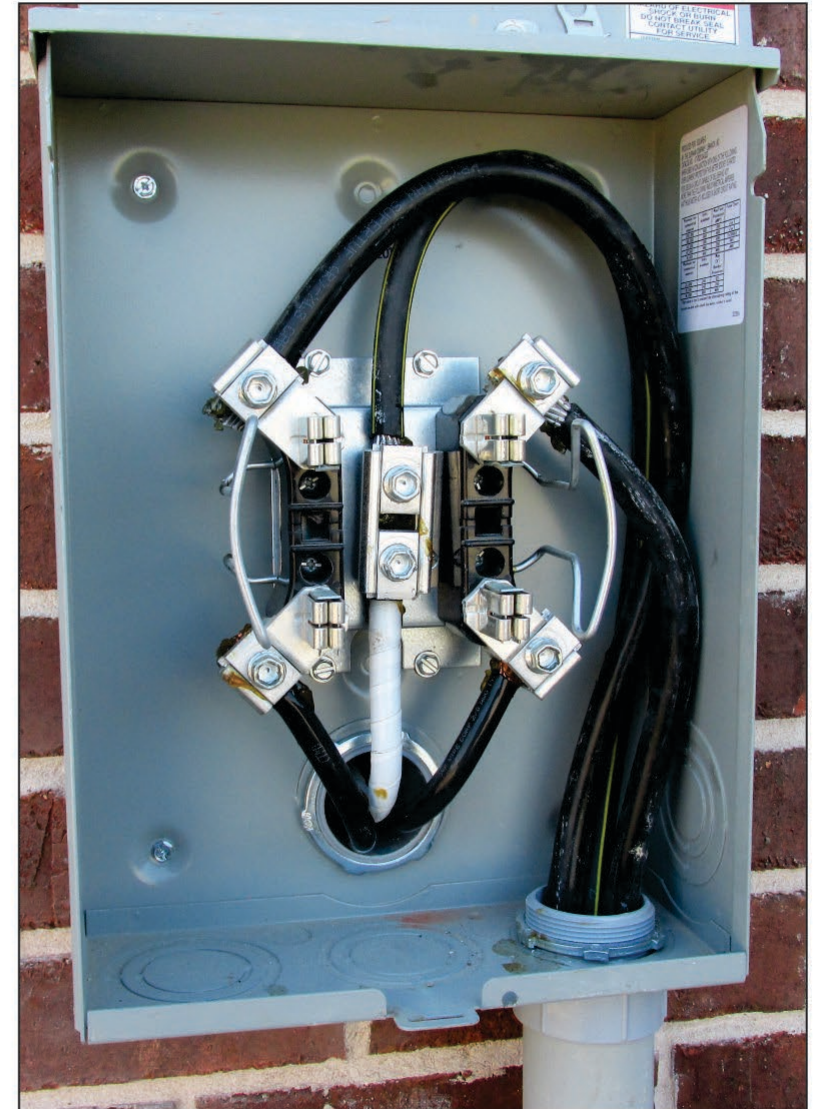
300.4(G) Fittings

Protective fittings to be installed to raceways **“prior to the installation of conductors”**

Where raceways will **contain 4 AWG or larger** insulated circuit conductors, **prior to the installation of conductors**, the conductors are to be protected in one of the following ways:

- a fitting that has been identified and provides a smooth rounded insulating surface
- a metal fitting that's listed and has smoothly rounded edges
- use of an identified insulating material that is securely fastened in place to separate the fitting or raceway
- threaded hubs or bosses that are an integral part of a raceway providing a smoothly rounded entry for conductors

These fittings can no longer be installed after the conductors have been installed



300.5 Underground Installations

(A) Minimum Cover Requirements

Table 300.5(A) Minimum Cover Requirements

Electrical Metallic Tubing (*EMT*) has been added to Column 3 of the table to clearly indicate that it can be installed in an underground location

- ⚠ EMT is permitted to be used in underground locations
- ⚠ Supplementary corrosion protection is generally required for EMT in direct contact with earth, but not required in all cases (*Example: Stainless tubing*)
- ⚠ *UL 797, Standard for Safety Electrical Metallic Tubing- Steel*, also indicates that EMT is permitted in underground installations
- ⚠ A new note #6 was added to the bottom of the table to direct the *Code* user to 358.10 for additional information requirements for directly buried EMT



Table 300.5(A) Column 3 (EMT)

Electrical metallic tubing (EMT) has been added to Table 300.5(A), Column 3 to indicate it can be installed in underground locations

Not a new change for the use of EMT
It has always been allowed with the use of supplementary corrosion protection

Some EMT such as stainless does not require the use of supplementary corrosion protection



Photo courtesy of IAEI Archives

300.5 Underground Installations

(D) Protection from Damage

The words “direct buried” were removed from the heading leaving behind “conductors and cables”

- ⚠ The text reading as “direct buried conductors and cables,” did not apply to buried raceways containing conductors
- ⚠ Only conductors that were directly buried were included in the 2020 *NEC* edition
- ⚠ This revision will provide both the installers and inspectors clarity as to requirements for underground conductor and cable installations



300.5 (D) Protection From Damage

The words “direct buried” were removed from the heading leaving behind “conductors and cables”

Buried raceways containing electrical conductors require the same protection as buried cables

Utilize **Table 300.5** for the correct burial depths in order to pass an electrical inspection

Photo courtesy of Scott Humphrey





*Photo courtesy
of Scott Humphrey*

300.6 Protection Against Corrosion and Deterioration

(A) Ferrous Metal Equipment

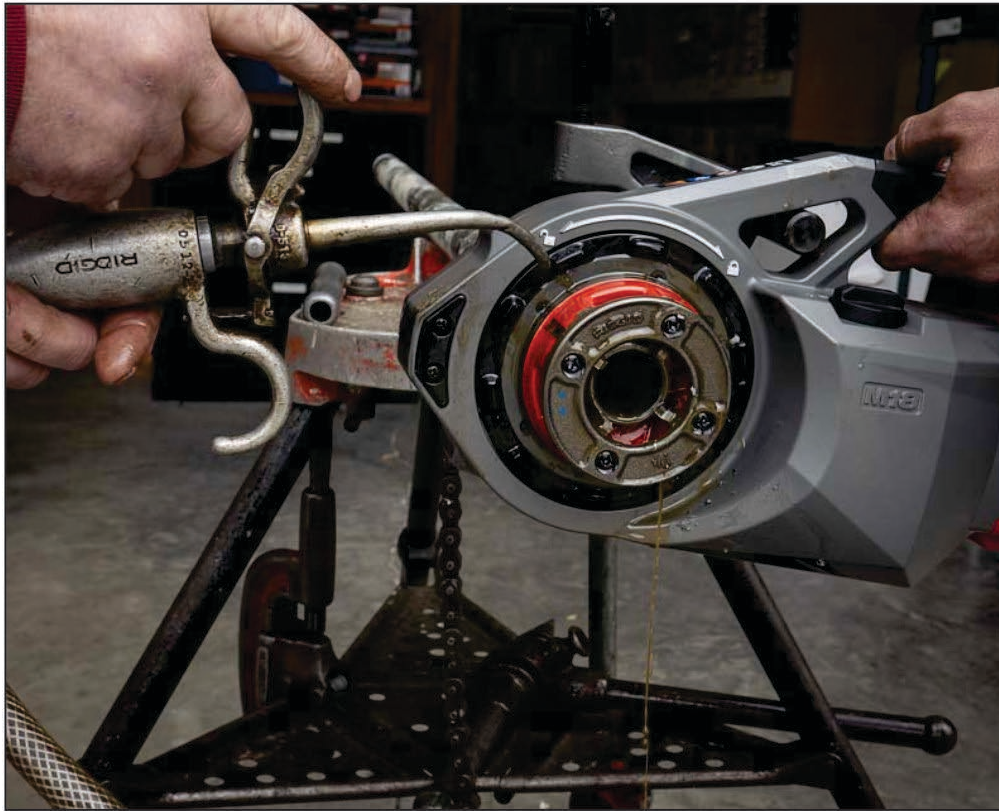
The informational note referencing field-cut threads has been removed and added into positive language

- ⚠ Adding "anywhere other than at the factory where the product is listed" adds clarity
- ⚠ Threads cut in the field are to be coated with an electrically conductive, corrosion-resistant compound that has been approved for that purpose
- ⚠ If the threads are cut at the factory, the field installation of this protective coating does not apply
- ⚠ Informational notes are not enforceable (*these are informative to the user of the Code*)
- ⚠ Moving the requirements into the section language allows for enforcement



300.6(A) Ferrous Metal Equipment

Electrical pipe **threads cut in the field** are to be coated with an electrically conductive, corrosion-resistant compound that has been approved for that purpose



If threads are **cut at the factory**, the field installation of a protective coating does not apply

Photos courtesy of Milwaukee Tools

300.11 Securing and Supporting

(C) Raceways Used as Means of Support

Class 3 circuit conductors are permitted to be supported by the raceway containing power supply conductors that supplies the equipment

- ⚠ Class 2 and Class 3 cables are now able to be supported by raceway
- ⚠ Support to be provided by the raceway containing power supply conductors that supplies the equipment
- ⚠ These cables are typically the same in size and weight so there should not be an issue
- ⚠ This also aligns with 725.143, which recognizes Class 2 and Class 3 circuit conductors and points back to 310.11(C) for their installation

300.14 Length of Free Conductors at Outlets, Junctions, and Switch Points

Language has been added permitting free conductors to be spliced at outlet, junction, and switch point locations

- ⚠ This clarifies that the conductor is permitted to be spliced with a shorter conductor to add length to it and meet the 6 inches required by this section
- ⚠ Previously left up to interpretation as to if the free conductor had to be continuous or was permitted to be spliced and extended at the box
- ⚠ When the drywall installer router damages the conductors within the box, some inspectors would not allow for the conductor to be spliced (*In some cases, the installer would be required to replace the NM cable to the box*)
- ⚠ This caused misunderstanding and confusion between the installer and the inspector
- ⚠ Additional issues could also arise where wall surfacing has been installed leaving the length of the free conductor less than the 6-inch requirement

300.14 Length of Free Conductors at Outlets, Junctions, and Switch Points

Clarifies that the conductor **is permitted to be spliced** with a shorter conductor to add length to it and meet the 6 inches required by this section

Photo below shows a router being used to expose the device box that was covered with drywall

Photo on right shows a device box with numerous conductors that could be damaged by a careless router



Careless router operator could cause a lot of damage to these conductors

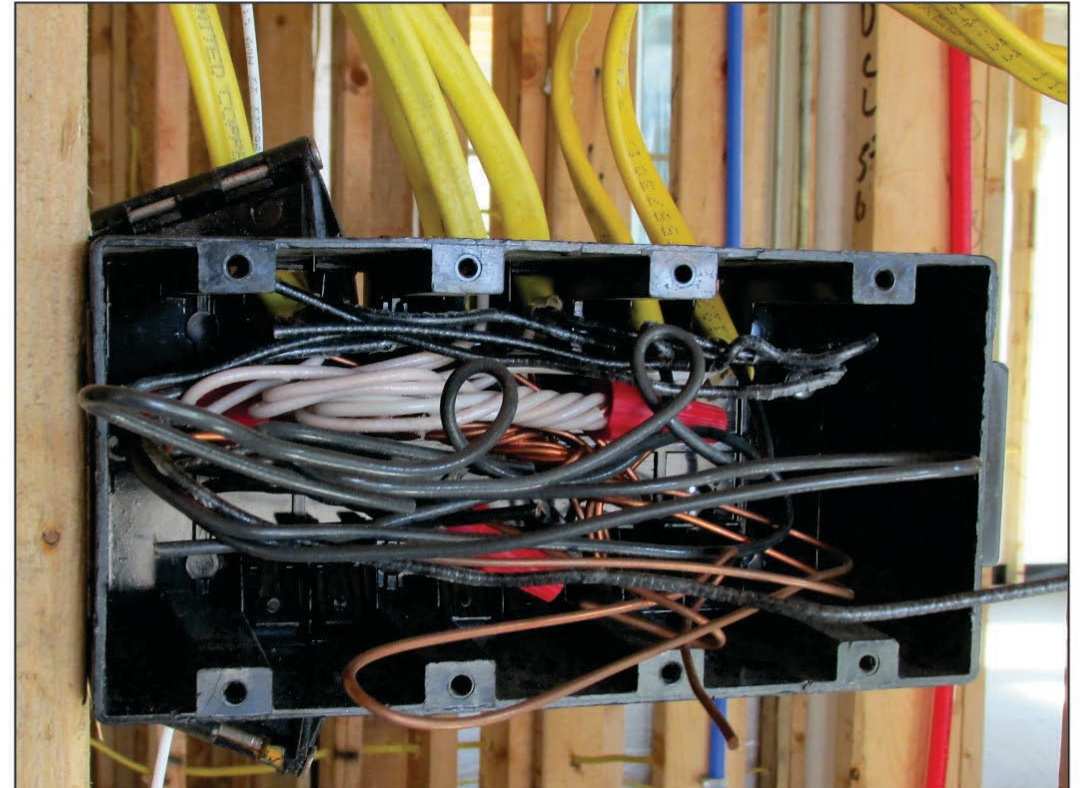


Photo courtesy of IAEI Archives

300.17 Number and Size of Conductors and Cables in Raceway

Conductors are installed *(as well as cables)* in raceways and requirements were needed so they are not damaged during and after their installation

- ⚠ The number and size of conductors **and cables** in a raceway is limited
- ⚠ Limited due to a need to dissipate heat generated by conductors
- ⚠ Conductors **and cables** are not to be damaged due to installation or removal
- ⚠ Insulation integrity of conductors **and cables** must be protected
- ⚠ The updated Informational Note offers direction to the location of the various wiring methods and their requirements



300.17 Number and Size of Conductors and Cables in Raceways

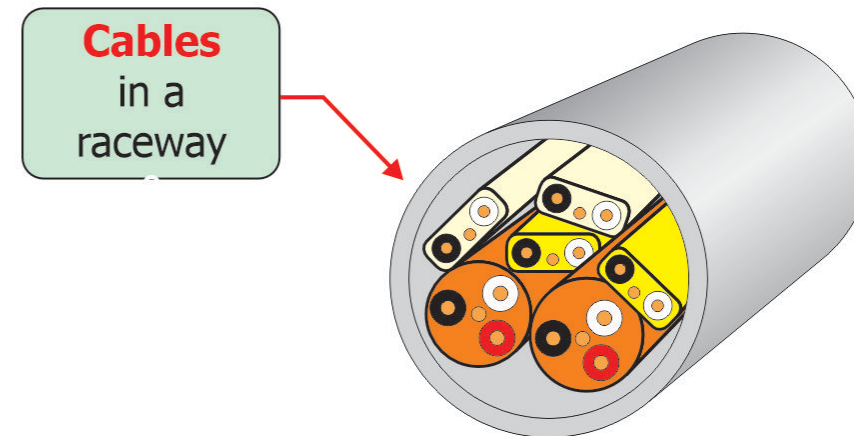
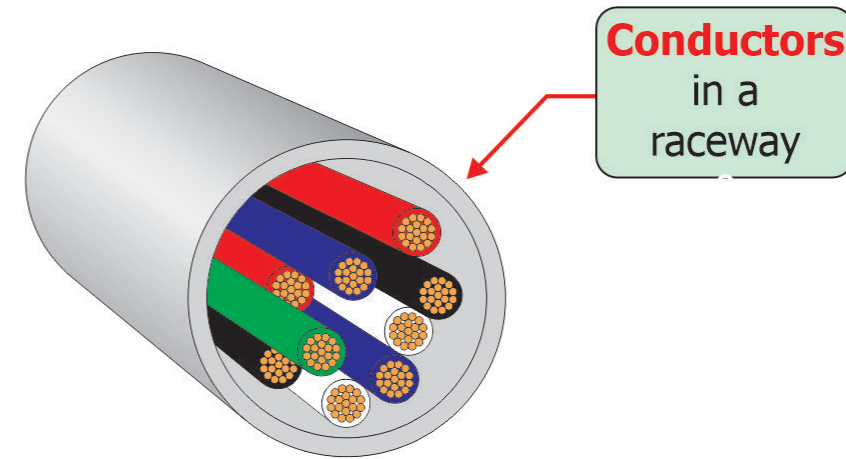
Conductors are installed (*as well as cables*) in raceways and requirements were needed so they are not damaged during and after their installation

