Continuing Education for Electricians

CETC CONNECTICUT ELECTRICAL Training Center, LLC

2025 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

2025 Continuing Education for Electricians

(For All Electrical License Holders)

Part 1 - Connecticut General Statutes

Sec. 20-340. Exemptions from licensing requirements

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

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

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

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

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

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

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

(f) How to register as an apprentice.

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

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

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

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

(a) Any licensee who installs, performs or directs the performance of work in violation of any applicable state statute, state code, or state regulation, any municipal code or ordinance, any of these regulations, or who violates generally accepted basic trade practices shall be subject to disciplinary action by the appropriate board.
(b) Licensed contractors alone shall be permitted to acquire building permits to perform work covered by chapter 393 of the General Statutes and the regulations promulgated thereunder. In order to apply for a building permit to perform work covered by chapter 393 of the General Statutes and the regulations adopted thereunder a contractor shall be directly employed by the business on a regular and full time basis. In applying for the building permit to perform work covered by chapter 393 of the General Statutes and the regulations promulgated thereunder the contractor is attesting to the fact that he is responsible for and will directly supervise the work being performed under said permit. Except as provided for in Section 20-338b of the General Statutes, the licensed contractor must sign each building permit application personally and may not delegate the signing of the permit to any employee, subcontractor or other agent. Any licensed contractor who violates these regulations shall be subject to disciplinary action by the appropriate board.
(c) No licensee shall engage in or offer to engage in business under any name other than that stated on his application for a license unless he has notified the board ten days prior to using the new name.
(d) Any holder of a journeyman's license who performs work without being in the direct and regular employ of a properly licensed contractor shall be subject to disciplinary action by the appropriate board.
(e) All licensed contractors shall keep a record of all employees they employ and exhibit such records to the Commissioner or her agents upon request.
(f) No one shall perform any work beyond the limitations stated on his license regardless of the type of license his employer holds. Further, no one holding a limited

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

Sec. 20-332b. 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.

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.

Dear Registered Apprenticeship Sponsor,

This letter is to inform you of new state reporting requirements and to request your collaboration in gathering this data. Connecticut General Statutes Section 31-22r(c) requires all Registered Apprenticeship sponsors to submit information along with their annual registration fee. Details provided on this form by sponsors will become public record.

To ensure effective processing, please fill in the requested information below and return this form to CTDOL/OAT with your annual Registered Apprentice renewal forms and payments.

Company Name:_____

Company Address:_____

Instructions for this form:
For each response below, please further break down the number by the categories below as follows:

1. The percentage of Registered Apprentices that completed the sponsor's program since 7/1/2023:_____

   Of that number, provide the percentage based on the following categories:

Gender Identity	Ethnicity	Race
Female _____	Hispanic or Latino _____	White, Non-Hispanic _____
Male _____	Not Hispanic or Latino _____	Black/African American _____
Non-Binary _____	Unknown _____	American Indian or Alaska Native_____
Unknown _____		Native Hawaiian or Other Pacific Islander_____
		Asian _____
		Two or more _____
		Unknown _____

2. Total number of Registered Apprentices currently participating in sponsor's program:_____

Of that amount, provide the number based on the following categories:

Gender Identity	Ethnicity	Race
Female _____	Hispanic or Latino _____	White, Non-Hispanic _____
Male _____	Not Hispanic or Latino _____	Black/African American _____
Non-Binary _____	Unknown _____	American Indian or Alaska Native_____
Unknown _____		Native Hawaiian or Other Pacific Islander_____
		Asian _____
		Two or more _____
		Unknown _____

3. Number of current journeypersons (including licensed journeypersons, contractors, and contractor of record if applicable) currently employed by sponsor :_____

Of that amount, provide the number based on the following categories:

Gender Identity	Ethnicity	Race
Female _____	Hispanic or Latino _____	White, Non-Hispanic _____
Male _____	Not Hispanic or Latino _____	Black/African American _____
Non-Binary _____	Unknown _____	American Indian or Alaska Native_____
Unknown _____		Native Hawaiian or Other Pacific Islander_____
		Asian _____
		Two or more _____
		Unknown _____

4. Number of Registered Apprentices who have advanced a year (or step) of their apprenticeship since the date of sponsor's previous registration, or year to date for new sponsors: _____

Of that amount, provide the number based on the following categories:

Gender Identity	Ethnicity	Race
Female _____	Hispanic or Latino _____	White, Non-Hispanic _____
Male _____	Not Hispanic or Latino _____	Black/African American _____
Non-Binary _____	Unknown _____	American Indian or Alaska Native_____
Unknown _____		Native Hawaiian or Other Pacific Islander_____
		Asian _____
		Two or more _____
		Unknown _____

5. Number of Registered Apprentices who have separated from such sponsor's program since the date of sponsor's previous annual registration, or year to date for new sponsor (how many Registered Apprentices left the program since your last registration):_____

Of that amount, provide the number based on the following categories:

Gender Identity	Ethnicity	Race
Female _____	Hispanic or Latino _____	White, Non-Hispanic _____
Male _____	Not Hispanic or Latino _____	Black/African American _____
Non-Binary _____	Unknown _____	American Indian or Alaska Native_____
Unknown _____		Native Hawaiian or Other Pacific Islander_____
		Asian _____
		Two or more _____
		Unknown _____

6. Number of Registered Apprentices who have completed an apprenticeship program since the previous registration (or year to-date for new sponsors):_____

Of that amount, provide the number based on the following categories:

Gender Identity	Ethnicity	Race
Female _____	Hispanic or Latino _____	White, Non-Hispanic _____
Male _____	Not Hispanic or Latino _____	Black/African American _____
Non-Binary _____	Unknown _____	American Indian or Alaska Native_____
Unknown _____		Native Hawaiian or Other Pacific Islander_____
		Asian _____
		Two or more _____
		Unknown _____

7. Number of Registered Apprentices who completed the program, AND are currently employed by the sponsor, AND (if applicable) have been issued an occupational license by the Department of Consumer Protection:_____

Of that amount, provide the number based on the following categories:

Gender Identity	Ethnicity	Race
Female _____	Hispanic or Latino _____	White, Non-Hispanic _____
Male _____	Not Hispanic or Latino _____	Black/African American _____
Non-Binary _____	Unknown _____	American Indian or Alaska Native_____
Unknown _____		Native Hawaiian or Other Pacific Islander_____
		Asian _____
		Two or more _____
		Unknown _____

2022 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, intend to adopt the following new codes, effective October 1, 2022:

- 2022 Connecticut State Building Code (CSBC)
- 2022 Connecticut State Fire Safety Code (CSFSC)
- 2022 Connecticut State Fire Prevention Code (CSFPC)

In accordance with the requirements of sections 29-252b, 29-292a and 29-291e of the Connecticut General Statues, the agency accepted comments from the public for a period of forty-five (45) days, beginning January 31, 2022 through the close of business March 17, 2022.

The comments received are now being considered for incorporation into the draft codes ahead of their submission of legislative review.

Draft 2022 State Codes

• The public comment drafts of the three proposed codes are available under Documents/Forms

• The legislative approval drafts of the three proposed codes are being prepared.

Proposed Model Codes:

The following codes are proposed to be adopted into the next state codes:

• 2021 International Building Code (IBC) by the ICC

• 2021 International Existing Building Code (IEBC) by the ICC

• 2021 International Energy Conservation Code (IECC) by the ICC

• 2021 International Mechanical Code (IMC) by the ICC

• 2021 International Plumbing Code (IPC) by the ICC

• 2021 International Residential Code (IRC) by the ICC

• 2021 International Swimming Pool & Spa Code (ISPSC) by the ICC

• 2020 NFPA 70 National Electrical Code (NEC) by NFPA

• 2017 ICC A117.1 Accessible and Usable Buildings and Facilities by the ICC

• 2021 International Fire Code (IFC) by the ICC

• 2021 NFPA 101 - Life Safety Code by the NFPA

• 2021 NFPA 1 - Fire 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

NOTE: Always refer to the State Building Officials website indicated above for all the most currently adopted codes and "AMENDMENTS" to the codes.

Finding State Building Code Interpretations

The State Building Inspector issues formal interpretations of the State Building Code pursuant to the authority granted by Section 29-252 of the Connecticut General Statutes. These interpretations may be issued at the request of a local building official or by the general public. The final interpretations are the opinion of the State Building Inspector.

The state building code interpretations can be found at the following web address:

https://portal.ct.gov/DAS/Office-of-State-Building-Inspector/State-Building-Code-Interpretations

2025 Continuing Education for Electricians

(For All Electrical License Holders)

Part 2 - Safety

U.S. DEPARTMENT OF LABOR

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, tradition 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 Bullet in (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 protect ion options, employers and workers can make informed decisions on selection and use.

Background

Figure 1- Example of a safety helmet.

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 protect ion 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, construct ion, maritime), and obtain optimum head protection.

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.

Manufactures 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 protect ion 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 protect ion 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 googles.

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.

OSHA Safety and Health Information Bulletin: Head Protection: Safety Helmets in the Workplace

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 protect ion to workers. These are marked “HT” on the label.

For cold environments, employers should select head protect ion 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 protect ion 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 protect ion 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

OSHA Occupational Safety and Health Administration

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.

988 SUICIDE & CRISIS LIFELINE

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

OSHA 4395-01 2024

Long-Term Stress Harms Everyone in the Workplace

SAFE WORKPLACE GOOD HEADSPACE

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

Workplace Stress

Workplace Stress Menu

Workers' Rights

Overview

Statistics

- Nearly one in five US adults live with a mental illness[2].
- Workplace stress has been reported to cause 120,000 deaths in the US each year[3].
- 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 2019-2021[4].
- 83% of US workers suffer from work-related stress and 54% of workers report that work stress affects their home life[5].
- 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 through[1]:

- 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

Submit Feedback

[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.

U.S. DEPARTMENT OF LABOR

Occupational Safety and Health Administration
200 Constitution Ave NW
Washington, DC 20210
1-800-321-OSHA
1-800-321-6742
www.osha.gov

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 stressor's 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.