Conductors and cables are limited in raceways

Must be able to dissipate heat

Must not damage conductors or cables during installation or removal

Insulation integrity to be protected



300.25 Exit Enclosures (*Stair Towers*)

An exception was added addressing egress lighting on outside exterior doorways

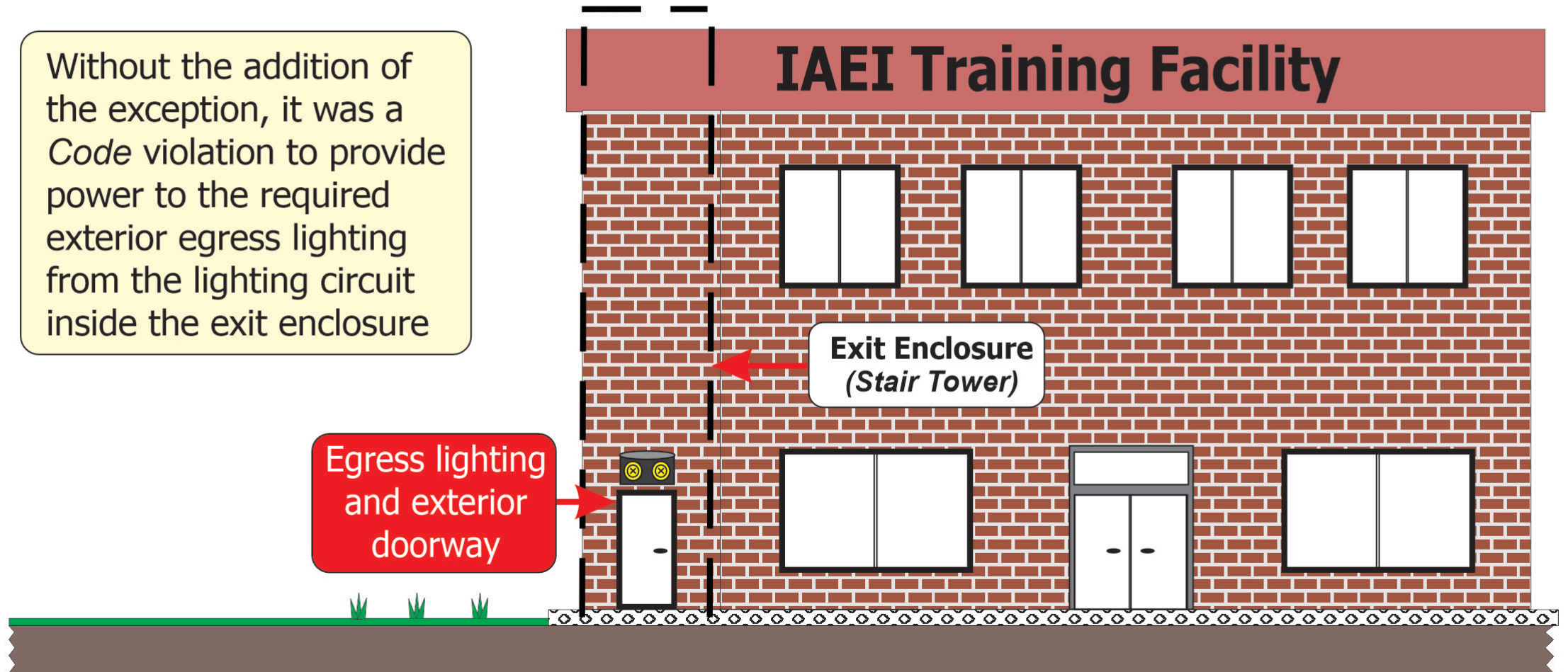
- ⚠️ Eliminated the term “be separated from the building” and added the words “have a fire resistance rating”
- ⚠️ “Fire resistance rating” is a defined term in the building code and, therefore, will clarify this requirement
- ⚠️ Outside exterior doorways are part of the means of egress and frequently require egress lighting to extend to the public way
- ⚠️ Without the addition of the exception, it was a *Code* violation to provide power to the required exterior egress lighting from the lighting circuit inside the exit enclosure



300.25 Exit Enclosures (*Stair Towers*)

Exception added addressing egress lighting on outside exterior doorways for stair towers

Without the addition of the exception, it was a *Code* violation to provide power to the required exterior egress lighting from the lighting circuit inside the exit enclosure



300.26 Remote-Control and Signaling Circuits Classification

A new Section 300.26 has been created for remote-control and signaling circuits

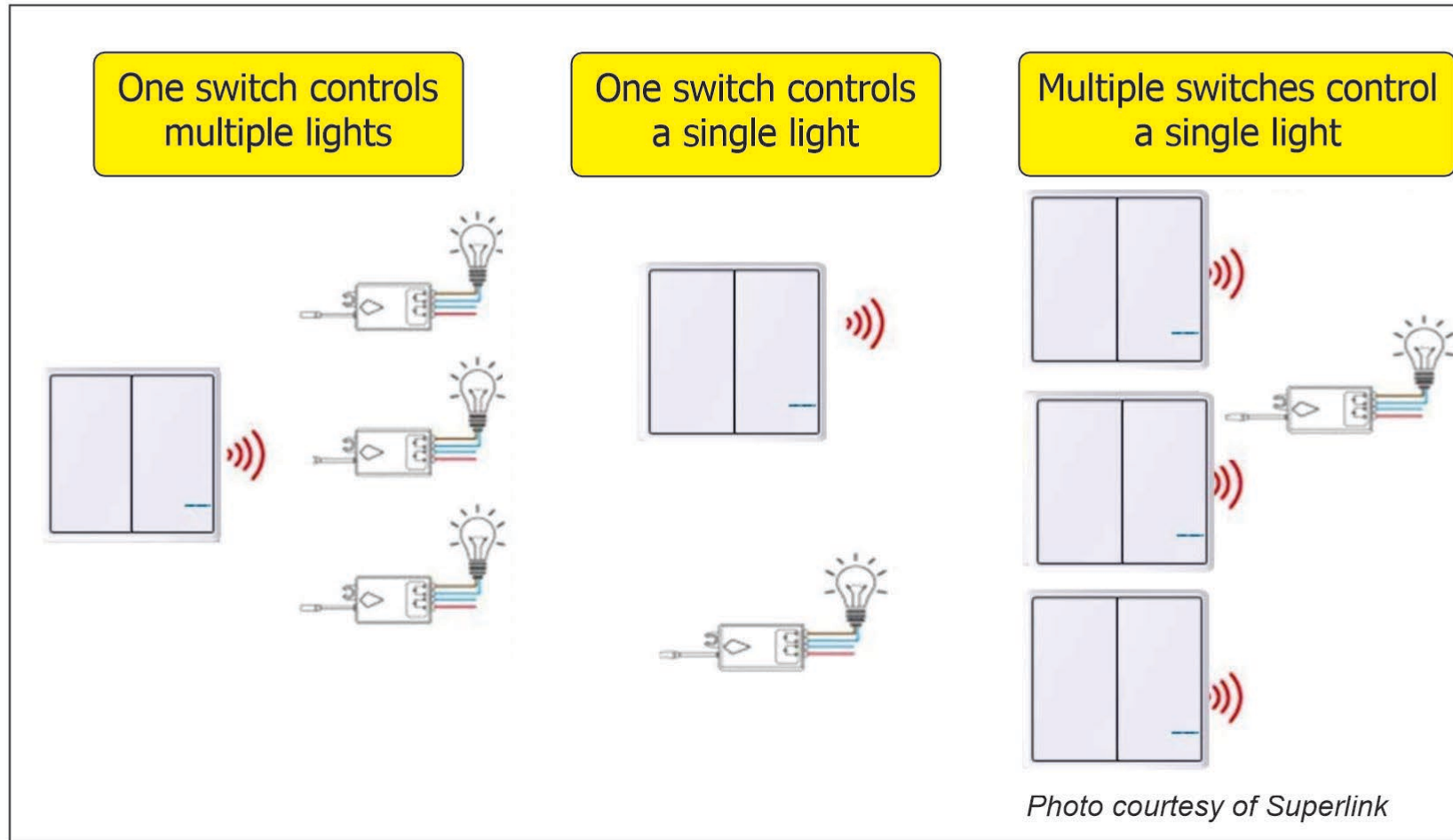
- ⚠ This should help to clarify that remote-control and signaling circuits can be either power-limited or non-power-limited
- ⚠ Class 1 circuits have been relocated from Art 725 to a new Article 724
- ⚠ Class 2 and 3 circuitry shall comply with Article 725
- ⚠ Power-limited Class 2, and Class 3 circuitry to comply with Section 725.3(E)
- ⚠ Sections 300.2 through 300.25 to govern remote-control and signaling circuits that are non-power-limited



300.26 Remote-Control and Signaling Circuits Classification

Section 300.26 was created by CMP-3 for remote-control and signaling circuits

- Class 1 circuitry has been relocated from Article 725 to Article 724
- Power-limited Class 2, and Class 3 circuitry to comply with Article 725
- Sections 300.2 through 300.25 for non-power-limited remote-control and signaling circuits





Article 305

Methods and Materials for Systems Rated Over 1000 Volts ac, 1500 Volts dc, Nominal

Article 305 General Requirements for Wiring Methods and Materials

Article 305 was created for general wiring methods and installations applying to Wiring Methods and Materials for Systems Rated Over 1000 Volts ac, 1500 Volts dc, Nominal

- ⚠ This content was formerly located as Part II of Art. 300
- ⚠ Increases safety by including more information on medium voltage (*MV*) installations
- ⚠ Greater likelihood for the electrical professional to apply all the wiring methods and installations requirements correctly if located in this new article
- ⚠ Medium voltage (*MV*) information will provide the electrical industry, including installers and inspectors, with more guidance toward installation requirements



Article 305 General Requirements for Wiring Methods and Materials

Article 305 was created for **general wiring methods and installations** applying to Wiring Methods and Materials for Systems Rated Over 1000 Volts ac, 1500 Volts dc, Nominal

Greater likelihood for electrical professionals to apply all the wiring methods and installations requirements for medium voltage (MV) correctly if located in this new article

Systems like these if not correctly installed can result in possible damage to the equipment and facility as well as injury and death to people



Photo courtesy of Rob Bowerman

Article 310

Conductors for General Wiring

Tables 310.16, 310.17, and 310.20

Deleted “XHWN” from the 90-degree Celsius columns of Tables 310.16, 310.17, and 310.20

- ⚠ Due to action from the correlating committee requesting CMP-6 to determine if Type XHWN is allowable for use at 90 degrees Celsius
- ⚠ CMP-6 decided that Type XHWN insulation was not rated for this temperature and deleted it from the above table columns
- ⚠ “XHWN” is an insulation that can be used in dry and wet locations and is of a flame-retardant, moisture-resistant thermoset type
- ⚠ It is listed at Table 310.4(1) as being rated for 75 degrees Celsius



Tables 310.16, 310.17, and 310.20

Deleted "XHWN" from the 90-degree Celsius columns

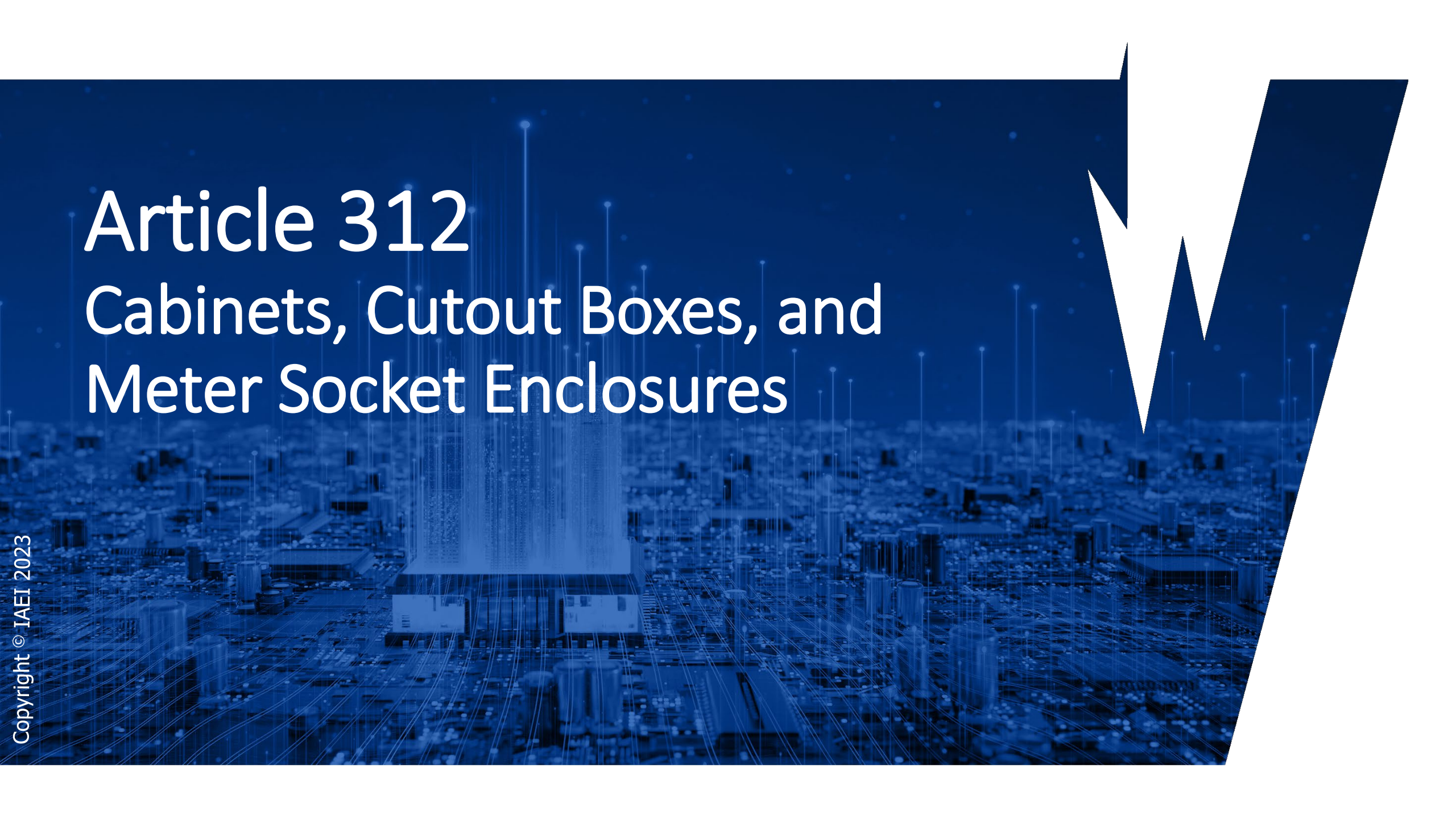
Type XHWN insulation is not rated for this temperature and was deleted from the above table columns

It is also not longer available on the market for purchase and installation



XHWN is listed in Table 310.4(1) as being rated for 75 degrees Celsius

XHWN can be used in dry and wet locations and is of a flame-retardant, moisture-resistant thermoset type



Article 312

Cabinets, Cutout Boxes, and Meter Socket Enclosures

312.10 Screws and Other Fasteners

New section added to address **field installed screws or other fasteners** entering a cabinet, cutout box, or meter socket

- ⚠️ Damage to the conductors has been an issue for some time creating a shock or fire hazard
- ⚠️ Injuries to electrical professionals have been reported due to accidental insulation or conductor damage as the result of inappropriate screw use
- ⚠️ Greater attention will be required by the installer as to the type of fastener they use and how far it protrudes into the wiring space
- ⚠️ The AHJ will need to be mindful and examine these enclosures to make sure this new requirement is being adhered to by the installer



312.10 Screws and Other Fasteners (cont.)

New section added to address **field installed screws or other fasteners** entering a cabinet, cutout box, or meter socket (cont.)

- ⚠ Screws are to be of a machine type with blunt ends
- ⚠ Other fasteners being installed are to be of the type with blunt ends
- ⚠ Screws or other fasteners **cannot extend** into the enclosure further than **6 mm (1/4 in.)** **unless the end** is protected with an approved means
 - 🔩 **Exception to above requirement:** Screws or other fasteners are permitted to extend into the enclosure not more than **11 mm (7/16 in.)** if located within 10 mm (3/8 in.) of an enclosure wall
- ⚠ **Note:** The 7/16-in. dimension accounts for the customary 1/2-in. screw passing through a 1/16-in. thick enclosure wall along the edges and at the corners of enclosures (*The natural curves in conductors at these locations allow for greater screw lengths*)



312.10 Screws and Other Fasteners

Example of a conductor damaged by a screw

Installer and inspector should verify conductors are installed away of locations where screws will fasten covers to cabinet



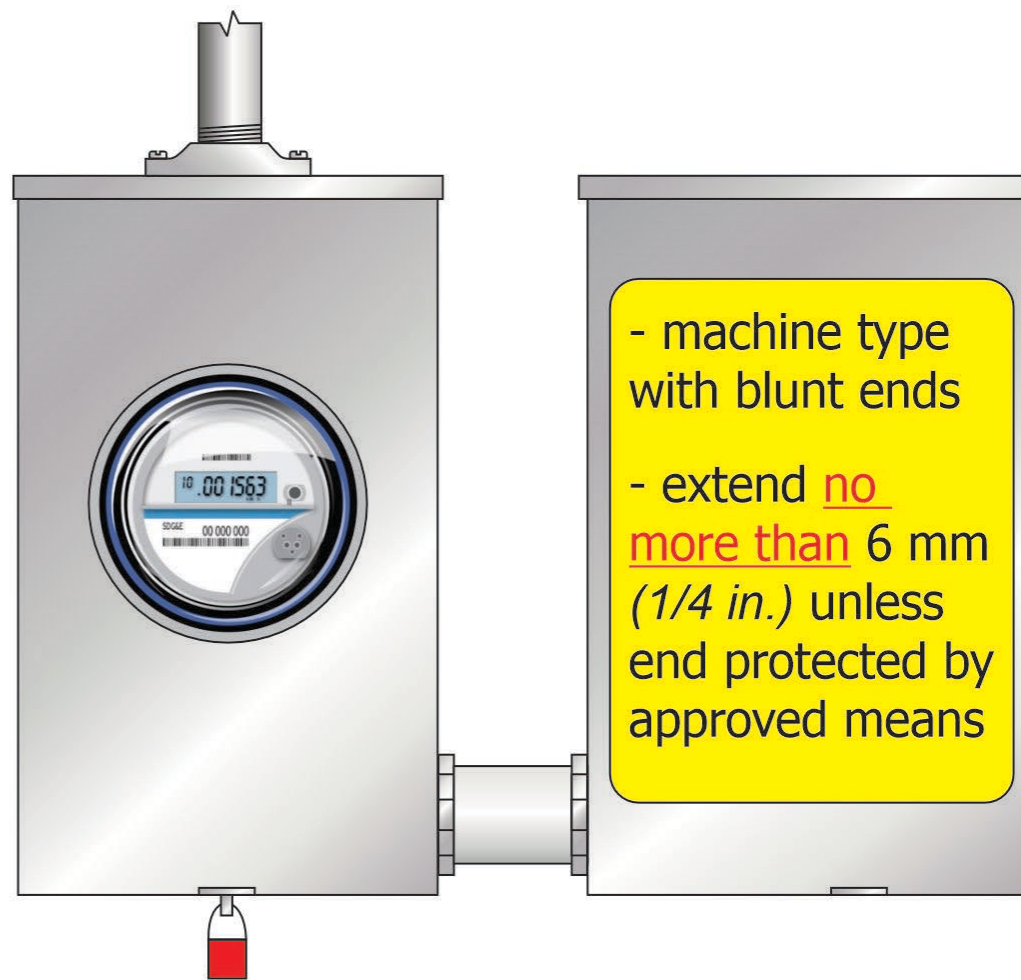
Photo courtesy of IAEI Archives

312.10 Screws and Fasteners

Damage to the conductors has been an issue for some time creating a shock or fire hazard

The possibilities of an abundance of arcs and sparks are greater with meter enclosures due to limited overcurrent protection upstream by the utility

Greater attention will be required by the installer and the AHJ as to the type of fastener they use and how far it intrudes into the wiring space



Article 314

Outlet, Device, Pull, and Junction
Boxes, Conduit Bodies, Fittings,
and Handhole Enclosures

314.5 Screws and Other Fasteners

New section added to address **screws and fasteners** entering the wiring space of boxes and conduit bodies

- ⚠ This addresses the installation of fasteners which are field installed into the wiring space of these boxes/conduit bodies
- ⚠ These fasteners and screws have been responsible for **damage to the conductor(s)** causing electrical shock and fire hazards
- ⚠ A new set of list items include 7 requirements concerning screw and fastener use
- ⚠ These fastener requirements apply during installation of boxes and conduit bodies
- ⚠ Fasteners such as drywall screws will not be acceptable for these installations

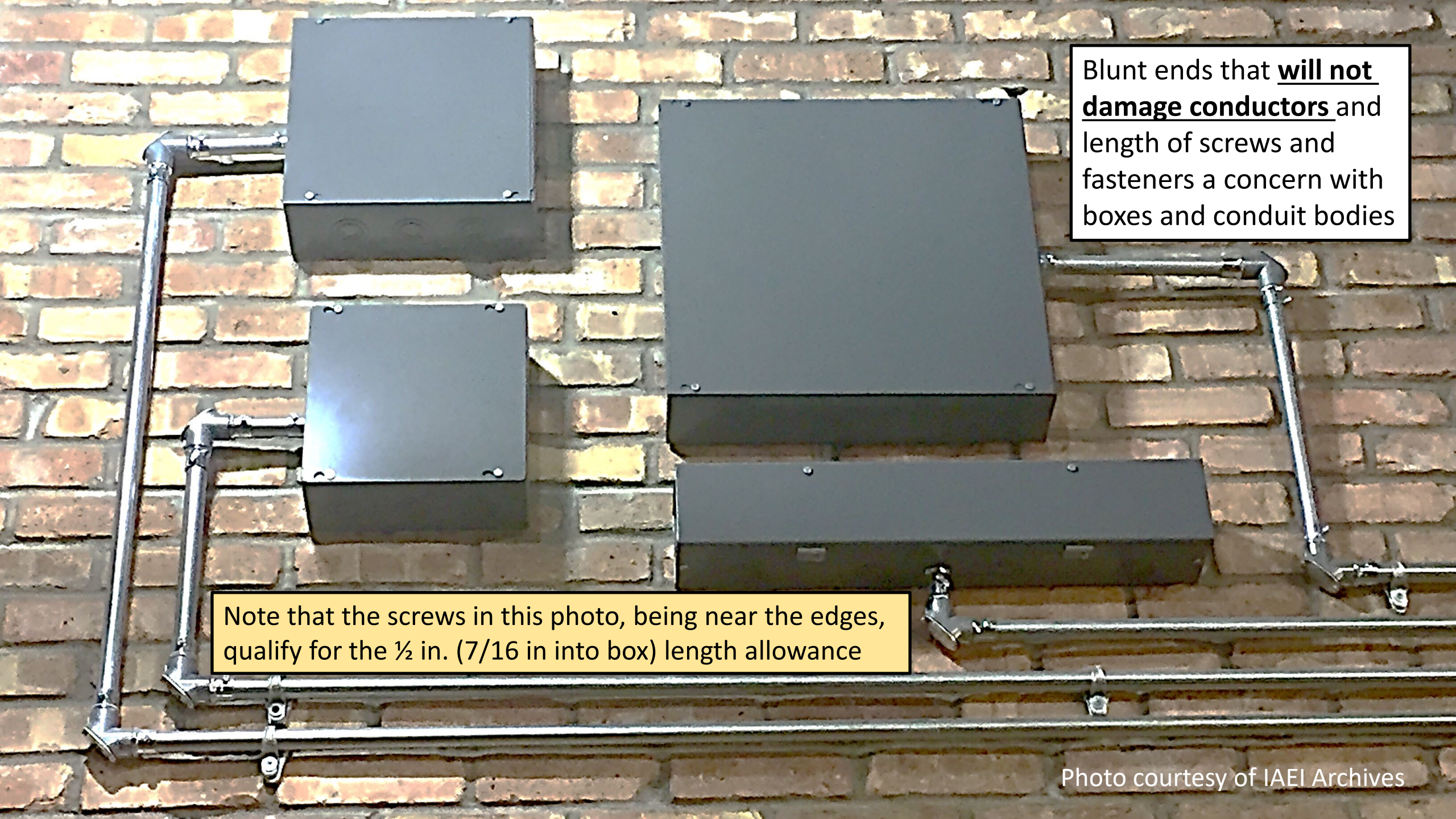


314.5 Screws and Other Fasteners (cont.)

Review of the Notes:

- ⚠ Applies to field wiring exclusively, not to screws provided by the manufacturer (*An example would be screws for ganging multiple outlet boxes*)
- ⚠ Outlet boxes are treated more conservatively due to greater congestion, which makes damage from screw or fastener wall penetrations very difficult to avoid
- ⚠ The 5/16-in. screw dimension refers to the common 3/8-in. screws that attach device yokes to raised covers, and wall plates to device yokes
- ⚠ The 7/16-in. screw dimension refers to the common 1/2-in. screw inserted into a 1/16-in. thick enclosure wall along the edges and at the corners of enclosures (*This is the standard length and positioning for pull box cover screws*)
- ⚠ Natural curves in conductors at these locations allow for greater screw lengths





Blunt ends that **will not damage conductors** and length of screws and fasteners a concern with boxes and conduit bodies

Note that the screws in this photo, being near the edges, qualify for the $\frac{1}{2}$ in. (7/16 in into box) length allowance

314.16 Number of Conductors in Outlet, Device, and Junction Boxes, and Conduit Bodies

(B) Box Fill Calculations

(6) Terminal Block Fill: A new section added to address volume allowance concerns when terminal blocks are installed in boxes

- ⚠️ A single volume allowance based on the largest conductor size terminated on the assembly will be required based on Table 314.16(B)(1)
- ⚠️ This **does not apply** to every conductor terminated to a pole of a terminal block assembly

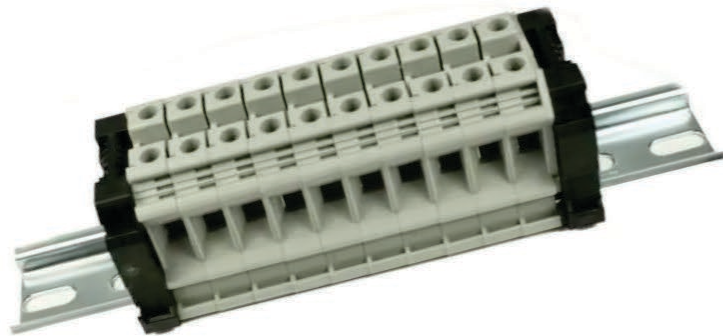


314.16(B)(6) Terminal Block Fill

Utilize **Table 314.16(B)(1)** to find single volume allowance for the **largest conductor terminated** on the terminal block assembly

This will not be encountered by many electrical installers

See 680.23(F)(2)(b) where requirements **disallow normal twist-on wire connectors** in the equipment grounding return path for in-pool line-voltage lights, but permits grounding terminals



Terminal Block Assembly



Photo courtesy of Steel City

314.24 Dimensions of Boxes

Substantiation was presented to CMP-9 to adjust the existing language by broadening the reach of this section to address side entries for outlet and device boxes

- ⚠️ These changes will help to ensure that conductor damage is not caused by the installation of devices into outlet and device boxes
- ⚠️ Adjusted the wording to ensure that the depth of boxes accommodates wiring method entries where those entry points line up with the backs of installed devices or equipment
- ⚠️ CMP became aware of damage to conductors from installed devices or other equipment of sufficient size to create a conflict with conductors entering these boxes
- ⚠️ A fire investigation concerning a GFCI receptacle installed on the outside of a house was also considered as substantiation for this change

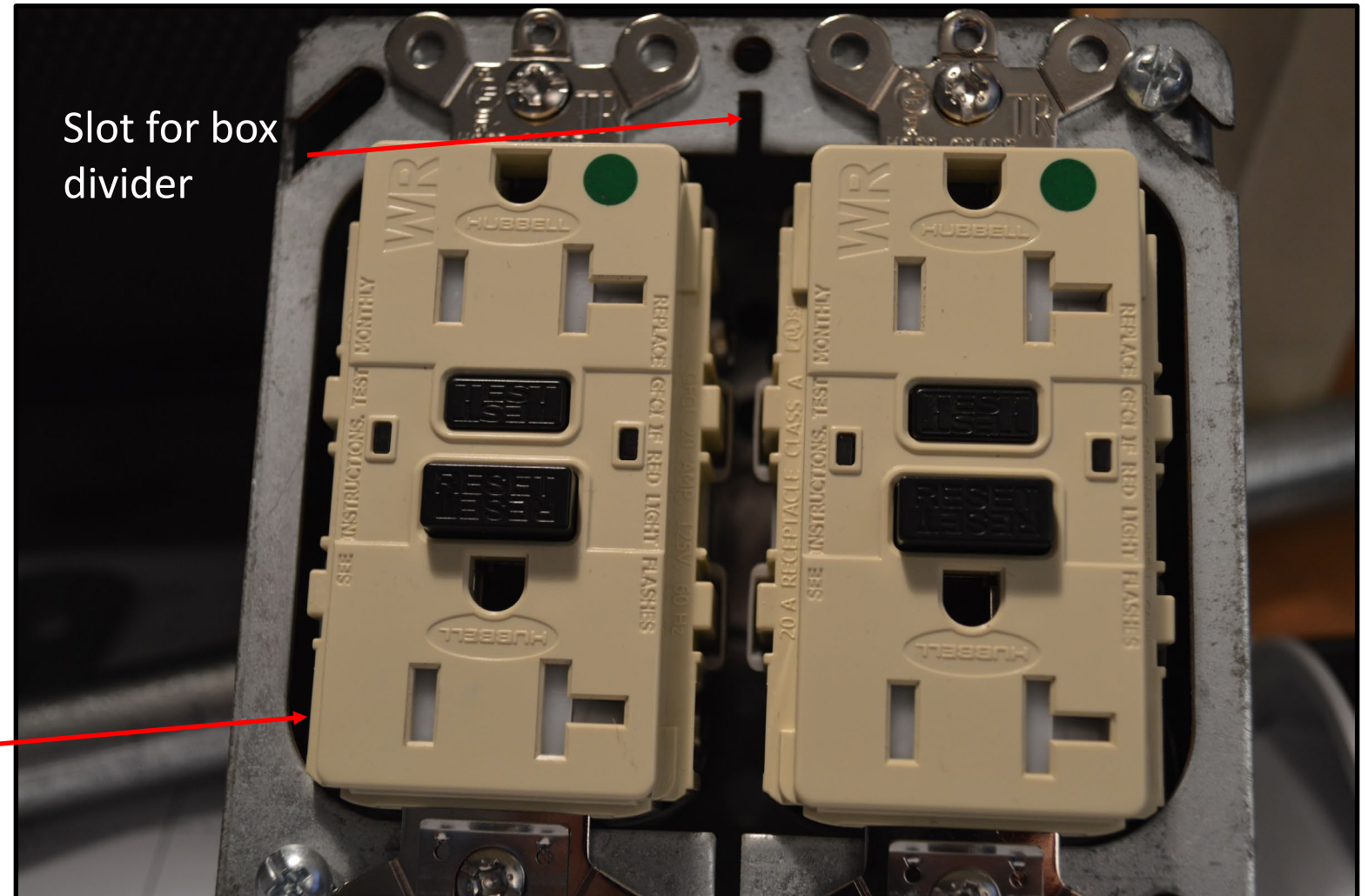


314.24 Dimensions of Boxes (cont.)

Note two NEMA device envelopes in full use (next slide), with 1/16-in. slot allowance for box divider in center, and radius (7/16-in.) corners; device corners are beveled to fit perfectly.