Workplace Stress

Workplace Stress Menu

Workers' Rights

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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Workplace Stress

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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Workplace Stress

Workplace Stress Menu

Workers' Rights

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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Workplace Stress

Workplace Stress Menu

Workers' Rights

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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2025 Continuing Education for Electricians

(For All Electrical License Holders)

Part 3 – 2020 National Electrical Code

2025 Unlimited License Types Including:

E-1, E-2, E-4, E-5, E-9

Analysis of Changes – 2020 *NEC*

Part 1 – NEC Chapter 4

Training Presentation By:
International Association of Electrical Inspectors

Chapter Four Equipment for General Use

400.12 Uses Not Permitted (Flexible Cords and Flexible Cables)

- Revisions were made to include "**flexible cords**" in the "Uses Not Permitted" section along with flexible cables, cord sets, and power supply cords
- During the 2017 *NEC* revision cycle, the rules for "Uses Not Permitted" for flexible cords and cables was revised
- Title of the article was expanded to "**Flexible Cords and Flexible Cables**"
- Section revised to put emphases on both flexible cords and flexible cables
- For the 2017 *NEC* revision, the terms "flexible cables, flexible cord sets, and power supply cords" was used, with "flexible cords" inadvertently left out
- Revised language makes it clear that cord sets (any length) and power-supply cords are not permitted to be used in any of the manners specified at 400.12 *(run through holes in walls, structural ceilings, suspended ceilings, dropped ceilings or floors, run through doorways windows etc.)*

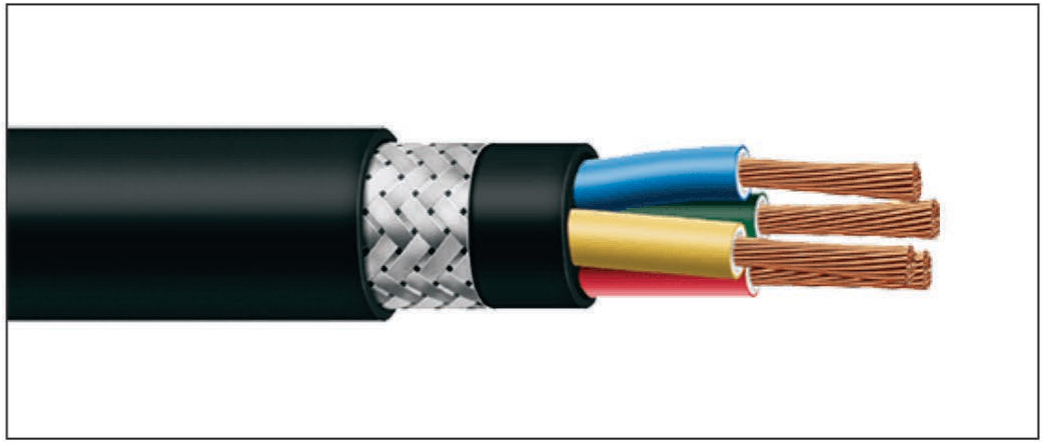
400.12 Uses Not Permitted (Flexible Cords and Flexible Cables) *(cont.)*

- A reference to **590.4** was added to **400.12(4), Exception to (4)**
- Section 590.4 *(Temporary Installations)* permits multiconductor cords or cables of a type identified in Table 400.4 for hard usage or extra-hard usage to be used as temporary feeders by 590.4(B) and as temporary branch circuits by 590.4(C)
- Part of their required conditions for use as a construction job site-type temporary branch circuit or feeder requires the cable assemblies, flexible cords, or flexible cables to "**not be installed on the floor or on the ground**"
- New reference added to the exception will allow temporary flexible cords and flexible cables to be used for temporary installation *(during construction)*, indoors or outdoors, to prevent cord damages by being supported or attached to a building surface

400.12 Uses Not Permitted - Flexible Cords and Flexible Cables

Unless specifically permitted in 400.10, flexible cords, flexible cables, cord sets, and power supply cords shall not be used as specified by 400.12 *(substitute for the fixed wiring, run through holes in walls, run through doorways and windows, where subject to physical damage, etc.)*

Flexible Cords



Flexible Cables

Cord Sets

Power Supply Cords

Table 402.3 Fixture Wires

- A new type of heat-resistant rubber-covered fixture wire **(FFHH-2)** was **added** to Table 402.3
- Fixture wire is covered by **Article 402**, **UL Product Spec Category ZIPR**, and investigated under **UL Product Standard 66**
- Type FFHH-2 fixture wire has a flexible stranding with a maximum operating temperature of **90°C (194°F)**
- Insulation consists of heat-resistant rubber or cross-linked synthetic polymer
- Type FFHH-2 fixture wire comes in sizes **18-16 AWG**

Table 402.3 Fixture Wires *(in part)*

Name	Type Letter	Insulation	AWG	Thickness of Insulation		Outer Covering	Max. Operating Temperature	Application Provisions
				mm	mils			
Heat-resistant rubber-covered fixture wire - flexible stranding	FFH-2	Heat-resistant rubber or ~~Cross~~ cross-linked synthetic polymer	18-16	0.76	30	Nonmetallic covering	75°C (167°F)	Fixture wiring
	FFHH-2		~~18-16~~	~~0.76~~	~~30~~		90°C (194°F)	
ECTFE-solid or 7-strand	HF	Ethylene chloro-trifluoroethylene	18-14	0.38	15	None	150°C (302°F)	Fixture wiring
ECTFE-flexible stranding	HFF	Ethylene chlorotrifluo-roethylene	18-14	0.38	15	None	150°C (302°F)	Fixture wiring
Tape insulated fixture wire - solid or 7-strand	KF-1	Aromatic polyimide tape	18-10	0.14	5.5	None	200°C (392°F)	Fixture wiring -limited to 300 volts
	KF-2	Aromatic polyimide tape	18-10	0.21	8.4	None	200°C (392°F)	Fixture wiring
Tape insulated fixture wire-flexible stranding	KFF-1	Aromatic polyimide tape	18-10	0.14	5.5	None	200°C (392°F)	Fixture wiring -limited to 300 volts
	KFF-2	Aromatic polyimide tape	18-10	0.21	8.4	None	200°C (392°F)	Fixture wiring

**Insulations and outer coverings that meet the requirements of flame retardant, limited smoke, and are so listed, shall be permitted to be marked for limited smoke after the Code type designation.*

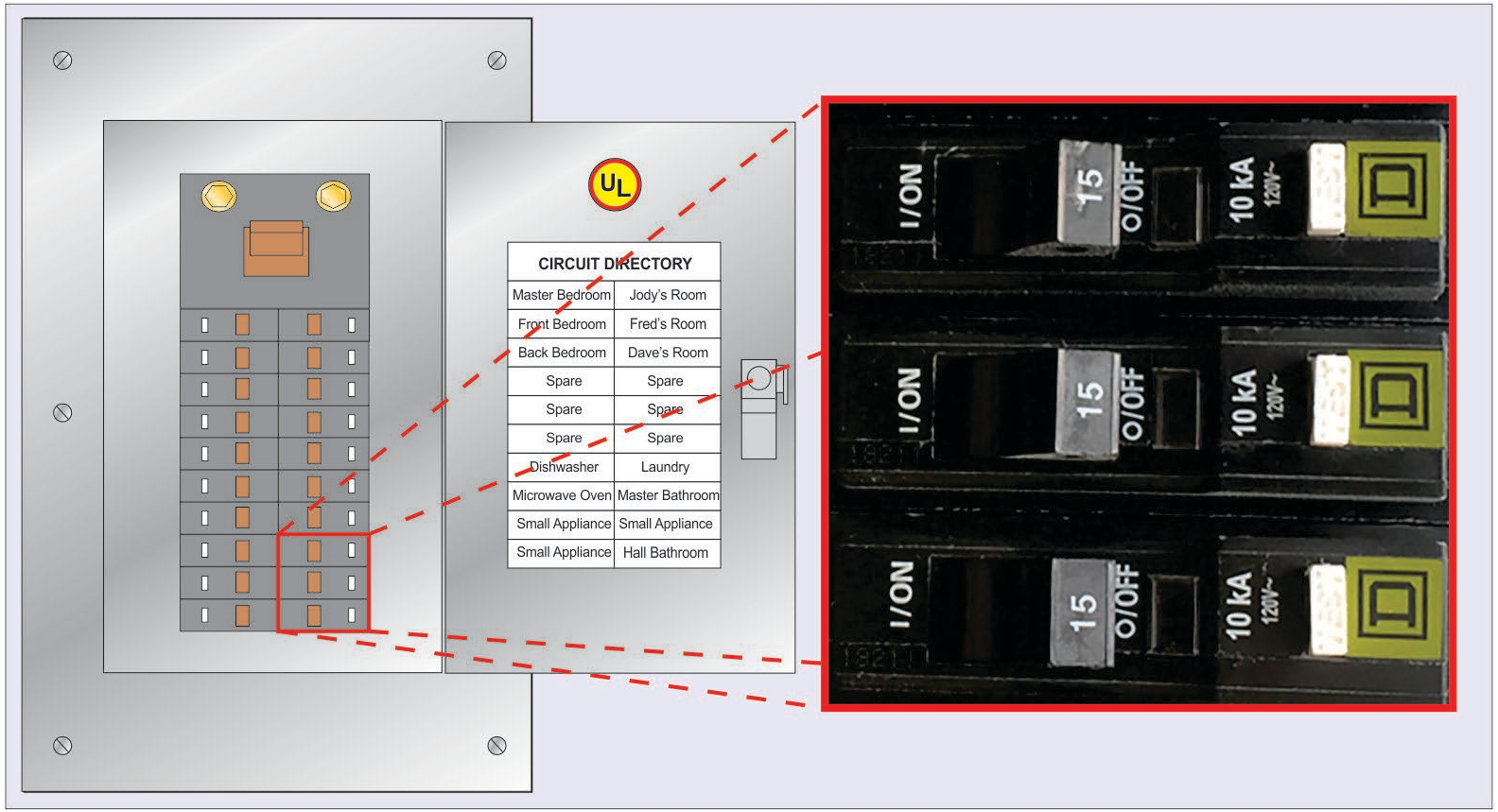
Reproduction of NEC Table 402.3 (in part)

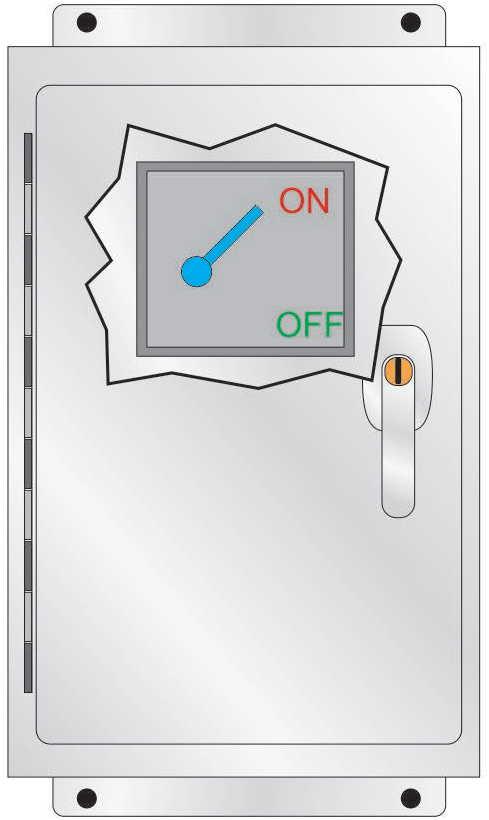
404.7 Indicating Requirements for Switches