These two GFCI devices project 1-in. into the box below the ring.

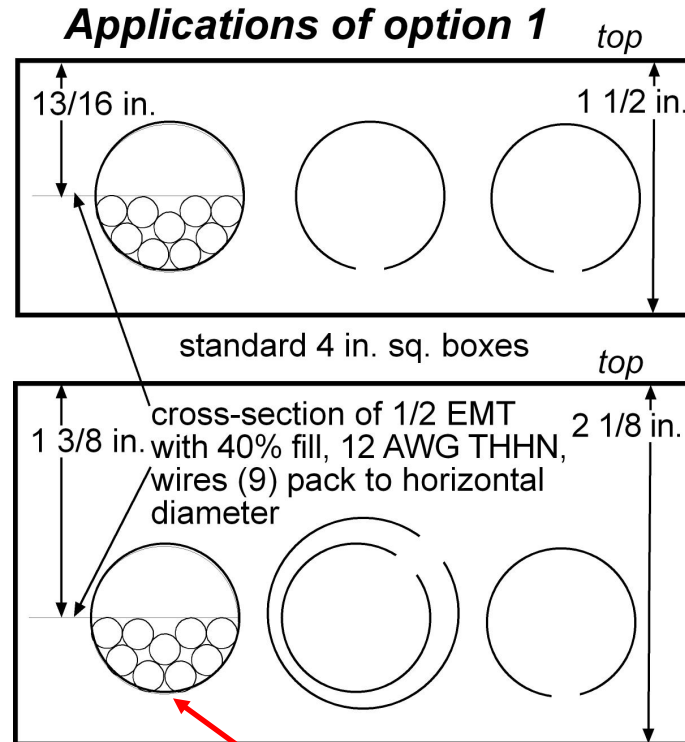
Device depths vary and must be measured in the field.



314.24 Dimensions of Boxes (cont.)

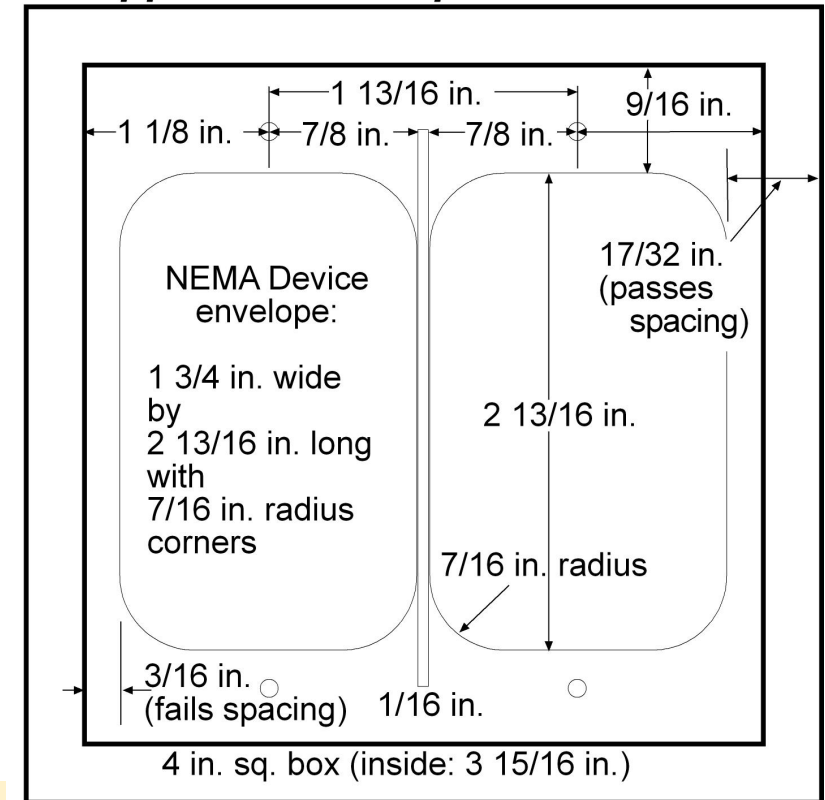
The GFCI receptacles (prior slide) would require a plaster ring or a raised cover to fit in this box safely, or wiring entries from top or bottom, or a 4 11/16-inch box, or the deeper box (below).

Many devices do not use the full NEMA envelope, such as snap switches.



This graphic informed the CMP 9 action setting the horizontal knock-out diameter as the fill limit for a side entry within 1/2 in. of a device body.

Applications of option 2



4 11/16 in. sq. box (inside: 4 5/8 in.)





Article 315

Medium Voltage Conductors, Cable, Cable Joints, and Cable Terminations

Article 315 Medium Voltage Conductors, Cable, Cable Joints, and Cable Terminations

Clarifications were made as to the voltages associated with conductors, cable, cable joints, and cable terminations

- ⚠ New article containing these requirements as well as new requirements for cable joints and terminations
- ⚠ These requirements were previously found in Article 311 in the 2020 *NEC* (*Article 311 has been deleted*)
- ⚠ Specification of the voltage requirements was needed to improve usability of the *Code*
- ⚠ Article includes voltages as follows:
 - 🔌 from 2001 volts to 35,000 volts ac, nominal
 - 🔌 from 2001 volts to 2500 volts dc, nominal
- ⚠ Adds clarity for the user of the *Code* at 315.16 on how to identify Type MV, Medium Voltage Cable







A photograph showing several medium voltage cables with black Raychem LUTT-76/25 sleeves installed in a rack. The cables are bundled together and connected to copper busbars. A yellow text box is overlaid on the image.

Medium Voltage
Cable Installation

Photo courtesy of Scott Humphrey

Article 315- Medium Voltage Conductors, Cables, Cable Joints, and Cable Terminations

Wire wheel information tag for medium voltage cable

 General Cable MARION, IN 46952	GCC ORD#: 76993705 
 UL LISTED	GCC LINE: 22.00 
E90501 MEDIUM VOLTAGE CABLE ISSUE NO. P-1054	4/0 AWG 3/C 19/W COMPACT ALUMINUM, ESS, .420" TRXLP, EIS, 5 MIL BARE COPPER TAPE, CABLE WITH FILLERS, 1 - #4 7/W BARE SOFT COPPER GROUND, TAPE, AIA, RED PVC, 35KV 133% INSUL LEVEL UL TYPE MV - 105 OR MC



Photos courtesy of Scott Humphrey



Photo courtesy of Scott Humphrey



15

Photo courtesy of Scott Humphrey

Article 320

Armored Cable: Type AC

320.23 In Accessible Attics

(A) Cables Run Across the Top of Framing Members

For **accessible attics**, the term **“Framing Members”** has replaced “Joists” when considering the installations of Armored Cable (*Type AC*)

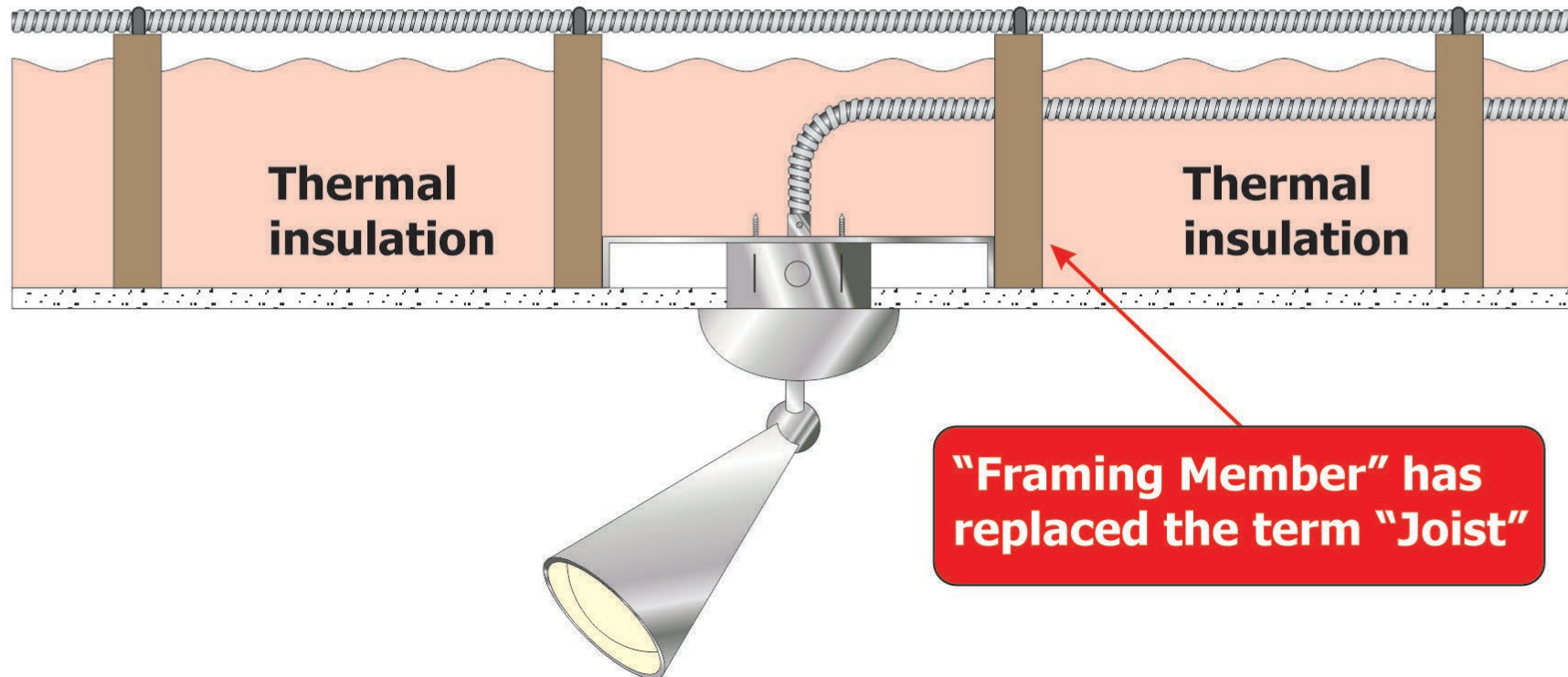
- ⚠ Most attic locations do not contain floor joists; they have ceiling joists
- ⚠ Change made to eliminate confusion for ceiling or floor locations where cables are installed
- ⚠ When cables are installed across the face of framing members, the reference to joists has been changed to the term **“equivalent horizontal surface”** to be more inclusive of any walking or crawling surface
- ⚠ The word “equivalent” removed by the Correlating Committee as a vague and unenforceable term (*SCR-45*)



320.23(A) Cables Run Across the Top of Framing Members

For accessible attics, the term **“Framing Members”** has replaced “Joists” as it pertains to the installation of Armored Cable (*Type AC*)

When AC cables are installed **across the face** of framing members, the reference to joists has been changed to the term **“equivalent horizontal surface”** to be more inclusive of any walking or crawling surface



Article 322

Flat Cable Assemblies: Type FC

322.56 Splices and Taps

(B) Taps

Changes were made to flat cable assembly requirements by removing “color-coded” and replacing it with “marked”

- ⚠ The term “color-coded” was changed to “marked” to correlate with the terminology found at 322.120 entitled “Marking”
- ⚠ Does not change the meanings of the requirements found at this location
- ⚠ Will provide clarity and unison with other code sections

Article 330

Metal-Clad Cable: Type MC

330.112 Insulation

(A) 1000 Volts or Less

Editorial changes made to correlate with the addition of 16 AWG copper conductors for general use wiring methods

- ⚠ The recognition of 16 AWG copper conductors for use as ungrounded, grounded and equipment grounding conductors in 330.104 was necessary for useability of the *Code*
- ⚠ Conductors to be of a type that is listed at **Table 310.4(1)** for conductor applications and installations rated for 600 volts



330.112 Insulation (cont.)

(A) 1000 Volts or Less

Editorial changes made to correlate with the addition of 16 AWG copper conductors for general use wiring methods (*cont.*)

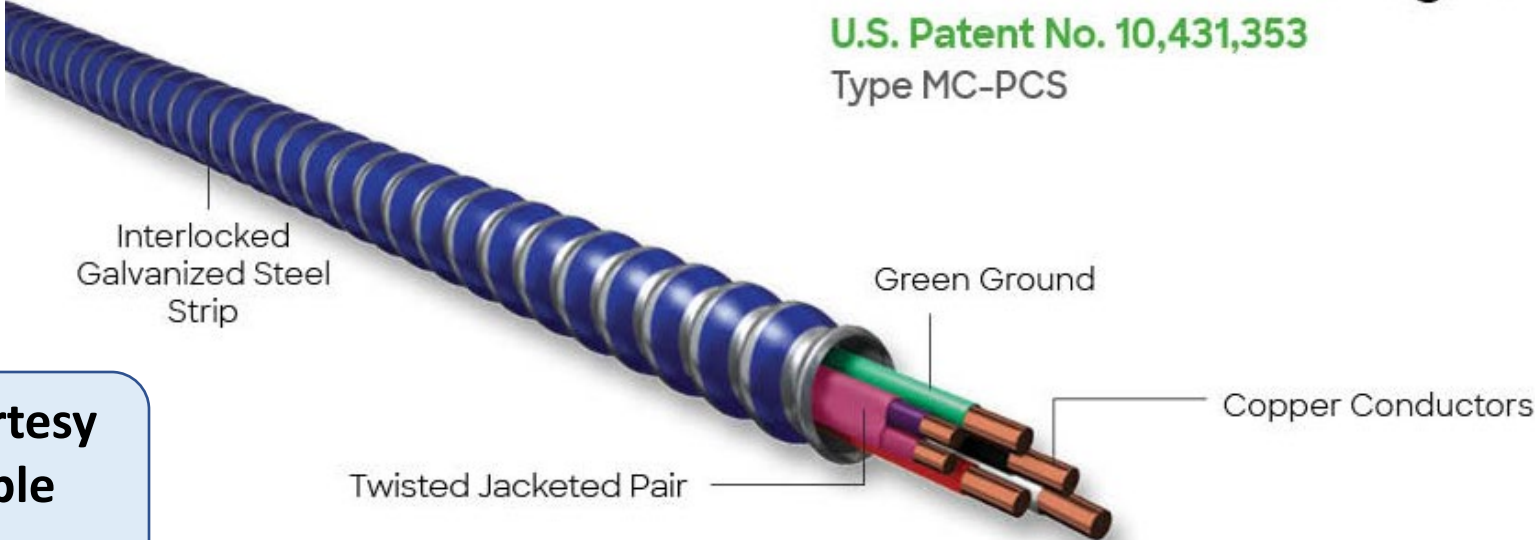
- ⚠ There was some confusion with the use of 16 AWG conductors for control and signal applications
- ⚠ Identification of the conductor types in 330.112(A) was necessary to identify the requirements for each conductor type
- ⚠ These conductors are to be of the type listed at **Table 402.3** for fixture wires