- Revisions clarifies that switches and circuit breakers indication must be visible **without opening the enclosure** to see the open/closed indication
- General-use switches and motor-circuit switches, circuit breakers, and molded case switches now required to indicate whether they are in the open (off) or closed (on) position in a **location that is visible when accessing the external operating means**
- Indicating provisions can apply to a circuit breaker located **behind the operable lid** of a panelboard and still comply with this rule
- Indication only applies after the cover is opened or accessed, unless the enclosure is equipped with an external operator
- Revision clarifies that the indication must be visible **when and after accessing the operating means**

404.7 Indicating Requirements for Switches

General-use switches and motor-circuit switches, circuit breakers, and molded case switches required to ~~clearly~~ indicate whether they are in the open (off) or closed (on) position in a location that is visible when accessing the external operating means





"Up" position of the handle generally required to be the closed (on) position

404.9 General-Use Snap Switches, Dimmers, and Control Switches

- Revisions were made to include **other switches with comparable control functions** *(not just snap switches)* in requirements for faceplates, grounding, and construction
- Over the last decade or so, there has been numerous "**control devices**" that are replacing the typical "snap switch" for operating lighting loads
- These other switching control devices must meet and satisfy these faceplate requirements just like a snap switch
- Snap switches, dimmers and control switches required to be **connected to an "equipment grounding conductor"** and a means to connect metal faceplates to the EGC *(whether or not a metal faceplate is installed)* must be provided *(previous rule stated metal faceplate was required to be "grounded")*
- Same basic changes also were implemented at **404.10** for "Mounting of General-Use Snap Switches, Dimmers, and Control Switches"

404.9 General-Use Snap Switches, Dimmers, and Control Switches

Faceplates provided for snap switches, dimmers, and control switches mounted in boxes and other enclosures required to be installed so as to completely cover the opening and, where the switch is flush mounted, seat against the finished surface

Metal faceplates are required to be bonded to an equipment grounding conductor (EGC)

Listed kits or listed assemblies are not required to be connected to an EGC if (4) conditions are met, including if the device is provided with a nonmetallic faceplate and the device is designed such that no metallic faceplate replaces the one provided

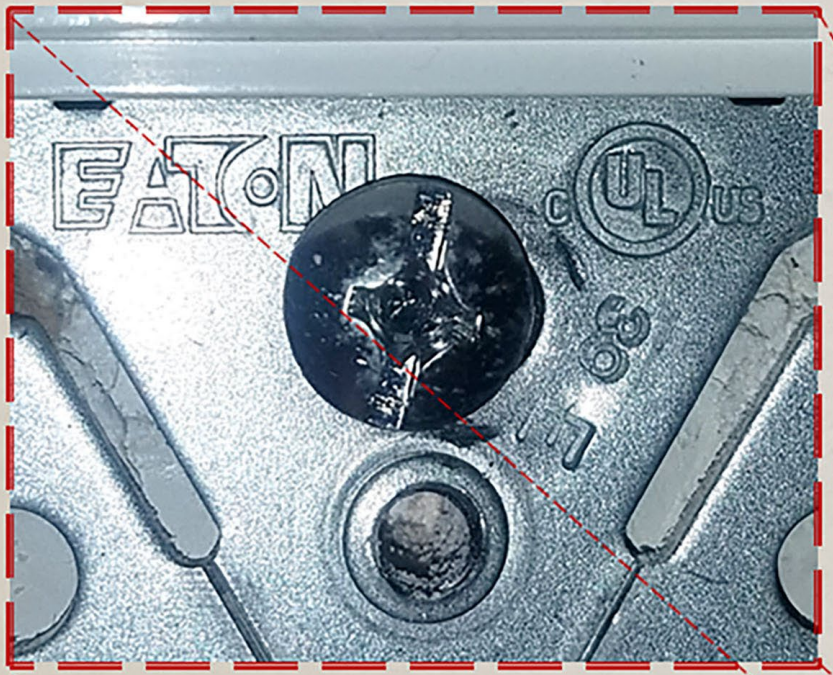
Snap Switches

Dimmers

Control Switches

404.14 Rating and Use of Switches

- Switches will now be required to be **listed** and used within their ratings
- Switches of the types covered in **404.14(A) through (E)** are limited to the control of loads as specified accordingly
- Switches used to control **cord-and-plug-connected loads** are limited as covered in **404.14(F)**
- Equipment used in electrical installations should be listed or labeled by a qualified, third-party electrical products testing laboratory
- **UL 20** (Standards for General-Use Snap Switches) and **UL 1472** (Solid-State Dimming Controls) are among the switching device standards that provide the identified construction, performance, and marking requirements for switching devices to be used in accordance with the *NEC*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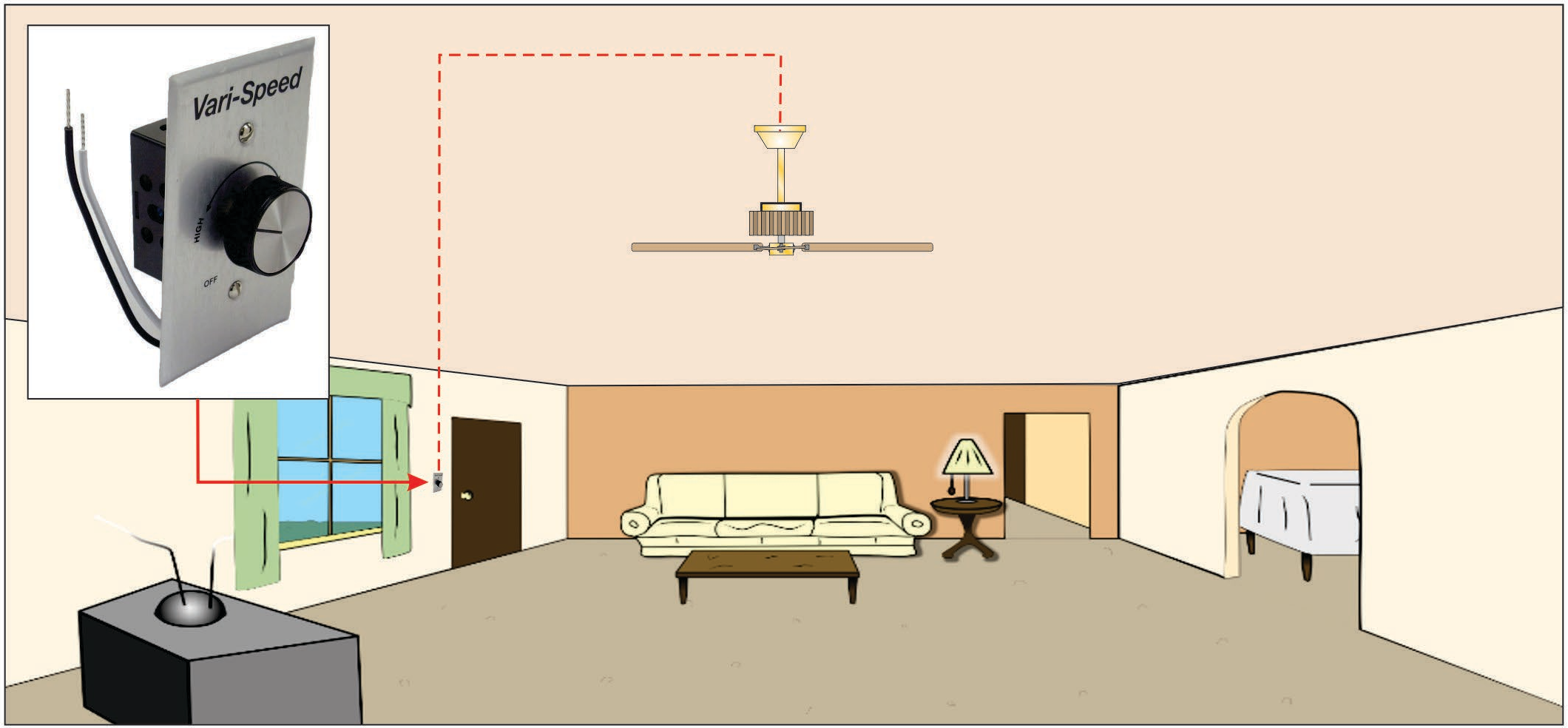
404.22 Electronic ~~Lighting~~ Control Switches

- Revision removes the word “**lighting**” from the phrase “electronic lighting control switches” as these switches may supply **non-lighting loads**
- Many electronic control switches are used in applications well beyond just simply lighting
- These electronic control devices may be used for fan speed control, receptacle control, appliance control, etc.
- The applicable product standards such as **UL 1472** (Solid-State Dimming Controls) describes these devices as simply “electronic control switches”

404.22 Electronic ~~Lighting~~ Control Switches

Electronic ~~lighting~~ control switches are generally prohibited from introducing current on the equipment grounding conductor during normal operation *(future effective date of January 1, 2020)*

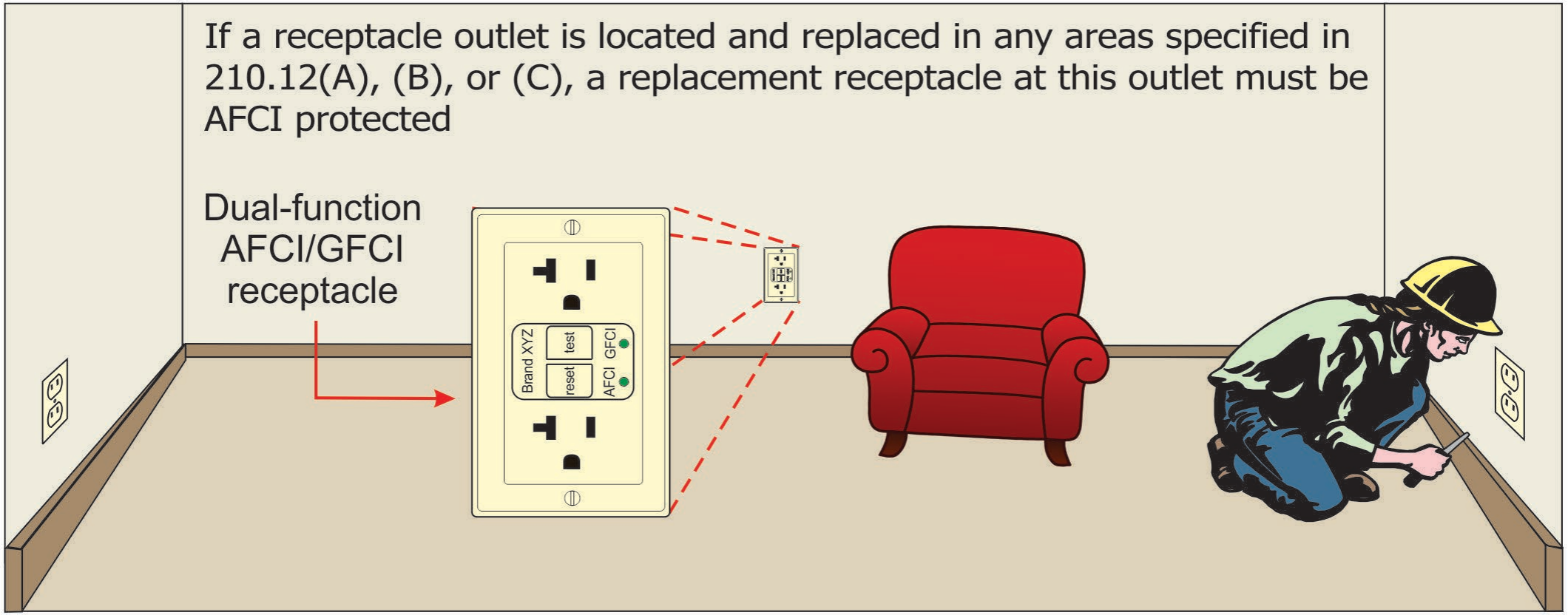


Electronic ~~lighting~~ control switches are required to be listed *(not just lighting controls)*

406.4(D)(4) Requirement Receptacles (AFCI)

- Previous Ex. No. 1 to AFCI replacements was **deleted** *(no longer relevant)*
- Commercially obtainable devices *(such as a dual-function AFCI/GFCI receptacle outlet)* are **readily available** that can satisfy the main rule rendering the exception irrelevant
- Previous Ex. No. 1 exempted AFCI protection where all the following applied:
  - (1) The replacement complies with 406.4(D)(2)(b)
  - (2) It is impracticable to provide an EGC as provided by 250.130(C)
  - (3) Listed combination type AFCI circuit breaker not commercially available
  - (4) GFCI/AFCI dual function receptacles are not commercially available

406.4(D)(4) Replacement Receptacles (AFCI)



~~**Ex. No. 1:** AFCI protection not required where all of the following apply: (1) Replacement complies with 406.4(D)(2)(b) *(two-wire system-GFCI)*, (2) Impracticable to provide an EGC as provided by 250.130(C), (3) Listed combination type AFCI circuit breaker not commercially available, (4) GFCI/AFCI dual function receptacles not commercially available~~

Previous Ex. No. 1 to AFCI replacements was deleted as it is no longer relevant and products that comply with the main requirement are readily available

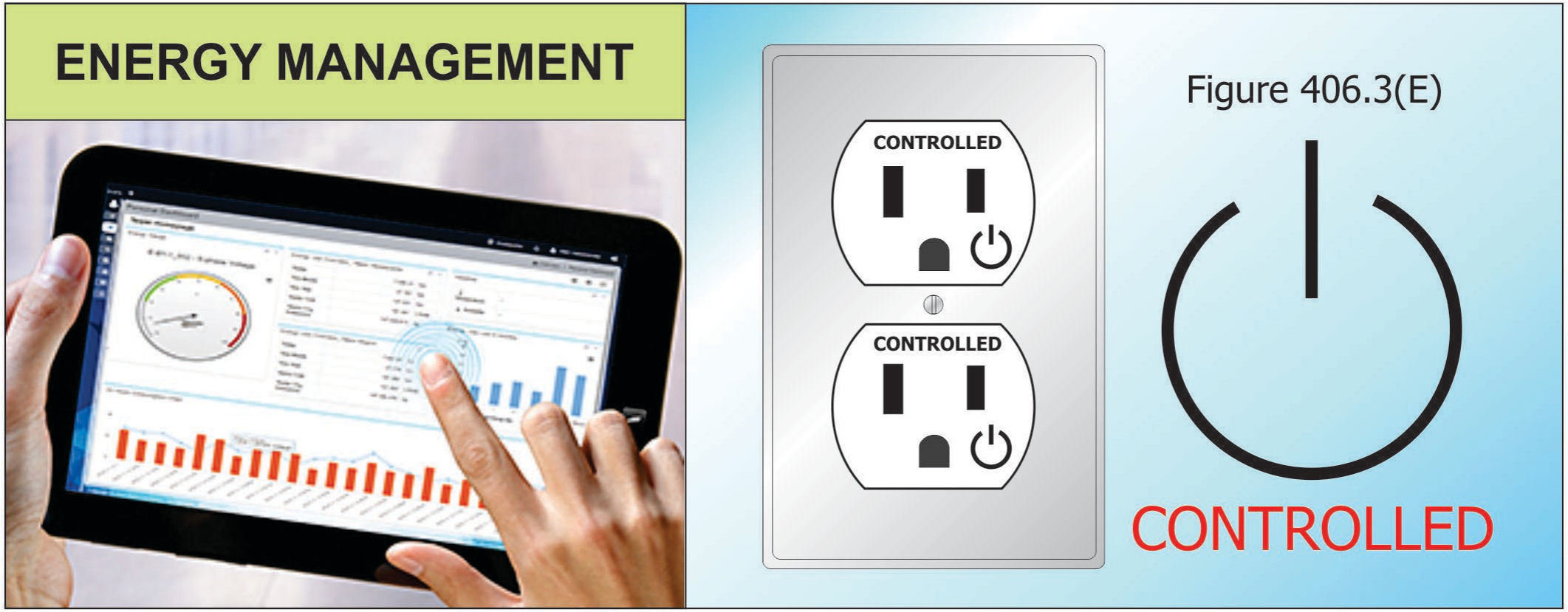
406.4(D)(7) Requirement of Automatically Controlled Receptacles

- Automatically controlled receptacles are now required to be replaced with **equivalently controlled receptacles**
- Section **406.3(E)** provides **identification marking requirements** of controlled receptacle *(marked with the word "Controlled" on the controlled receptacle along with a controlled receptacle symbol)*
- Receptacle(s) managed by an **energy management system** that are replaced will now be required to be replaced with equivalently controlled receptacles
- If a remodel or renovation results in the automatically controlled receptacle **no longer being required to be automatically controlled**, the receptacle and any associated receptacle markings would be required to be replaced with a receptacle and faceplate not marked in accordance with 406.3(E)

406.4(D)(7) Replacement of Automatically Controlled Receptacles

Automatically controlled receptacles to be replaced with equivalently controlled receptacles

If automatic control is no longer required, receptacles and associated 406.3(E) receptacle markings to be replaced with a receptacle and faceplate not marked in accordance with 406.3(E)



All nonlocking-type, 125-volt, 15- and 20-ampere receptacles controlled by an automatic control device, energy management, or building automation shall be marked with the “Controlled Receptacle Marking Symbol” from Figure 406.3(E) and the word “CONTROLLED” *[see 406.3(E)]*

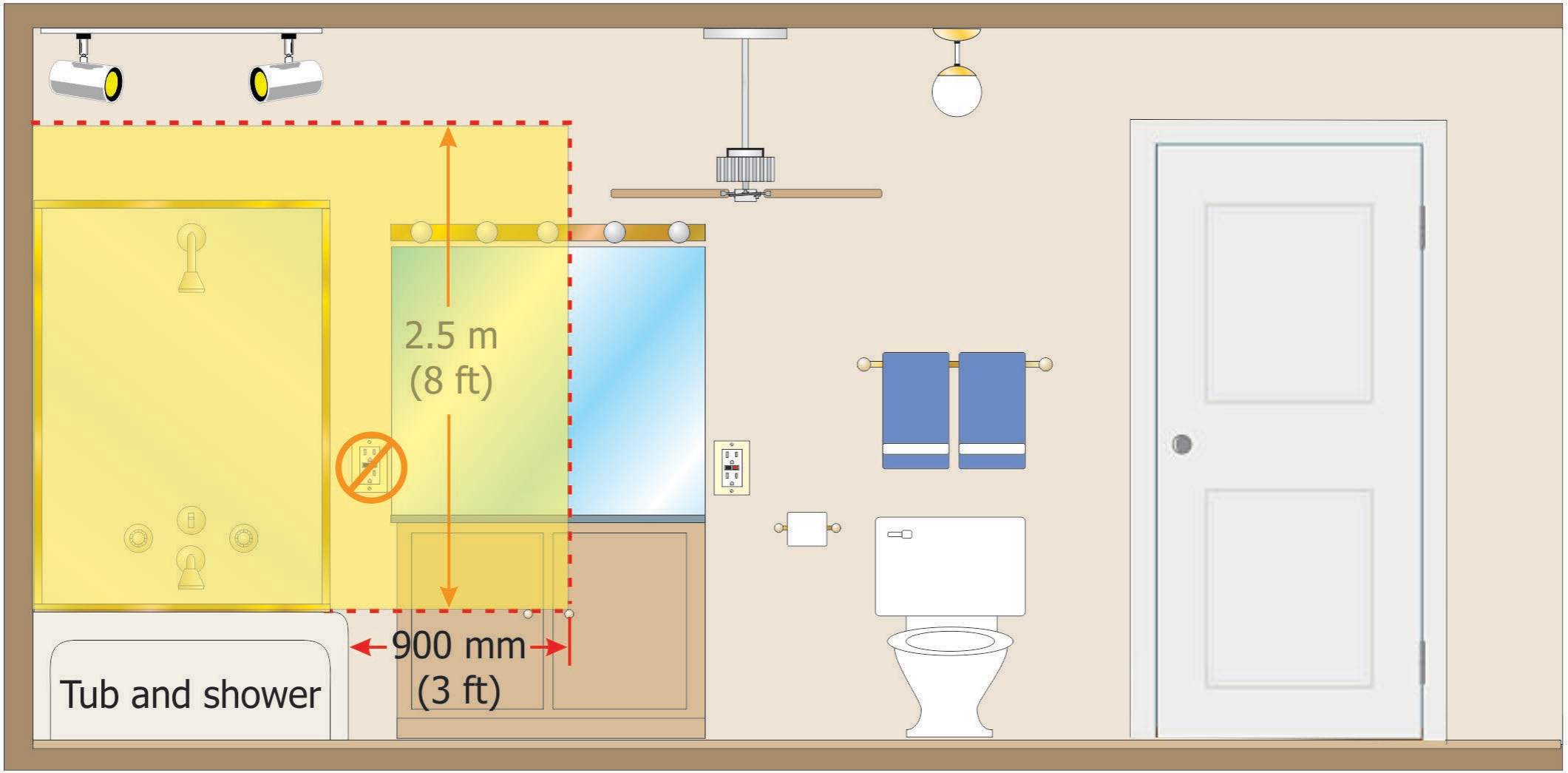
406.5(G)(2) Receptacle Mounting Under Sinks