MC Tuff Luminary Cable

U.S. Patent No. 10,431,353

Type MC-PCS

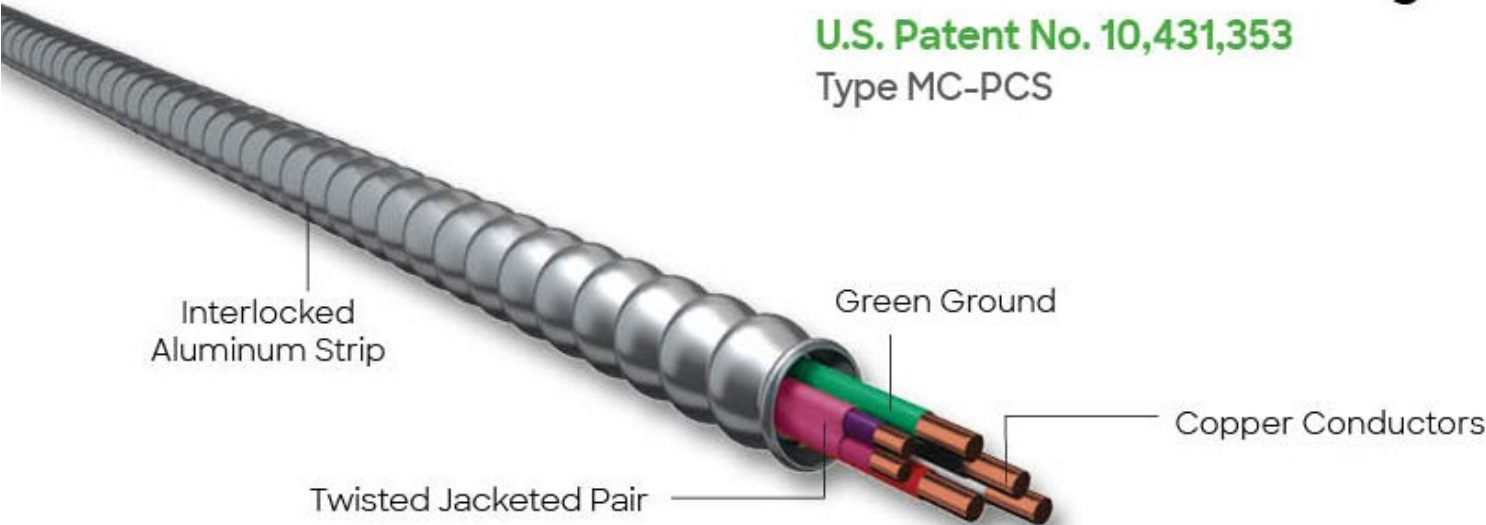


Photos Courtesy of AFC Cable Systems

MC Lite Luminary Cable

U.S. Patent No. 10,431,353

Type MC-PCS



Article 337

Type P Cable



Article 337 ~~Type IM~~ Type P Cable

Changes all references of the former Type P cable to Type IM cable

- ⚠ The purpose for including Type IM cable was to recognize a suitable wiring method for oil field drilling rig locations that are land-based
- ⚠ Installation requirements in this article include:
 - 🔧 Bending radius
 - 🔧 Ampacity
 - 🔧 Listing and
 - 🔧 Uses permitted or not permitted
- ⚠ Off-shore marine-type installations would not be found in the scope of the *NEC*
- ⚠ Type P cables used for offshore drilling rigs are not under the purview of the *NEC*

Note: No Change

This reverted back to Type P Cable during a vote at the NFPA Meeting



Article 337 Type P ~~Industrial Mobile Cable (Type IM)~~

~~Will change all references of Type P cable to Type IM cable~~ **(no change)**

Installation requirements for this product include:

- Bending radius
- Ampacity
- Listing
- Uses permitted
- Uses not permitted

Recognize as a suitable wiring method for oil field drilling rig locations that are land-based

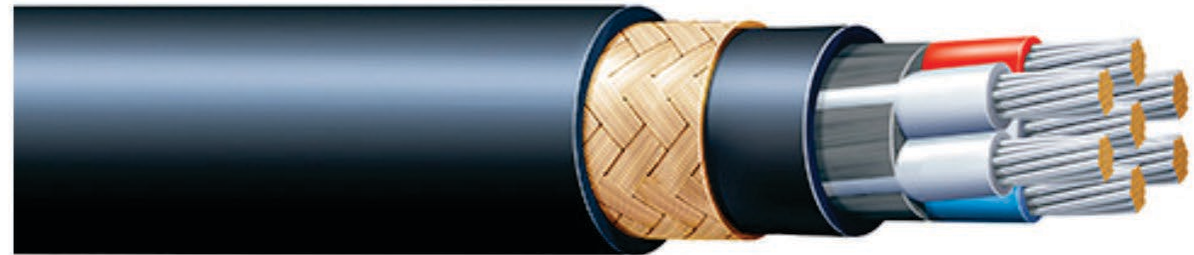


Photo courtesy of ICC Cable Corporation



Article 342

Intermediate Metal Conduit (*IMC*)

342.20 Size

(B) Maximum

A change was made for Intermediate Metal Conduit (*IMC*) by specifying that 6-inch trade size is the largest that can be installed

- ⚠️ Now to include trade size 5 and 6-inch IMC
- ⚠️ Maintains consistency in the rigid metal raceway articles
- ⚠️ *UL Standard 1242, Electrical Intermediate Metal Conduit – Steel*, does not currently include IMC trade sizes 5 and 6
- ⚠️ Could be a concern for AHJs, installers, and designers regarding listing requirements
- ⚠️ **Note: 342.30 (also 344.30) Securing and Supporting** Exception: For concealed work in finished buildings or prefinished wall panels where securing is impracticable, unbroken lengths (*without coupling*) of **IMC are permitted to be fished**
- ⚠️ New exception extends provisions for this practice now in place (*since the 1996 edition*) for EMT to IMC (*Same change occurs in 344.30 for RMC*)



342.20(B) Maximum (*Intermediate Metal Conduit*)

A change was made for Intermediate Metal Conduit (*IMC*) by specifying that **6-inch trade size is the largest** that can be installed

Note:

Installing 6 in. IMC is not for the faint of heart



Article 344

Rigid Metal Conduit (*RMC*)

344.28 Reaming and Threading (*Rigid Metal Conduit*)

Clarifies that manufacturer's requirements for reaming and threading of PVC-coated rigid metal conduit (*RMC*) should be followed

- ⚠ This change was brought about by NEMA due to the installer accidentally damaging PVC rigid metal conduit when they were reaming and adding threads to the conduit
- ⚠ The use of proper threading and clamping tools specifically designed for PVC-coated conduit should be used so that the exterior PVC coating is not damaged
- ⚠ Standard threading and clamping tools that are used with non-PVC coated RMC will damage the outside PVC coating and should not be used
- ⚠ A new informational note was added to assist installers with this procedure
- ⚠ Reference NECA 101-2013, *Standard for Installing Steel Conduits (Rigid, IMC, EMT)*



344.28 Reaming and Threading (*Rigid Metal Conduit*)

Clarifies that **manufacturer's requirements** for reaming and threading of PVC-coated rigid metal conduit (*RMC*) **should be followed**

Proper threading and clamping tools specifically designed for PVC-coated conduit should be used so that the exterior PVC coating is not damaged when being field cut, reamed, or threaded


See NECA 101-2013, Standard for Installing Steel Conduits (*Rigid, IMC, EMT*)



Photos courtesy of Plastibond



PVC Rigid Metal Conduit vise for cutting, reaming, and threading



Article 352

Rigid Polyvinyl Chloride Conduit (*PVC*)

352.44 Expansion Fittings

- ⚠ Requirements were added for an expansion fitting to be installed for underground runs of direct buried PVC conduit that emerge from the ground
- ⚠ Separated into two first level subdivisions
 - 🔧 **(A) Thermal Expansion and Contraction** – Existing language of 352.44 including Table 352.44(A) addresses the thermal expansion and contraction of a PVC conduit system
 - 🔧 **(B) Earth Movement** – New content added to address earth movement events



352.44(B) Earth Movement (*Expansion Fittings*)

(B) Earth Movement


Requirements were added for an expansion fitting to be installed for underground runs of direct buried PVC conduit that emerge from the ground

- ⚠ PVC raceways and associated fitting are sometimes pulled away from the bottom of electrical enclosures due to earth movement
- ⚠ In some cases, the raceway and fitting are pushed into the electrical enclosure or equipment
- ⚠ This typically results from the settling of the soil because it was not compacted properly when the raceway was covered or from frost heave events during cold weather



352.44(B) Earth Movement (*Expansion Fittings*)

Requirements were added for an expansion fitting to be installed for underground runs of direct buried PVC conduit that emerge from the ground




Earth movement resulting in PVC raceway being pulled loose from the male adapter



PVC expansion fittings installed in Wisconsin due to earth movement during cold weather

Photos courtesy of IAEI Archives



Article 353

High Density Polyethylene Conduit *(HDPE Conduit)*

353.48 Joints

Revised to specify that the joining methods of High-Density Polyethylene Conduit (*HDPE*) are to be made by a method identified by the manufacturer

- ⚠ Heat fusion or butt fusion joints are not to be permitted
- ⚠ Heat and butt fusion may “burn” or damage the cabling when it is subsequently pulled over the lip
- ⚠ The lip will also reduce the potential wire pull surface area and conduit fill calculations
- ⚠ *UL Standard 651A, Schedule 40 and 80 High Density Polyethylene (HDPE) Conduit* is performance-based
- ⚠ Including a list format may inadvertently omit a joining method that could meet the performance requirements of the standard



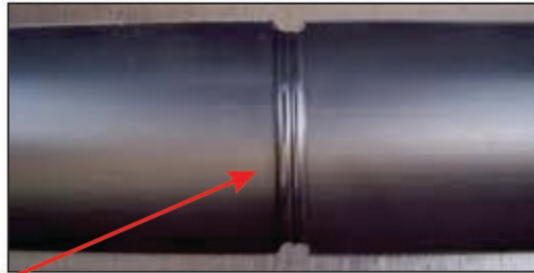
353.48 Joints [High Density Polyethylene Conduit (HDPE)]

Joining methods of High Density Polyethylene Conduit (HDPE) **for electrical installations** are to be made by a method **identified by the manufacturer**

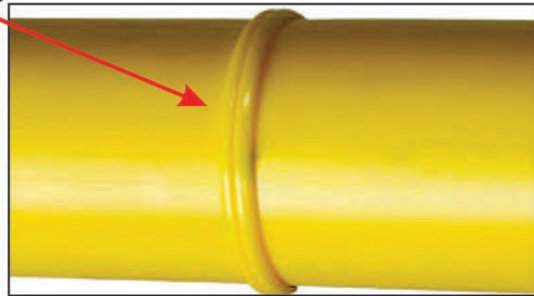
May damage the cabling or conductors when it is pulled over the lip
The lip will also reduce the potential wire pull surface area and conduit fill calculations

Heat fusion or butt fusion joints **not permitted** for High Density Polyethylene Conduit (HDPE)

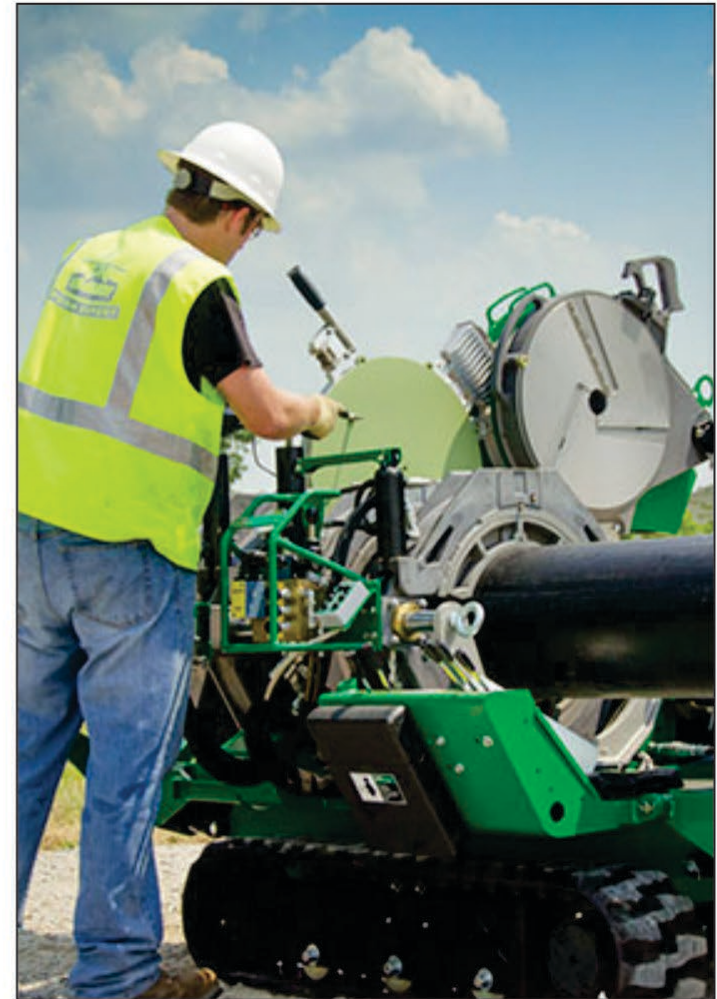
Butt Fusion



Heat Fusion



Lip



Photos courtesy of HDPE Supply



Article 358

Electrical Metallic Tubing (*EMT*)

358.20 Size

(B) Maximum

This change increases the maximum size of Electrical Metallic Conduit (*EMT*) to metric designator 155 (*trade size 6*)

- ⚠️ 5- and 6-inch EMT is not addressed in previous editions of the Code
- ⚠️ Both are similar to materials used to create 5- and 6-inch rigid metal conduit (*RMC*), which have a proven result in the industry
- ⚠️ The outer diameter will be the same as 5- and 6-inch RMC but will have a thinner wall
- ⚠️ Both EMT sizes conform to the minimum bend radii shown in Chapter 9, Table 2 of the *NEC*
- ⚠️ Chapter 9 Table 4 and Appendix C.1 and C.1(A) have been updated to include these new trade sizes



358.20(B) Maximum (*EMT Raceways*)