- Receptacle outlets are now **prohibited** from being installed in the area **beneath a sink** in the **face-up position**
- Receptacle outlets have been prohibited for being installed in the face-up position in or on **countertop surfaces or work surfaces** since the **2002 *NEC*** *(dwelling units)* and all countertops and work surfaces since the **2014 *NEC***
- Common sight to see plumbing pipes connecting to a sink (supply and drain) leaking from time-to-time under a sink area such as a kitchen sink
- Receptacle for such things as a garbage disposer installed in the face-up position under the sink is subject to water entering the **polarized slots of the receptacle** creating a hazardous condition
- New language will help mitigate a **potential hazard**

406.9(C) Bathtub or Shower Stall Restricted "Zone" (Receptacles)

- Receptacle outlet(s) located in the area around a **bathtub or shower stall** have been revised to include a **restricted "zone"** similar to luminaires in said areas with an exception added for smaller space bathrooms
- Receptacles are now prohibited from being installed within a zone measured **900 mm (3 ft) horizontally** and **2.5 m (8 ft) vertically** from the top of the bathtub rim or shower stall
- In bathrooms with dimensions less than the required zone, receptacle(s) are permitted to be installed opposite the bathtub rim or shower stall threshold on the **farthest wall within the room**
- Previous language at 406.9(C) stated that receptacles were not be installed "within or directly over a bathtub or shower stall"
- This language was **vague** leading to **confusion** and **inconsistent interpretation** as to what defined the bathtub or shower stall "area"

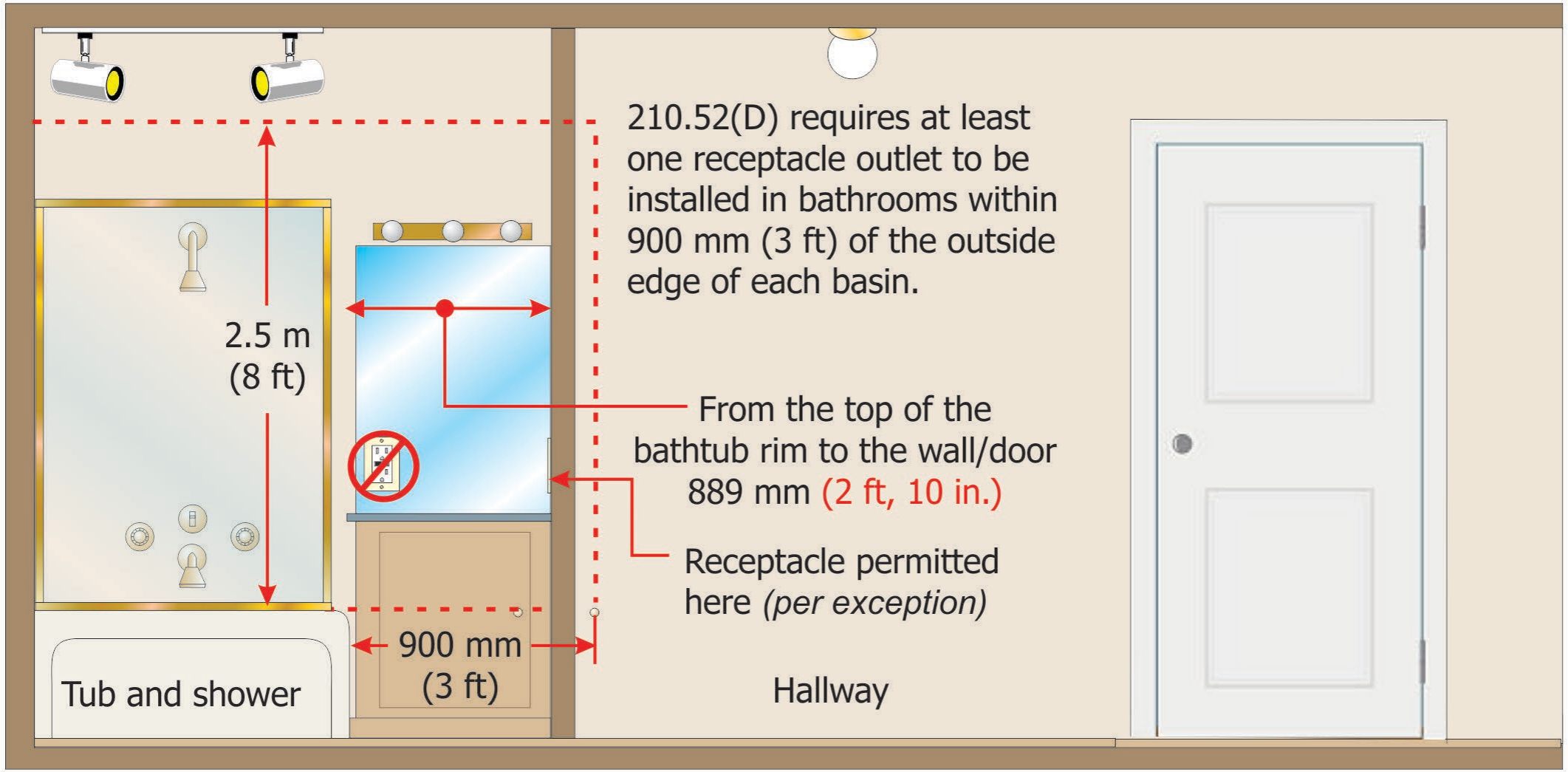
406.9(C) Bathtub and Shower Space



Receptacles shall not be installed within a zone measured 900 mm (3 ft) horizontally and 2.5 m (8 ft) vertically from the top of the bathtub rim or shower stall threshold.

Exception: In bathrooms with less than the required zone the receptacle(s) permitted to be installed opposite the bathtub rim or shower stall threshold on the farthest wall within the room.

406.9(C) Bathtub and Shower Space



Receptacles shall not be installed within a zone measured 900 mm (3 ft) horizontally and 2.5 m (8 ft) vertically from the top of the bathtub rim or shower stall threshold.

Exception: In bathrooms with less than the required zone the receptacle(s) permitted to be installed opposite the bathtub rim or shower stall threshold on the farthest wall within the room.

406.12 Tamper-Resistant Receptacles

- Requirements for **tamper-resistant (TR) receptacles** were **expanded**
- New areas include: **(1)** Attached and detached garages and accessory buildings of dwelling units, **(2)** Common areas of multifamily dwelling units, **(3)** Common areas of and hotels and motels, and **(4)** Assisted living facilities
- Attached and detached garages and accessory buildings to dwelling units are subject to the same TR receptacle requirements of the main dwelling unit
- At 406.12(4), the word "**elementary**" was **removed** leaving the term "**preschools and education facilities**" as places requiring TR receptacles
- Difficult for the AHJ to determine what age group of students will be utilizing the space

406.12 Tamper-Resistant Receptacles *(cont.)*

- The word "**waiting**" was changed to "**awaiting**" at 406.12(6) to match the wording used at **518.2** for examples of assembly occupancies where the term "**Places of awaiting transportation**" is used
- 406.12(6) now includes "places of awaiting transportation, gymnasiums, skating rinks, and auditoriums" that require TR receptacles
- The word "**Dormitories**" was changed to "**Dormitory units**" at 406.12(7) to match the newly defined term now found in Article 100
- **Assisted living facilities** are becoming commonplace around the country, which are essentially dwelling units but typically don't qualify as a dwelling unit as they **typically cannot meet the definition of a dwelling unit** as defined in Article 100 *(no permanent provision for cooking)*

406.12 Tamper-Resistant Receptacles

TR receptacles requirements or clarification was expanded to the following areas:

Attached and detached garages and accessory buildings to dwelling units

Common areas of multifamily dwellings and common areas of guest rooms and guest suites of hotels and motels

Assisted living facilities as small children can be present in these facilities as well

406.12 Tamper-Resistant Receptacles

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Assisted living facilities as small children can be present in these facilities as well

406.13 Single-Pole Separable-Connector Type

- New requirements were added to Article 406 pertaining to "**single-pole separate connectors**"
- Single-pole separable-connector are addressed in Article 520 *(Theaters, Audience Areas of Motion Picture and Television Studios, Performance Areas, and Similar Locations)* and Article 530 *(Motion Picture and Television Studios and Similar Locations)*
- A "Single-Pole Separable Connector" is defined as "a device that is installed at the ends of portable, flexible, single-conductor cable that is used to establish connection or disconnection between two cables or one cable and a single-pole, panel-mounted separable connector."
- Common industry practice to provide paralleled inputs of single-pole separable connectors on equipment so that paralleled sets of single conductor feeders may be used for powering high amperage equipment

406.13 Single-Pole Separable-Connector Type *(cont.)*

- New requirements were added to Article 406 pertaining to "**single-pole separate connectors**" *(cont.)*
- Article 406 contained requirements for a variety of different types of plugs and receptacles such as receptacle with USB charger, tamper-resistant receptacles and weather-resistant receptacles, but article did not address single pole separable connectors
- New section covers listing and labeling, locking or latching type connectors, marking requirements, proper identification of the grounded circuit conductor (white-colored housing) and connectors designated for connection to the EGC (green-colored housing), interchangeability for ac or dc use or for different current ratings or voltages, and identification of the proper connection and disconnection sequence necessary for the safe use of these devices

406.13 Single-Pole Separable-Connectors

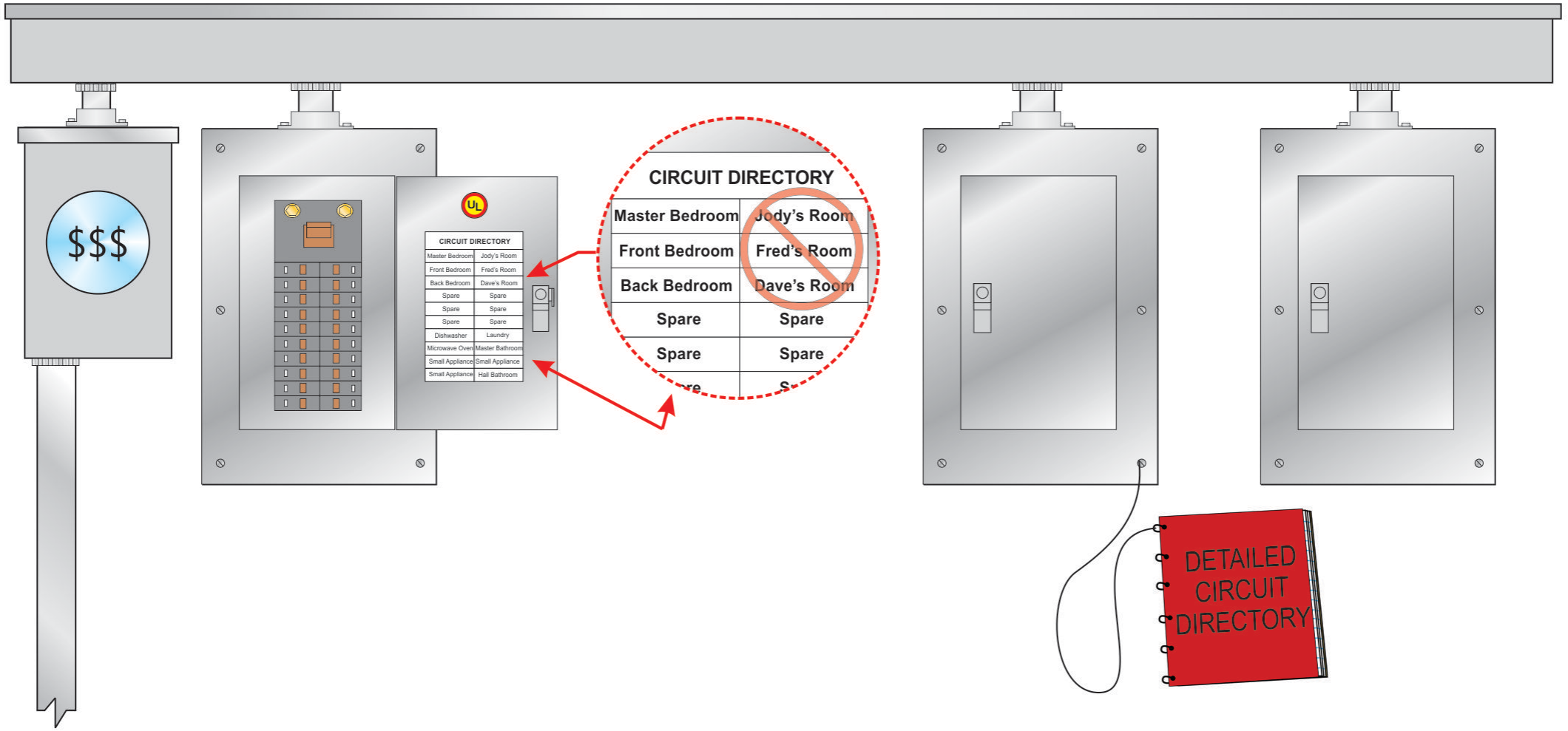
New section added to Article 406 at 406.13 titled, “Single-Pole Separable-Connector Type” covering the construction as well as the performance and marking requirements for listed single-pole separable-connectors

Single-Pole Separable Connector. A device that is installed at the ends of portable, flexible, single-conductor cable that is used to establish connection or disconnection between two cables or one cable and a single-pole, panel-mounted separable connector.

408.4(A) Circuit Directory or Circuit Identification

- Revisions were made to allow the circuit directory for a panelboard to be located in an "**approved location adjacent**" to the panelboard door
- Previous requirement only allowed circuit directory to be located **on the face or inside of the panel door** in the case of a panelboard
- All panelboard circuits and any circuit modifications are required to be legibly identified as to its clear, evident, and specific purpose or use with an approved degree of detail to distinguish each circuit from all others
- This adjacent location could include a **prominently labeled notebook** of circuit directories for adjacent panelboards that might even include graphics
- Only so much "**real estate**" inside of a panelboard lid or door
- New allowance of an adjacent location for the circuit directory supports the concept that the **more detail that is provided in a circuit directory the better** in terms of meeting the safety objectives of 408.4

408.4(A) Circuit Directory or Circuit Identification



Every circuit and circuit modification required to be legibly identified as to its clear, evident, and specific purpose or use

Identification required to be included in a circuit directory that is located on the face, inside of, or in an approved location adjacent to the panel door in the case of a panelboard

408.6 Short-Circuit Current Rating for *Switchboards, Switchgear, and Panelboards*

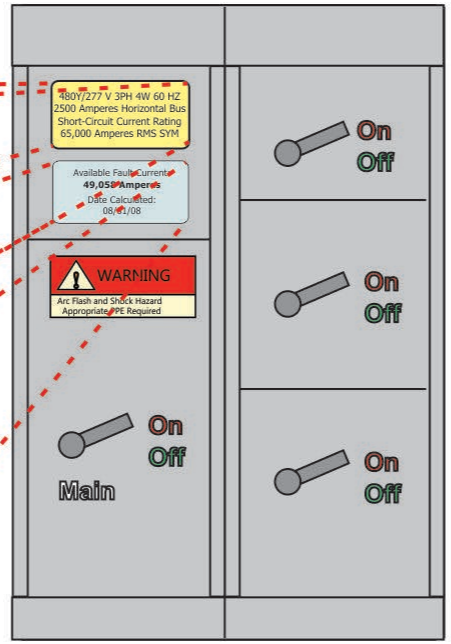
- New requirement added for **available fault current** and **date calculation performed** to be **field marked** on the enclosure at the point of supply for switchboards, switchgear, and panelboards *(other than dwelling units)*
- All switchboards, switchgear, and panelboards *(including panelboards at dwelling units)* are required to have a short-circuit current rating not less than the available fault current
- Enforcement community has a difficult time enforcing proper fault current ratings on such equipment as switchboards, switchgear, and panelboards without the knowledge of the available fault current
- Equipment is usually properly marked with the **short-circuit current rating** by the manufacturer, but there is typically no information on the jobsite as to the **available fault current at the equipment**
- *NEC* clearly addresses short-circuit current ratings for specialized equipment such as industrial control panels in **409.22**, elevators in **620.16** and industrial machinery in **670.5**

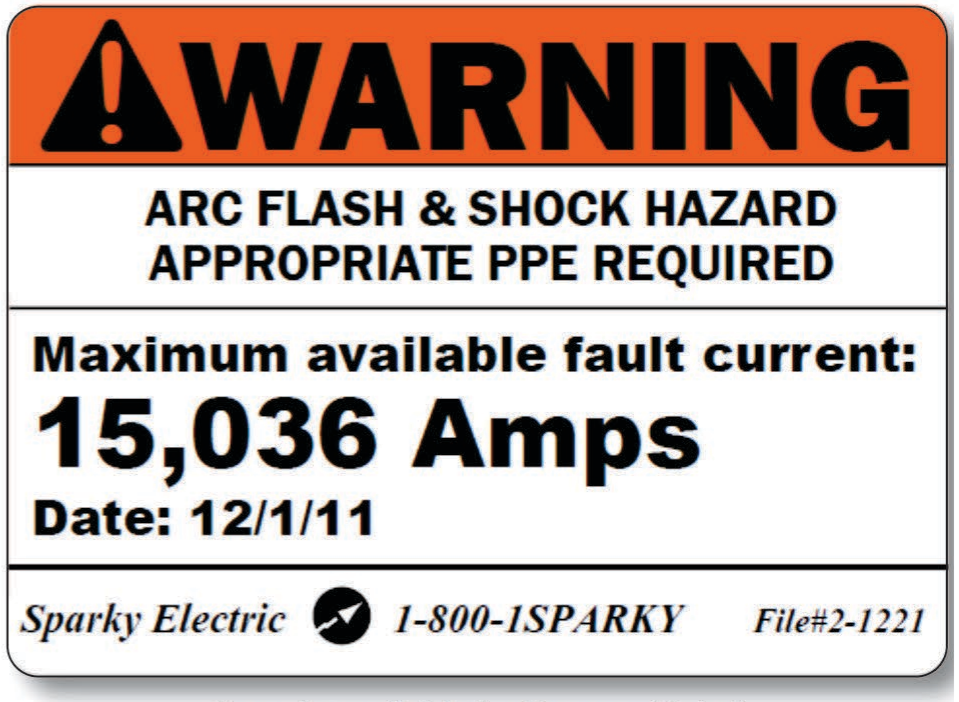
408.6 Short-Circuit Current Rating for Switchboards, Switchgear, and Panelboards

Switchboards, switchgear, and panelboards must have a short-circuit current rating not less than the available fault current

480Y/277-V 3-PH 4-W 60-HZ
2500-Amperes Horizontal Bus
Short-Circuit Current Rating
65,000 Amperes RMS SYM

Available Fault Current:
48,088 Amperes
Date Calculated:
08/01/19





Sample available fault-current label

**Markings shall comply with 110.21(B)(3)*

Available fault current and the date the calculation was performed to be field marked on the enclosure at the point of supply *(other than one- and two-family dwelling units)*

408.8 Reconditioning of Equipment (Switchboards, Switchgear, and Panelboards)

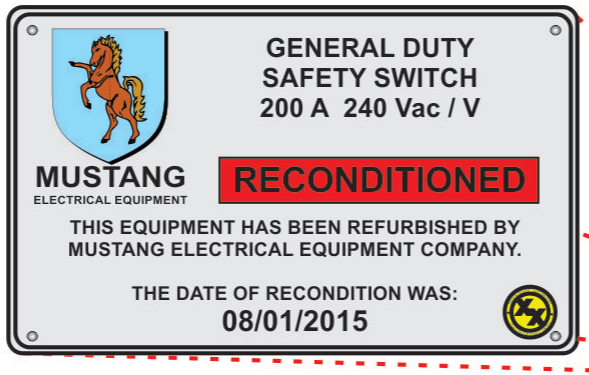
- New section added to address **reconditioning** of panelboards **(No)** and switchboards and switchgear **(Yes)**
- Marking requirement for reconditioned equipment at **110.21(A)(2)**
- Panelboards are defined as encompassing the bus structure but not the enclosure, typically a cabinet *(fundamentally different from switchboards and switchgear)*
- Panelboard listings are available for bus structures that can be field mounted in enclosures, as is appropriate
- Buswork itself is unlikely to be fit for reconditioning, but replacement is generally an option with field inspection and without additional listing
- When the available fault current exceeds 10,000 amperes, the enclosure must be evaluated in conjunction with the panel bus