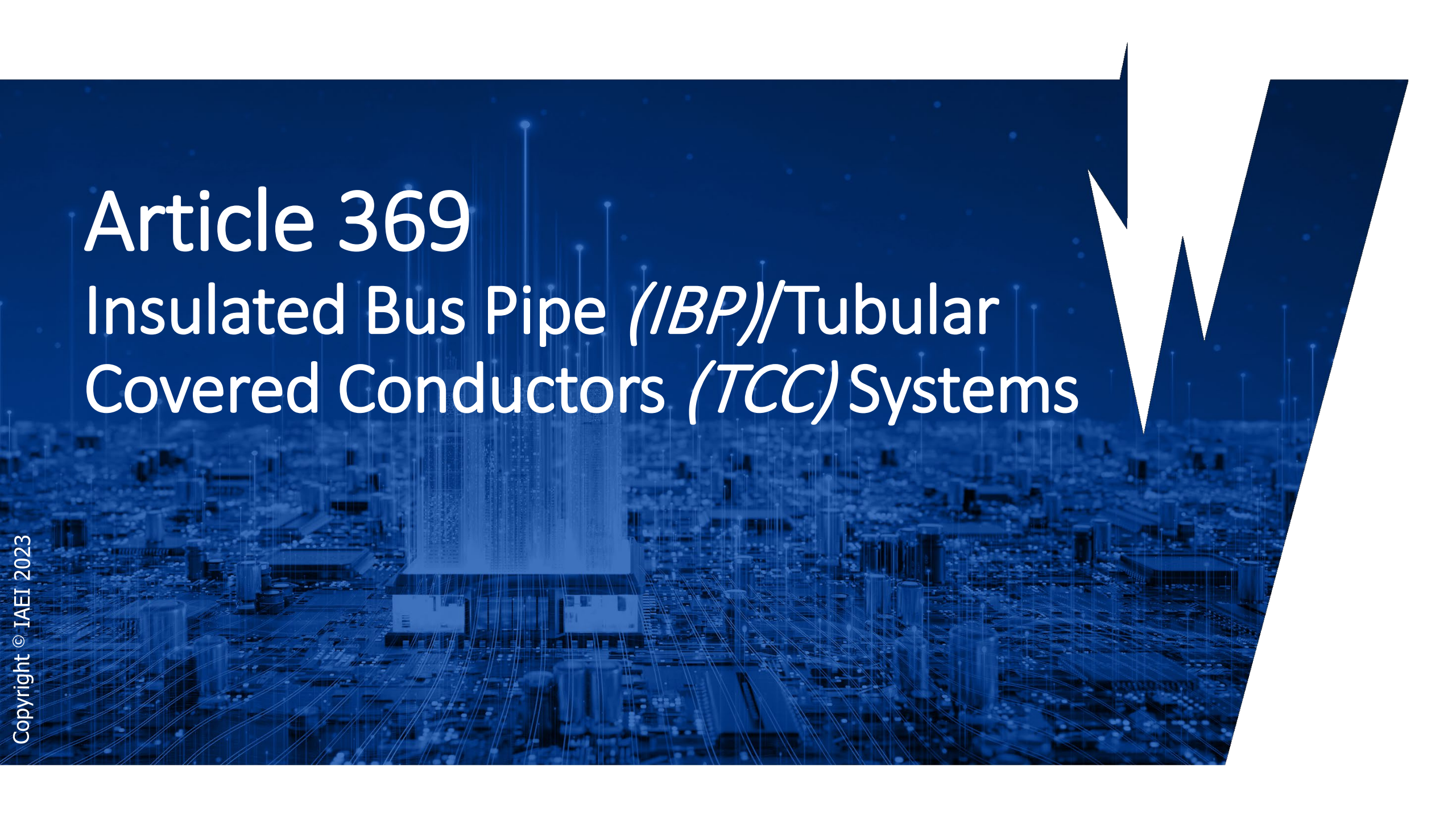
Increases the **maximum size** of Electrical Metallic Conduit (EMT) to **6 inches**

Better be young and in good shape
to install 5 and 6 inch EMT all day

5 and 6 in. EMT sizes conform to
the minimum bend radii shown in
Chapter 9 Table 2

Chapter 9 Table 4 and Appendix
C.1 and C.1(A) have been updated
to include these new trade sizes





Article 369

Insulated Bus Pipe (*IBP*)/Tubular Covered Conductors (*TCC*) Systems

Article 369 Insulated Bus Pipe/Tubular Covered Conductors

New Article 369 covers the use, installation, and construction specifications for insulated bus pipe (*IBP*) systems

- ⚠ Insulated bus pipe (*IBP*), also known as Tubular Covered Conductor (*TCC*), has been used for many years in shipboard and utility applications in Europe and utility applications in the United States
- ⚠ The system incorporates cable systems, bus bars, metal-enclosed bus, resin-impregnated bushings, and tap boxes
- ⚠ These systems are lighter, consume less volume, and take less time to install than a traditional system
- ⚠ Has been proven as a practical alternative to using medium voltage cables, bare busbars, or bare conductors
- ⚠ See the new definition in Article 100 for Insulated Bus Pipe (*IBP*)



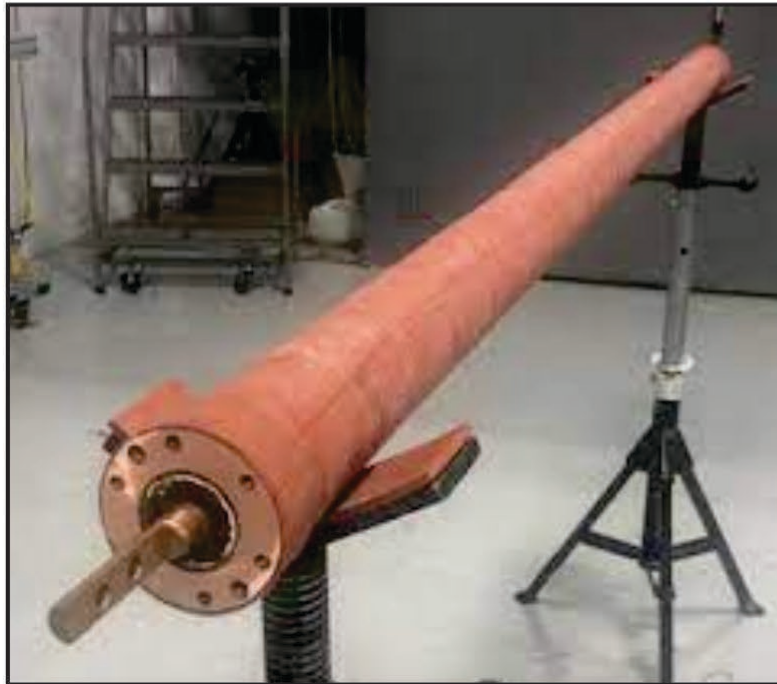
Article 369 Insulated Bus Pipe/Tubular Covered Conductors

Cover the use, installation, and construction specifications for insulated bus pipe (IBP) systems

Used for many years in **shipboard and utility** applications in Europe and utility applications in the United States

Has been proven as a practical alternative to using medium voltage cables, bare busbars, or bare conductors

See the new definition in Article 100 for Insulated Bus Pipe (IBP)



*Photos courtesy of NSRP
National Shipbuilding
Research Program*



Article 371

Flexible Bus Systems

Article 371 Flexible Bus Systems

This new article covers the use and installation requirements of flexible bus systems and their associated fittings

- ⚠ Addresses a new product (*Flexible Bus Systems*) that provides many of the benefits of both bus duct and cable
- ⚠ Its flexibility reduces installation time by making it easier to make connections in the field without the need for special tools
- ⚠ It is light in weight compared to an equivalent bus duct or conductors in a conduit



Article 371 Flexible Bus Systems (*cont.*)

This new article covers the use and installation requirements of flexible bus systems and their associated fittings (*cont.*)

- ⚠ Inspectors, installers, and designers need to be aware that flexible bus systems should be listed
- ⚠ Currently, there is not a specific standard available for listing this product, but two outlines of investigations have been developed
- ⚠ See the new definition in Article 100 for *Flexible Bus Systems*



Article 371 Flexible Bus Systems

Covers the use and installation requirements of flexible bus systems and their associated fittings

Flexibility reduces installation time by making it easier to make connections in the field without the need for special tools

It is light in weight compared to an equivalent bus duct or conductors in a conduit

Inspectors, installers, and designers need to be aware that **flexible bus systems should be listed**



Photos courtesy of nVent

Flexible Bus



Flexibility reduces installation time making it easier for connections in the field without the need for special tools

Photo courtesy of Chuck Mello

Flexible Bus



Flexibility reduces installation time making it easier for connections in the field without the need for special tools

Photo courtesy of Chuck Mello

Article 371 Flexible Bus Systems (*cont.*)

- ⚠ Flexible
- ⚠ Rectangular
- ⚠ Overall insulation



1

UL 1387

Outline of Investigation for Flexible Insulated Bus

Issue Number: 1

August 9, 2022

Flexible Bus Systems

- ⚠ An assembly
- ⚠ Flexible insulated bus
- ⚠ Associated fittings used to secure, support, and terminate the bus
- ⚠ Engineered systems for specific site location
- ⚠ Assembled at the point of installation

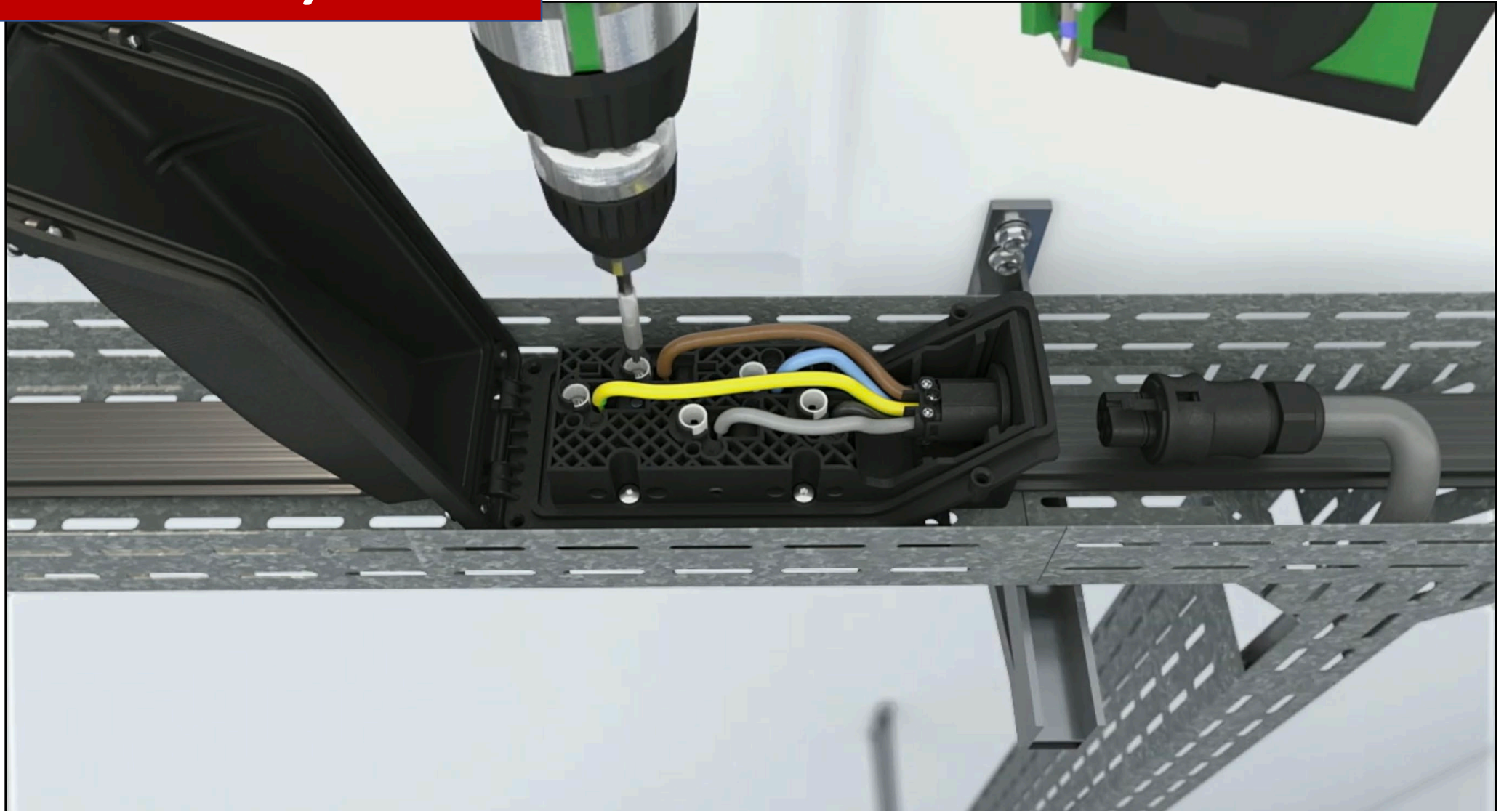
UL 1386

Outline of Investigation for Flexible Bus Systems

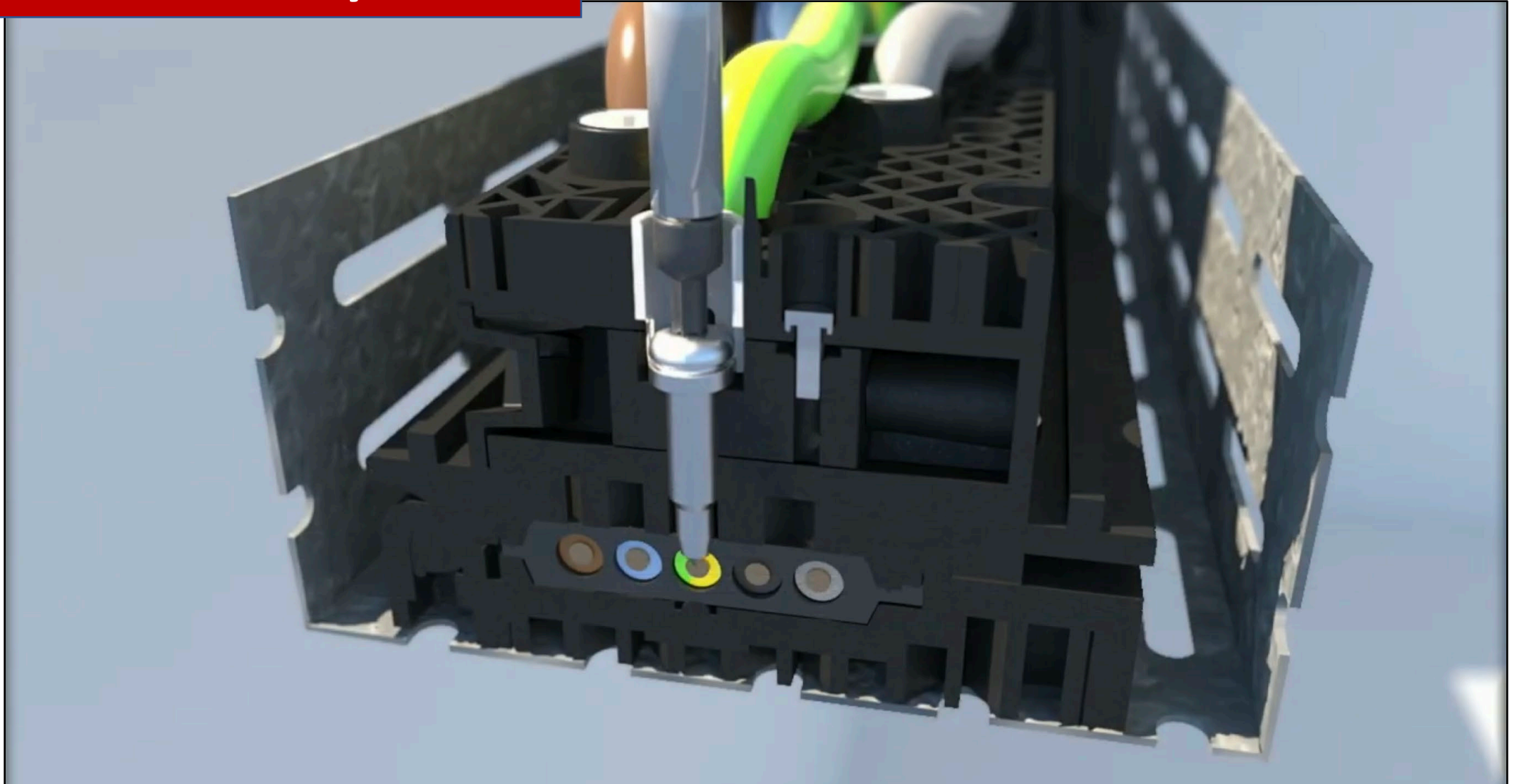
Issue Number: 1

August 30, 2022

Flexible Bus System




Flexible Bus System



Article 371 Flexible Bus Systems (*cont.*)

Part I General

 371.1 General

 371.6 Listing Requirements



Article 371 Flexible Bus Systems (cont.)