408.8 Reconditioning of Equipment (Switchboards, Switchgear, and Panelboards)

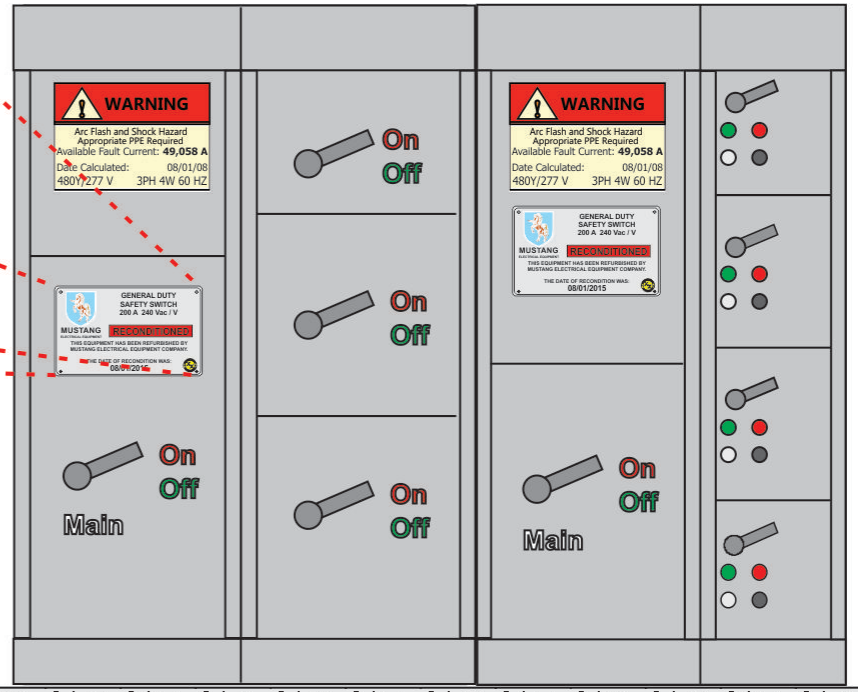
- New section added to address **reconditioning** of panelboards **(No)** and switchboards and switchgear **(Yes)** *(cont.)*
- Switchboards and switchgear can be reconditioned, and typically that work is **done in place** due to the inherent construction difficulties and expense in removing and reinstalling it *(involves a field evaluation)*
- In some cases an accident may damage a section but not warrant condemning an entire switchboard or switchgear line-up

408.8 Reconditioning of Equipment for Switchboards, Switchgear, and Panelboards

Panelboards NOT Permitted to be Reconditioned



Switchboards and Switchgear Permitted to be Reconditioned



*See also 110.21(A)(2)

Panelboards shall not be permitted to be reconditioned

Switchboards and switchgear, or sections of switchboards or switchgear, shall be permitted to be reconditioned

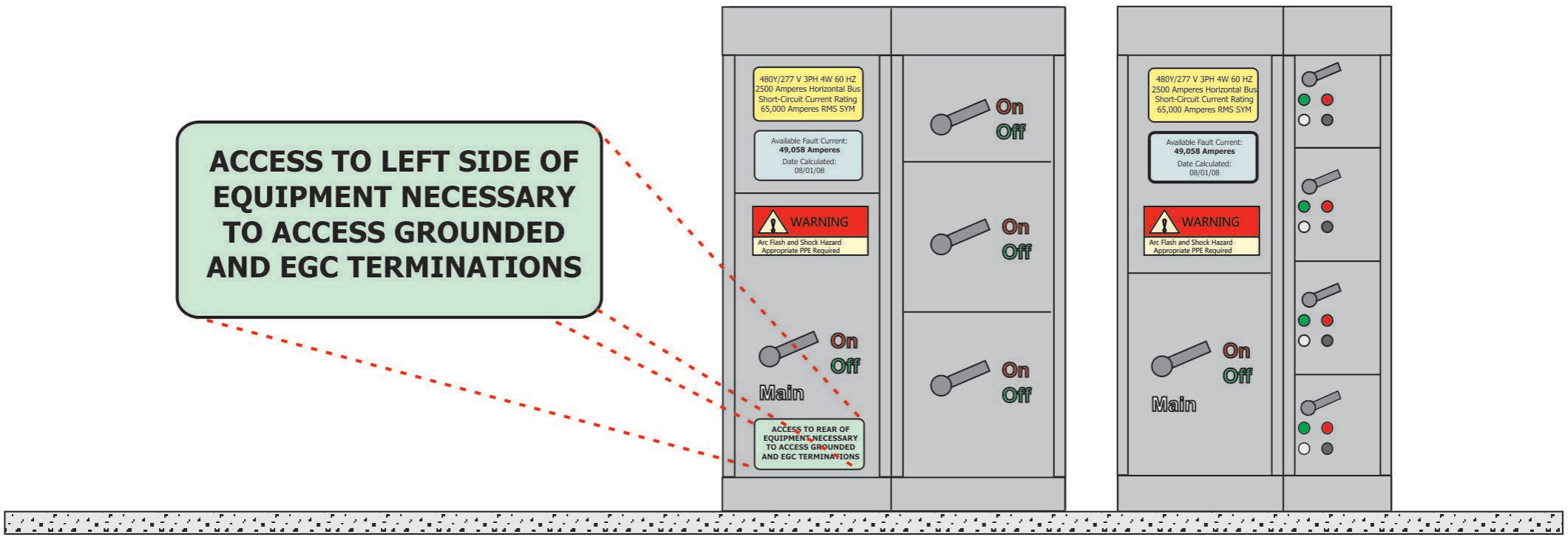
408.18(C) Switchboards and Switchgear Requiring Rear or Side Access

- New provision will require switchboards and switchgear requiring **rear or side access** to be marked (by manufacturer) on the front of said equipment indicating rear or side access is needed
- Existing 408.3(D) was moved to new 408.18(C) to emphasis the requirement that **grounded and grounding terminals** be installed such that it is not necessary to reach across ungrounded bus or terminal(s) to make connections
- Where a section of a switchboard or switchgear has an opening requiring rear or side access, that opening must provide proper working space as called for by 110.26
- This type of gear is often installed against a wall, precluding rear or side access, especially if it is not known that rear or side access is needed

408.18(C) Switchboards and Switchgear Requiring Rear or Side Access *(cont.)*

- New provision will require switchboards and switchgear requiring **rear or side access** to be marked (by manufacturer) on the front of said equipment indicating rear or side access is needed *(cont.)*
- Without this new rule for manufactures to provide a **label on the front of the equipment**, this is a problem that will only intensify as market pressures on scarce electrical room areas steadily limit the placement of switchgear in the middle of a floor

408.18(C) Switchboards and Switchgear - Rear or Side Access



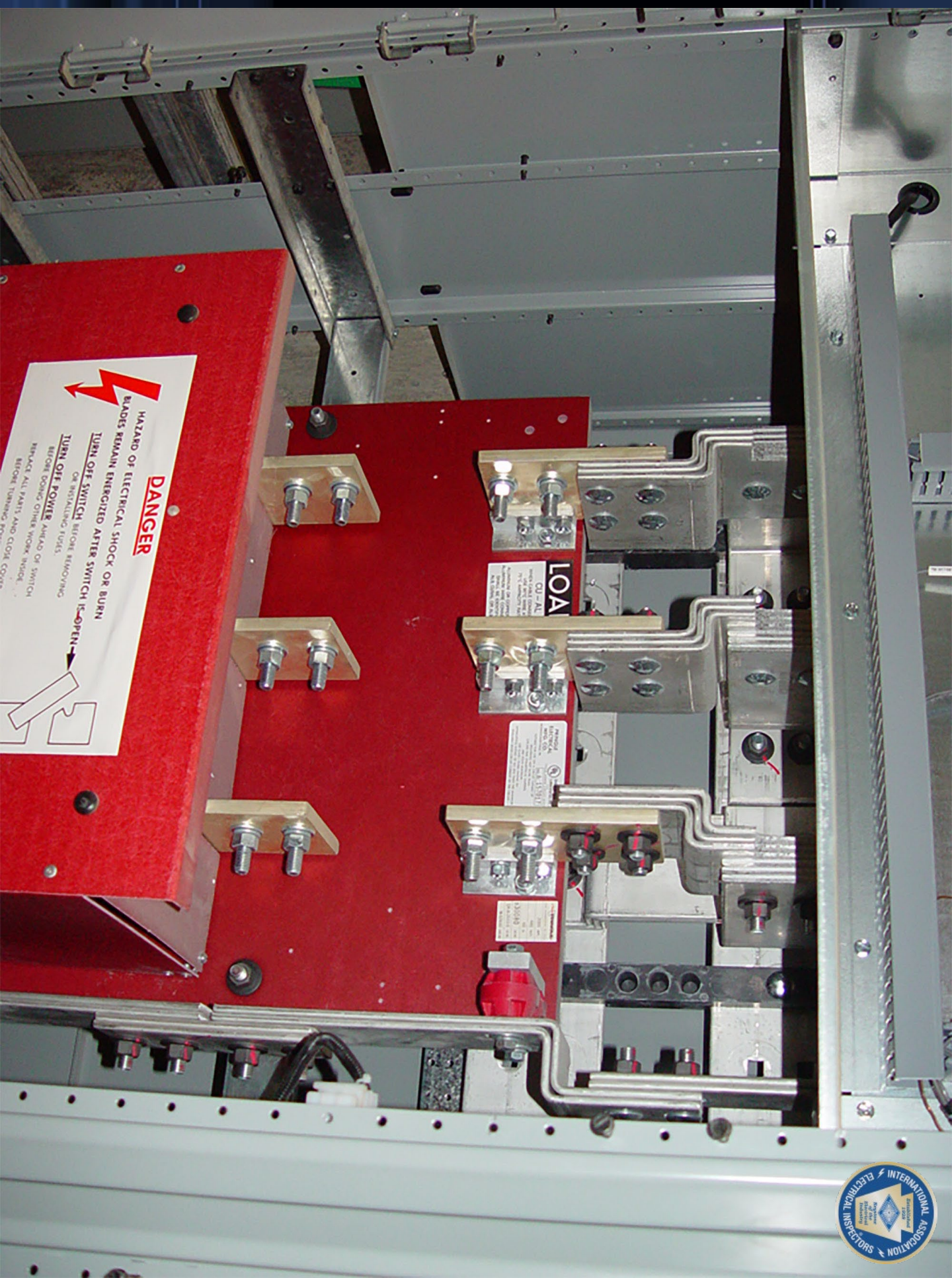
For switchboards and switchgear, each section of equipment that requires rear or side access to make field connections shall be so marked by the manufacturer on the front of said equipment

Section openings requiring rear or side access shall comply with 110.26 *(working space)*