Part II Installation




- ⚠ 371.10 Uses Permitted
- ⚠ 371.12 Uses Not Permitted
- ⚠ 371.14 Installation Design
- ⚠ 371.17 Overcurrent Protection
- ⚠ 371.18 Flexible Bus Systems Installation
- ⚠ 371.20 Terminations
- ⚠ 371.30 Securing and Supporting
- ⚠ 371.40 Short Circuit Current Rating
- ⚠ 371.60 Grounding



Article 371 Flexible Bus Systems (*cont.*)

Part III Construction Specifications

371.120 Marking

-  (A) System Nameplate
-  (B) Associated Fittings
-  (C) Flexible Insulated Bus



Article 371 Flexible Bus Systems (cont.)

371.6 Listing Requirements

Flexible bus systems are **required to be listed**

- ⚠ Must be included in a list published by an organization that is acceptable to the authority having jurisdiction
- ⚠ UL 1387, Outline of Investigation for Flexible Insulated Bus (*August 9, 2022*)
- ⚠ UL 1386, Outline of Investigation for Flexible Bus Systems (*August 30, 2022*)



Article 371 Flexible Bus Systems (cont.)

371.17 Overcurrent Protection

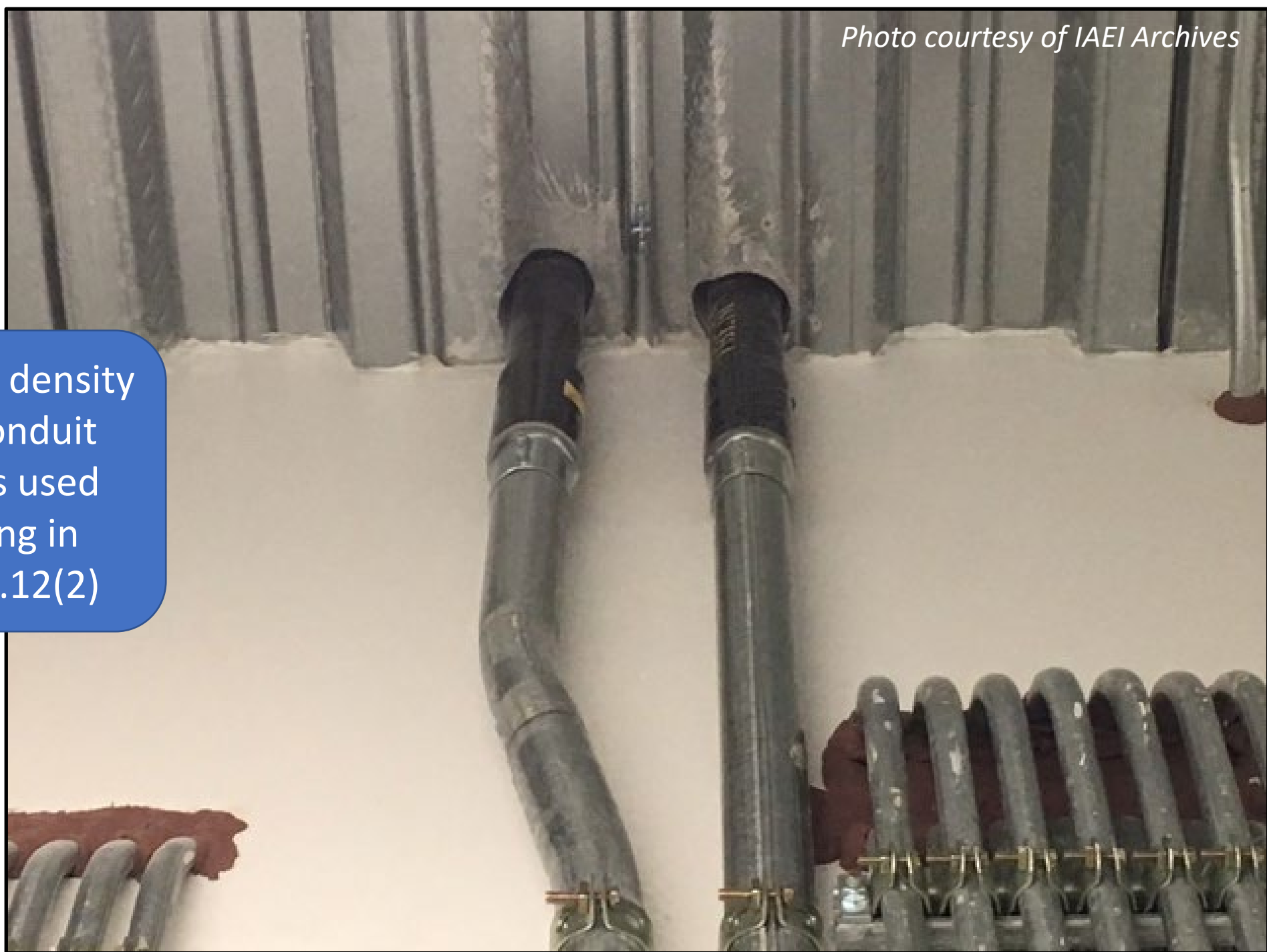
Flexible bus systems are **required to be listed**

- ⚠ (A) When used for services (**NEC 230.90**)
- ⚠ (B) When used as feeders (**NEC 215.3**)
- ⚠ (C) When used as a branch circuits (**NEC 210.20**)
- ⚠ (D) Protection of flexible bus systems used on transformer secondary [**NEC 240.21(C)**]
- ⚠ (E) Flexible bus systems connected to generator terminals (**NEC 445.12 and 445.13**)
- ⚠ (F) Flexible bus systems connected to battery terminals [**NEC 240.21(H)**]
- ⚠ (G) Addresses when flexible bus systems are reduced in size requiring OCPD

Article 398

Open Wiring on Insulators

Photo shows high density polyethylene conduit (HDPE) that was used within a building in violation of 353.12(2)



2023 National Electrical Code (NEC)

Errata and Tentative Interim Amendments (TIA)

Users of the National Electrical Code (NEC) should be aware that the NEC may be amended from time to time through the issuance of Tentative Interim Amendments (TIA) or corrected by Errata. Errata is a list of errors in a printed work discovered after printing and shown with corrections.

The NEC at any point in time consists of the current edition together with any Tentative Interim Amendments and any Errata then in effect.

For official, detailed information visit the National Fire Protection Association's website:

<https://www.nfpa.org/codes-and-standards/all-codes-and-standards/list-of-codes-and-standards/detail?code=70>

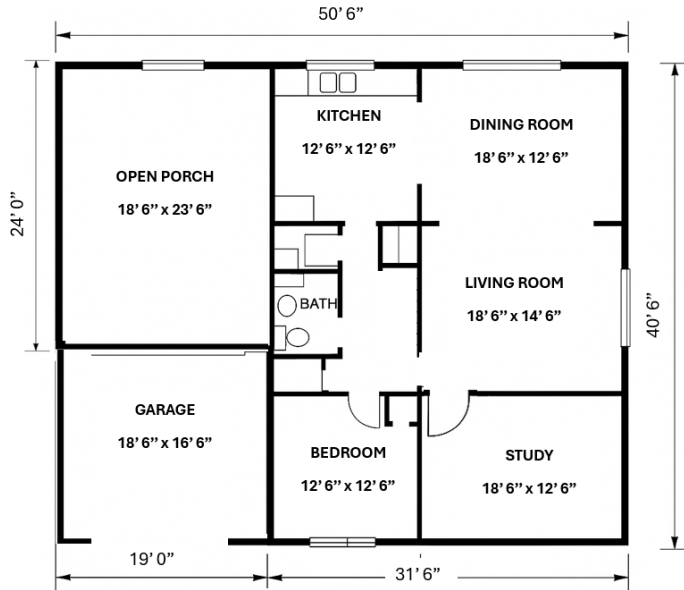
APPENDIX "B"

2026 CEU Calculations Based on the 2023 NEC

- Floor area calculation 220.5(C)

Question

Calculate the floor area for the illustration below to determine the proper square footage to be used for the load calculations.



- A. 2,045.25 square feet
- B. 1,275 square feet
- C. 1,729.85 square feet
- D. 1,589.25 square feet

Solution:

Section 220.5(C)

Length: 40 feet 6 inches = 40.5 feet

Width: 50 feet 6 inches = 50.5 feet

$40.5 \text{ ft} \times 50.5 \text{ ft} = 2,045.25 \text{ square feet}$

Not Included is the Open Porch

Length: 24 feet 0 inches = 24.0 feet

Width: 19 feet 0 inches = 19.0 feet

$24 \text{ ft} \times 19 \text{ ft} = 456.0 \text{ square feet}$

Calculated floor area

Total outside dimension – not included

$2,045.25 \text{ ft}^2 - 456.0 \text{ ft}^2$

1,589.25 square feet

Answer

- D. 1,589.25 square feet

- Load calculation for Electric Vehicle Supply Equipment 220.57

Question 1

A multi-unit dwelling complex has 4 electric vehicle charging stations, each rated at 6.8 kW (240V, single-phase) from the nameplate.

What is the minimum calculated load (in kilowatts) that must be considered for the feeder calculation serving the EV charging stations?

- A. 27.2 kW
- B. 34.0 kW
- C. 36.1 kW
- D. 28.8 Kw

Solution:

Section 220.57

The EVSE load shall be calculated at either 7200 watts (volt-amperes) or the nameplate rating of the equipment, whichever is higher.

$$7.2 \text{ kW} \times 4 = 28.8 \text{ kW}$$

Answer:

D. 28.8 kW

Question 2

What is the minimum branch circuit size for a Level II EVSE with a 32-ampere current rating?

- A. 32 A
- B. 35 A
- C. 40 A
- D. 55 A

Solution:

Sections 625.42 and 210.19(A)(1) EVSE are considered a continuous load so the branch circuit must be rated at 125% of the continuous load.

$$32 \text{ A} \times 1.25 = 40 \text{ A minimum OCPD}$$

Answer: C. 40 A

Question 3

What is the minimum size XHHW-2 copper conductor permitted to supply a Level II EVSE that has a 30-ampere current rating, assuming 75° terminations?

- A. 12 AWG
- B. 10 AWG
- C. 8 AWG
- D. 6 AWG

Solution:

Sections 625.42 and 210.19(A)(1) EVSE are considered a continuous load so the branch circuit must be rated at 125% of the continuous load.

$$30 \text{ A} \times 1.25 = 37.5 \text{ A}$$

Table 310.16

While XHHW-2 has a temperature rating of 90° C the conductor must be rated at 75° because of the terminations.

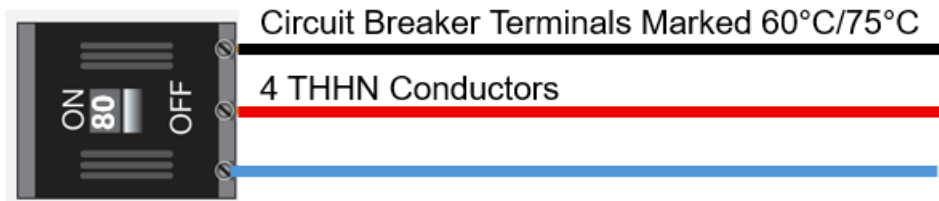
XHHW-2 = 8 AWG is rated for 50 A at 75° C.

Answer: C. 8 AWG

- Problems using a temperature correction factor to cables, conductors in raceways

Question 1

What is the ampacity of a 4 THHN conductor terminated to an 80-ampere circuit breaker that is marked for 60°C/75°C terminations?



- A. 70 A
- B. 85 A
- C. 80 A
- D. 95 A

Solution:

Table 310.16

THHN Conductors have a 90°C rating

Section 110.14(C)(1)(a)(3)

The circuit breaker terminations are marked 60°C/75°C so you use the 75°C column of Table 310.16 to determine the ampacity of the 4 THHN conductors.

Answer: B. 85 A

Question 2

What is the ampacity of the 4 THHN conductors when terminated to the 80-ampere circuit breaker when only marked for 60°C terminations?

- A. 70 A
- B. 85 A
- C. 80 A
- D. 95 A

Solution:

Table 310.16

THHN Conductors have a 90°C rating

Section 110.14(C)(1)(a)(1)

The circuit breaker terminations are marked 60°C so you use the 60°C column of Table 310.16 to determine the ampacity of the 4 THHN conductors.

Answer: A. 70 A

Question 3

Determine the ampacity of three 8 AWG THWN copper conductors installed in EMT in an ambient temperature of 40°C. All the conductors are current-carrying conductors. Calculate to the nearest ampere.



- A. 35 A
- B. 40 A
- C. 44 A
- D. 50 A

Solution:

Note 1:

Table 310.15(B) shall be referenced for ampacity correction factors where the ambient temperature is other than 30°C (86°F).

Table 310.16

8 AWG THWN = 50 A

Ambient Temperature Correction Based on 30°C (86°F)

Table 310.15(B)(1)(1), 75°C col.

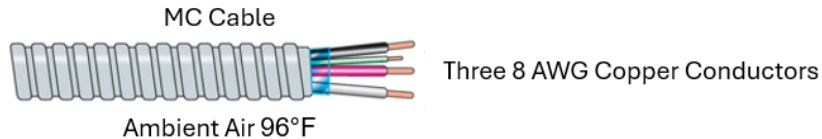
THWN copper at 40°C = 0.88

$50 \text{ A} \times 0.88 = 44 \text{ A}$

Answer: C. 44 A

Question 4

A 3-conductor 8 AWG copper plus an equipment grounding conductor Type MC cable is installed in an area with an ambient temperature of 96°F. The conductors within the cable assembly have THHN insulation, and all three conductors are considered current-carrying conductors. Determine the ampacity of the current-carrying conductors in this application. Calculate to the nearest ampere.



- A. 35 A
- B. 40 A
- C. 45 A
- D. 50 A

Solution:

Table 310.16
8 AWG THHN = 55 A

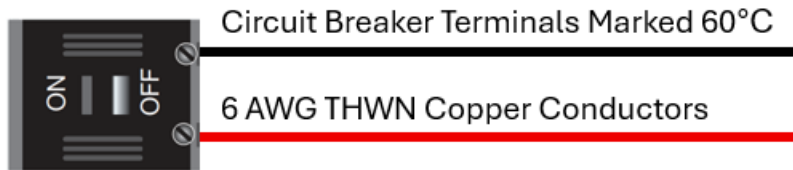
Table 310.15(B)(1)(1), 90°C col.
THHN copper at 96°F = 0.91
 $55 \text{ A} \times 0.91 = 50.05 \text{ A}$

Answer: 50 A

- Temperature Limitations of Equipment

Question 1

A 6 AWG THWN copper conductor is connected to a circuit breaker with termination temperature limitation marked (not to exceed) 60°C. What is the ampacity of the 6 AWG THWN copper conductor now that it is connected to this circuit breaker?



- A. 50 A
- B. 55 A
- C. 65 A
- D. 75 A

Solution:

Table 310.14(1)

Table 310.16

6 AWG THWN = 65 A

Section 110.14(C)(1)(a)(2) Limited by circuit breaker to 60°C

110.14(C)(1)(a)(2) applies

Circuit breaker terminations = 60°C

Table 310.16 Ampacity

THWN ampacity at 75°C is not permitted

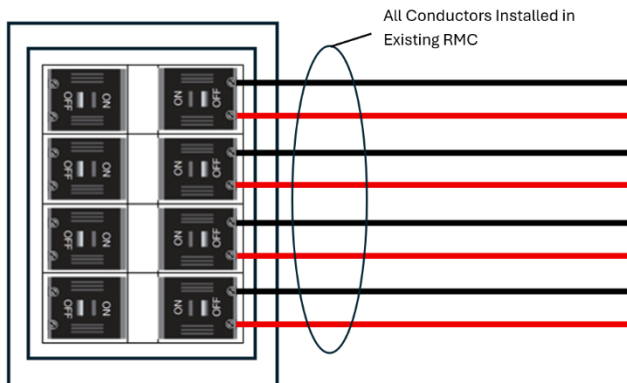
Use ampacity of 6 AWG copper at 60°C

6 AWG THWN copper limited to 60°C ampacity = 55 A

Answer: 55 A

Question 2

Eight 6 AWG THWN copper current-carrying conductors are installed to replace existing wiring within an existing single rigid metal conduit. The area of installation has an ambient temperature of 30°C. The new eight 6 AWG THWN conductors are connected to existing 50-ampere 2-pole circuit breakers with a marked terminal temperature rating of 60°C. What is the ampacity of the conductors, and is this an acceptable installation?



- A. 45.5 A
- B. 52.5 A
- C. 55 A
- D. 75 A

Solution:

Section 110.14(C)(1)
Table 310.14(1)
Table 310.16 Ampacity
6 AWG THWN at 75°C = 65 A

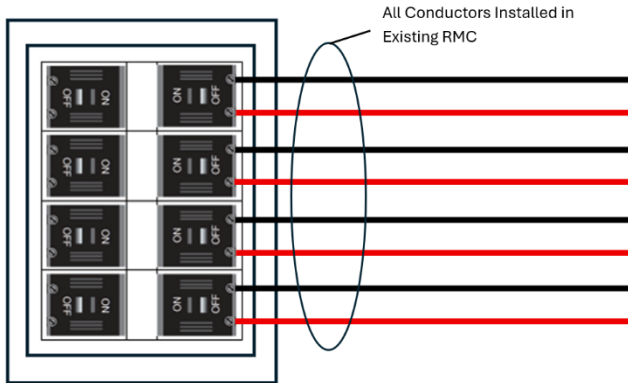
Table 310.15(C)(1) Adjustment Factors
8 current-carrying conductors = 70%
 $65 \text{ A} \times 0.70 = 45.5 \text{ A}$

6 AWG in 60°C column = 55 A
Ampacity = 45.5 A does not exceed the 60°C value but it is not large enough for the 50 A OCP so it is not permitted.

Answer: 45.5 A

Question 3

Eight 6 AWG THHN copper current-carrying conductors are installed to replace existing wiring within an existing single rigid metal conduit. The area of installation has an ambient temperature of 30°C. The new eight 6 AWG THHN conductors are connected to existing 50-ampere 2-pole circuit breakers with a marked terminal temperature rating of 60°C. What is the ampacity of the conductors, and is this an acceptable installation?



- E. 45.5 A
- F. 52.5 A
- G. 55 A
- H. 75 A

Solution:

Section 110.14(C)(1)
Table 310.14(1)
Table 310.16 Ampacity
6 AWG THHN at 90°C = 75 A

Table 310.15(C)(1) Adjustment Factors
8 current-carrying conductors = 70%
 $75 \text{ A} \times 0.70 = 52.5 \text{ A}$

6 AWG in 60°C column = 55 A
Ampacity = 52.5 A does not exceed the 60°C value so it is permitted.

Answer: 52.5 A

- Continuous loads and branch circuit 210.20

Question 1

What is the minimum standard branch circuit size required for a 208-volt, single-phase, 8-kW continuous load, assuming terminations are rated for 75°C?

- A. 40 A
- B. 45 A
- C. 50 A
- D. 60 A

Solution:

Section 210.20(A)

$$\text{Load} = \frac{8,000}{208}$$

$$\text{Load} = 38.46 \text{ A}$$

Continuous load adjustment = Load x 125%

$$\text{CL} = 38.46 \times 1.25$$

$$\text{CL} = 48.08 \text{ A}$$

Table 240.6(A)

Next standard breaker size = 50A

Answer: C. 50 A is the next standard breaker size

Question 2

A 277-volt, single-phase circuit supplies a 6-kW continuous load and an 8 kW noncontinuous load.

1. What is the minimum standard size inverse-time circuit breaker (with terminations dual rated and marked at 60°C/75°C)?
 - A. 45 A
 - B. 50 A
 - C. 60 A
 - D. 70 A
2. Determine the minimum size XHHW-2 copper circuit conductors for this branch circuit.
 - A. 6 AWG
 - B. 4 AWG
 - C. 2 AWG
 - D. 1 AWG

Solution Part 1 OCPD Size:

Calculation 1

Continuous Load (CL)

$$CL = \frac{6,000}{277}$$

$$CL = 21.7 \text{ A}$$

Calculation 2

Noncontinuous Load (NCL)

$$NCL = \frac{8,000}{277}$$

$$NCL = 28.9 \text{ A}$$

Calculation 3

Section 210.20(A)

Minimum standard size inverse-time circuit breaker

$$\text{Min. OCPD} = (CL \times 125\%) + NCL$$

$$\text{Min. OCPD} = (21.7 \times 125) + 28.9$$

$$\text{Min. OCPD} = 56 \text{ A}$$

Table 240.6(A)

Next standard size rating is 60 A

Answer: C. 60 A circuit breaker rated 60°C/75°C

Solution Part 2 Conductor Size:

210.19(A)

Min. Ampacity = (CL x 125%) + NCL

Min. Ampacity = (21.7 x 125) + 28.9

Min. Ampacity = 56 A

Section 110.14(C)(1)(a)(3)

90°C rated conductors connected to a circuit breaker rated 60°C/75°C

Table 310.16 Ampacity using 75°C

6 AWG XHHW-2 at 75°C is good for 65 A and can be protected by the 60A OCPD

Answer: A. 6 AWG XHHW-2

- Continuous loads and feeders 215.3

Question 1

A 3-phase, 4-wire feeder supplies a continuous load of 75 amperes and a noncontinuous load of 75 amperes to a second-floor equipment distribution switchboard.

Determining the minimum ampacity for this feeder, select the proper AWG XHHW-2 copper conductor size. The terminals of the circuit breaker and switchboard are rated 75°C.

- A. 1/0 AWG
- B. 2/0 AWG
- C. 3/0 AWG
- D. 4/0 AWG

Solution:

215.2(A)(1) Minimum Rating and Size

Min. Ampacity = (CL x 125%) + NCL

Min. Ampacity = (75 x 125) + 75

Min. Ampacity = 168.75 A

Section 110.14(C)(1)(a)(3)

XHHW-2 Conductors are rated for 90°C but the terminals are rated for 75°C.

Table 310.16 Ampacity using 75°C

2/0 AWG XHHW-2 at 75°C is good for 175A

Answer: B. 2/0 AWG XHHW-2

Question 2

A feeder supplies a continuous load of 100 amperes and a noncontinuous load of 35 amperes.

1. What is the minimum standard rating of time-delay fuses used for the feeder overcurrent protection?
 - A. 150 A
 - B. 175 A
 - C. 200 A
 - D. 225 A
2. What size THWN copper conductors are needed?
 - A. 1 AWG
 - B. 1/0 AWG
 - C. 2/0 AWG
 - D. 3/0 AWG

Solution:

Calculation 1

Section 215.3 OCPD selection

Min. OCPD = (CL x 125%) + NCL

Min. OCPD = (100 x 125%) + 35

Min. OCPD = 160 A

Table 240.6(A)

Next standard size rating is 175 A

Answer: B. 175 A time-delay fuse

Calculation 2

Section 215.2(A)(1) Minimum Rating and Size

Table 310.16

2/0 AWG THWN has an ampacity of 175 A and has adequate ampacity for 160 A load.

Answer: C. 2/0 AWG THWN

- **Table 300.5(A) Minimum Cover Requirements**

Question 1

A homeowner would like to add a 120/240-volt four circuit panel for lights and receptacles to a shed located 75 feet from the house. They have an extra bundle of EMT and wire from a previous project and want to use that instead of buying new conduit. What is the minimum burial depth for the EMT?

- A. EMT is not permitted for direct burial
- B. 12 inches
- C. 18 inches
- D. 24 inches

Solution:

Table 300.5(A)

Column 3 for One-and two-family dwellings 18 inches

Answer: C. 18 inches

Question 2

You are installing a 24-volt lighting circuit for an outdoor decorative fountain in a landscaped public area. The power source is a listed Class 2 power supply, and the lighting circuit is limited to not more than 30 volts. The circuit is run underground using Type UF cable with GFCI protection and overcurrent protection not exceeding 20 amperes.

- A. 6 inches
- B. 12 inches
- C. 18 inches
- D. 24 inches

Solution:

Table 300.5(A)

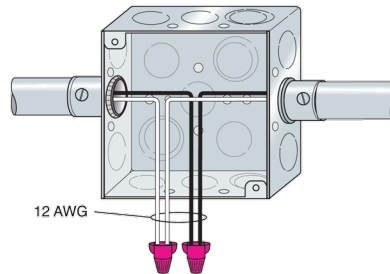
Table 300.5(A), Note 2, low-voltage circuits ($\leq 30V$) with GFCI and $\leq 20A$ protection may be buried at 6 inches using direct burial cable such as UF.

Answer: A. 6 inches

- Adding conductors to an existing box 314

Question 1

What is the maximum number of 14 AWG conductors that can be added and pulled through the 4 x 1 ½ square box?



- A. 4
- B. 6
- C. 8
- D. 10

Solution:

Table 314.16(A)

Volume of a 4 × 1 ½ square box = 21 in.³

Table 314.16(B)(1)

Existing 12 AWG = 2.25 in.³

Total occupied space is 4 conductors: 4 x 2.25 cubic inches = 9

Unoccupied space: 21 – 9 = 12 in.³

Table 314.16(B)(1)

14 AWG = 2 in.³ with 12 cubic inches remaining

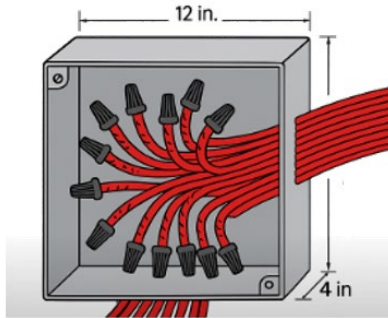
Number of conductors = 12 / 2

$$= 6$$

Answer: B. 6 additional 14 AWG conductors

Question 1

Determine the maximum number of additional 12 AWG conductors that can be added and added and spliced in a 12 in. × 12 in. × 4 in. junction box when it already contains 12 spliced 12 AWG conductors.



- A. 244 additional conductors
- B. 256 additional conductors
- C. 286 additional conductors
- D. 290 additional conductors

Solution:

Step 1: Determine the Junction Box Volume

12 in. × 12 in. × 4 in.

Volume = 576 cubic inches

Step 2: Volume Allowance per Conductor

Table 314.16(B)

12 AWG = 2.25 cubic inches

Step 3: Volume Used by Existing Conductors

12 – 12 AWG Spliced conductors × 2.25 cubic inches = 27 cubic inches

Step 4: Remaining Box Volume

576 cu in – 27 cu in = 549 cubic inches remaining

Step 5: Determine How Many Additional Spliced Conductors Can be Added

Each spliced conductor = 1 box fill unit = 2.25 cu in

$$\frac{549}{2.25} = 244 \text{ additional conductors}$$

Answer: A. 244 additional conductors

- Maximum number of conductors spliced in a conduit body 314.16(C)

Question 1

Determine the maximum number of 6 AWG THW conductors that can be spliced in a 2-inch EMT conduit body that is marked with a volume allowance of 82 cubic inches.?



- A. 8
- B. 10
- C. 14
- D. 16

Solution:

Section 314.16(C)

Table 314.16(B)(1)

Step 1: Volume Allowance Required per Conductor

6 AWG = 5 in.³

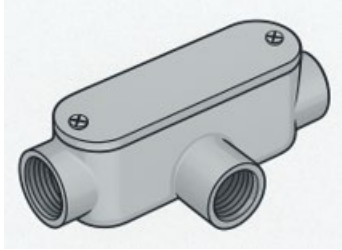
Step 2: Calculate the Maximum Number of Spliced 6 AWG Conductors

$$\frac{82}{5} = 16.4$$

Answer: 16 Conductors

Question 2

A Type T conduit body is used as a junction box installation. It has a volume marked as 20.0 cubic inches. What is the maximum number of 12 AWG THHN conductors that may be spliced inside this conduit body.



- A. 6
- B. 8
- C. 9
- D. 10

Solution:

Solution:

Section 314.16(C)

Table 314.16(B)(1)

Step 1: Volume Allowance Required per Conductor

12 AWG = 2.25 in.³

Step 2: Calculate the Maximum Number of Spliced 12 AWG Conductors

$$\frac{20}{2.25} = 8.8$$

Answer: B. 8 Conductors

- Voltage drop examples

Question 1

Calculate the voltage drop on a single-phase circuit with 32 amperes of load, 320 feet from the load to the panelboard, and served by 8 AWG copper THHN conductors.

- A. 13 V
- B. 14 V
- C. 15 V
- D. 16 V

Solution:

Where:

K = 12.9 for copper or 21.2 for aluminum

I = 32 A

D = 320 ft

CM = Circular mils of the conductor

Chapter 9, Table 8

8 AWG copper = 16,510 CM

$$V_d = \frac{2 \times K \times I \times D}{CM}$$

$$V_d = \frac{2 \times 12.9 \times 32 \times 320}{16,510}$$

$$V_d = \frac{263,424}{16,510}$$

$$V_d = 15.95 V$$

Answer: D. 16 V

Question 2

A 480-volt branch circuit is to be installed with three 1/0 AWG THWN copper conductors serving a 140-ampere, 3-phase load. Determine the maximum length of the conductors, with the voltage drop not exceeding 3%.

- A. 460 feet
- B. 477 feet
- C. 493 feet
- D. 502 feet

Solution:

210.19 Informational Note

$$V_d = V_{\text{Supply}} \times 3\%$$

$$V_d = 480 \times 0.03$$

$$V_d = 14.4 \text{ V}$$

Chapter 9 Table 8

1/0 AWG = 105,600 cmil

$$L = \frac{\text{CM} \times V_d}{1.73 \times K \times I}$$

$$L = \frac{105,600 \times 14.4}{1.73 \times 2.9 \times 140}$$

$$L = 477 \text{ feet}$$

Answer: B. 477 feet