Load terminals for field wiring shall comply with 408.18(C)(1), (C)(2), or (C)(3) *(prohibits reaching across ungrounded uninsulated bus to make connections)*

408.18(C) Switchboards and Switchgear – Rear and Side Access

408.18(C) Switchboards and Switchgear – Rear and Side Access

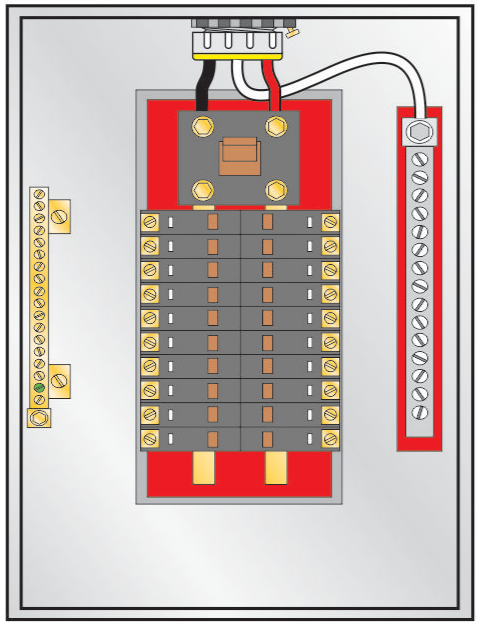


408.36 Overcurrent Protection for Panelboards

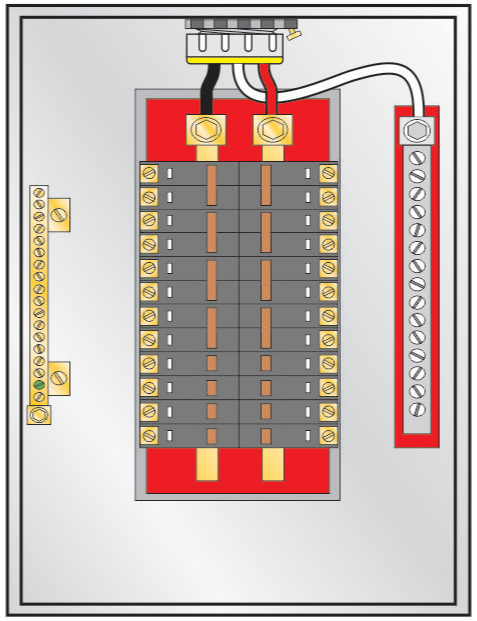
- Existing Ex. No. 1 was **deleted** due to revisions to **230.71(B)**, which eliminates more than one service disconnecting means in the **same panelboard or enclosure**
- 230.71(B) allows up to six means of disconnect for a service, but the multiple disconnecting means must now be located in **separate enclosures** *(no longer permitted to be located in the same enclosure)*
- Panelboards are generally required to be provided with individual overcurrent protected having a rating not greater than that of the panelboard with OCPD iocated within the panelboard itself or at any point on the supply side of the panelboard
- Previous Ex. No. 1 rule gave permission to exclude this individual overcurrent protection if the panelboard was being used as service equipment with up to six means of disconnect as previously permitted by 230.71

408.36 Overcurrent Protection for Panelboards

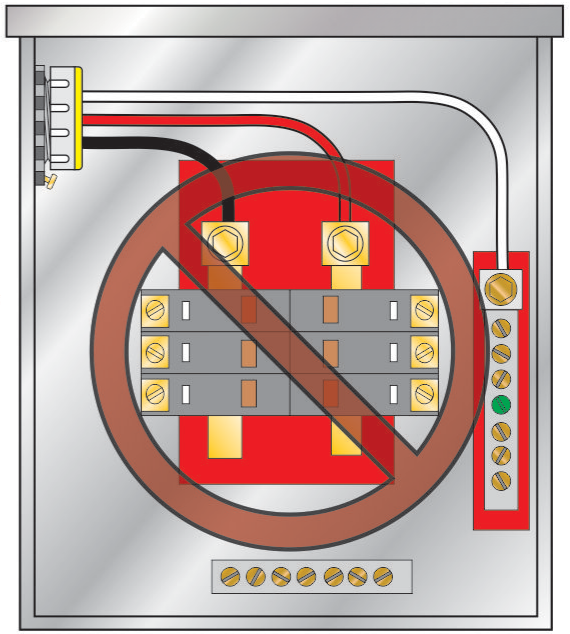
Panelboards generally required to be provided with individual overcurrent protected having a rating not greater than that of the panelboard with this overcurrent protection located within the panelboard itself or at any point on the supply side of the panelboard



Panelboard with main in same cabinet



"Main Lug Only" panelboard *(with main at supply side of feeder)* [408.36, Ex. No. 1]



Six means of disconnect in one enclosure [previous 408.36, Ex. No. 1]

408.36 Ex. No. 1 was deleted with revision of 230.71(B) which allows up to six means of disconnect for a service, but the multiple disconnecting means must now be located in separate enclosures *(no longer permitted to be located in the same enclosure)*

408.43 Panelboard Orientation

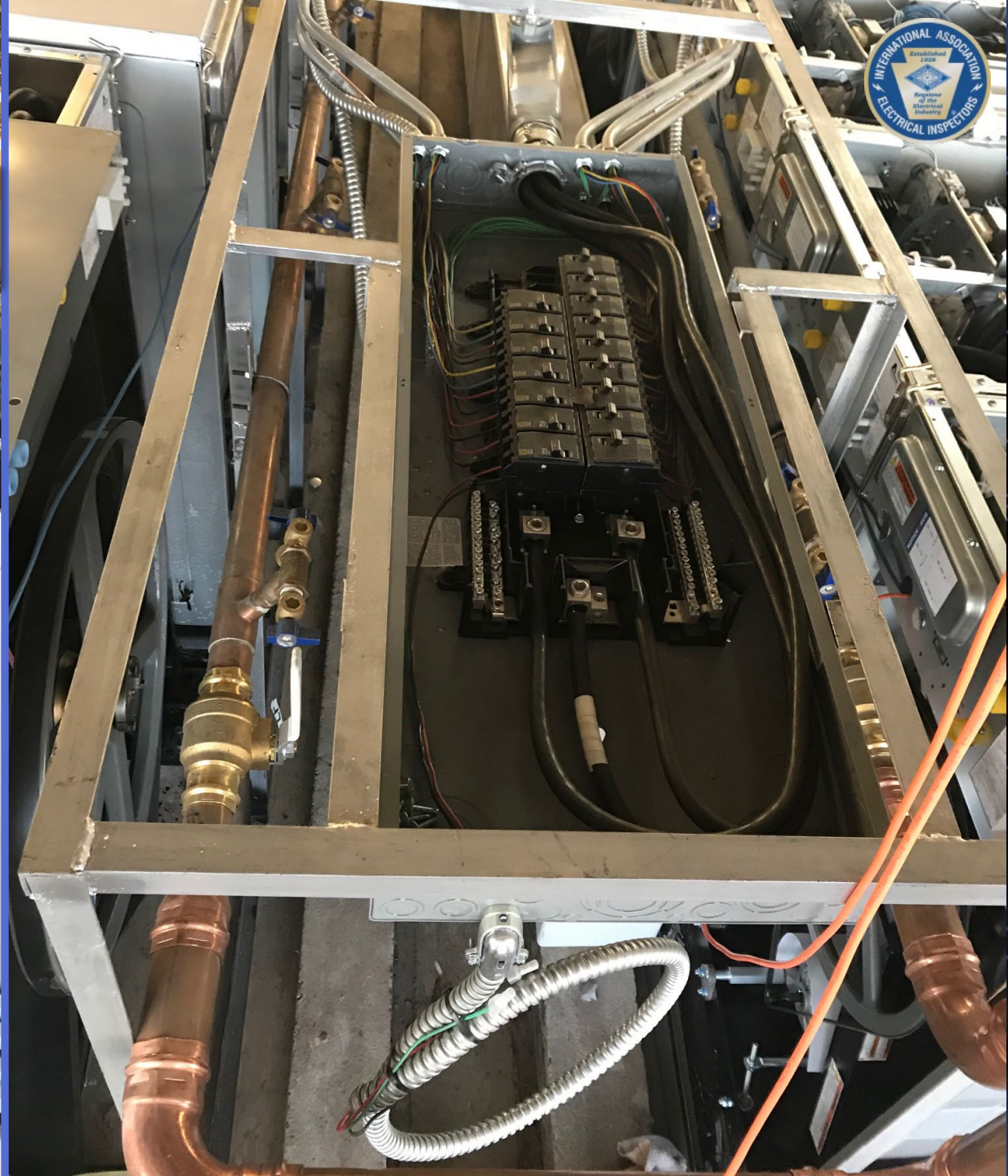
- Panelboards shall not be installed in the **face-up position**
- Installing panelboards in a face-up position increases the likelihood that **contaminants** accumulate on the circuit breakers and panelboard bussing, creating a hazard
- Additionally creates a challenge with applying **work space requirements**
- New text prevents the installation of panelboards in the face-up position and no overcurrent devices would be allowed on such a panelboard
- It should be noted that this new limitation does not prohibit the mounting of a panelboard in a horizontal face-down position

408.43 Panelboard Orientation

408.43 Panelboard Orientation: Panelboards shall not be installed in the face-up position.

Panelboard mounted in face-up position

Photos courtesy of Dave Williams



410.2 Definitions: Clothes Closet Storage Space and 410.16 Luminaires in Clothes Closets

- The word "**Clothes**" was added at the definition," Figure 410.2 and the requirements of 410.16 to limit these requirements to "**Clothes Closet Storage Spaces**"
- Previously throughout Article 410 storage spaces were often referred to as "closet storage space"
- 1990 *NEC* substantiation that brought about limitations for luminaires in storage closets was indeed based on **clothes closets**
- This revision could necessitate research into **other types of closet storage** *(bath towels, blankets, bed sheets, etc.)*
- Other types of storage closets perhaps need this same protection as a clothes closet

410.2 Definitions: Clothes Closet Storage Space and 410.16 Luminaires in Clothes Closets

Clothes Closet Storage Space. The volume bounded by the sides and back closet walls and planes extending from the closet floor vertically to a height of 1.8 m (6 ft) or to the highest clothes-hanging rod and parallel to the walls at a horizontal distance of 600 mm (24 in.) from the sides and back of the closet walls, respectively, and continuing vertically to the closet ceiling parallel to the walls at a horizontal distance of 300 mm (12 in.) or the width of the shelf, whichever is greater; for a closet that permits access to both sides of a hanging rod, this space includes the volume below the highest rod extending 300 mm (12 in.) on either side of the rod on a plane horizontal to the floor extending the entire length of the rod.

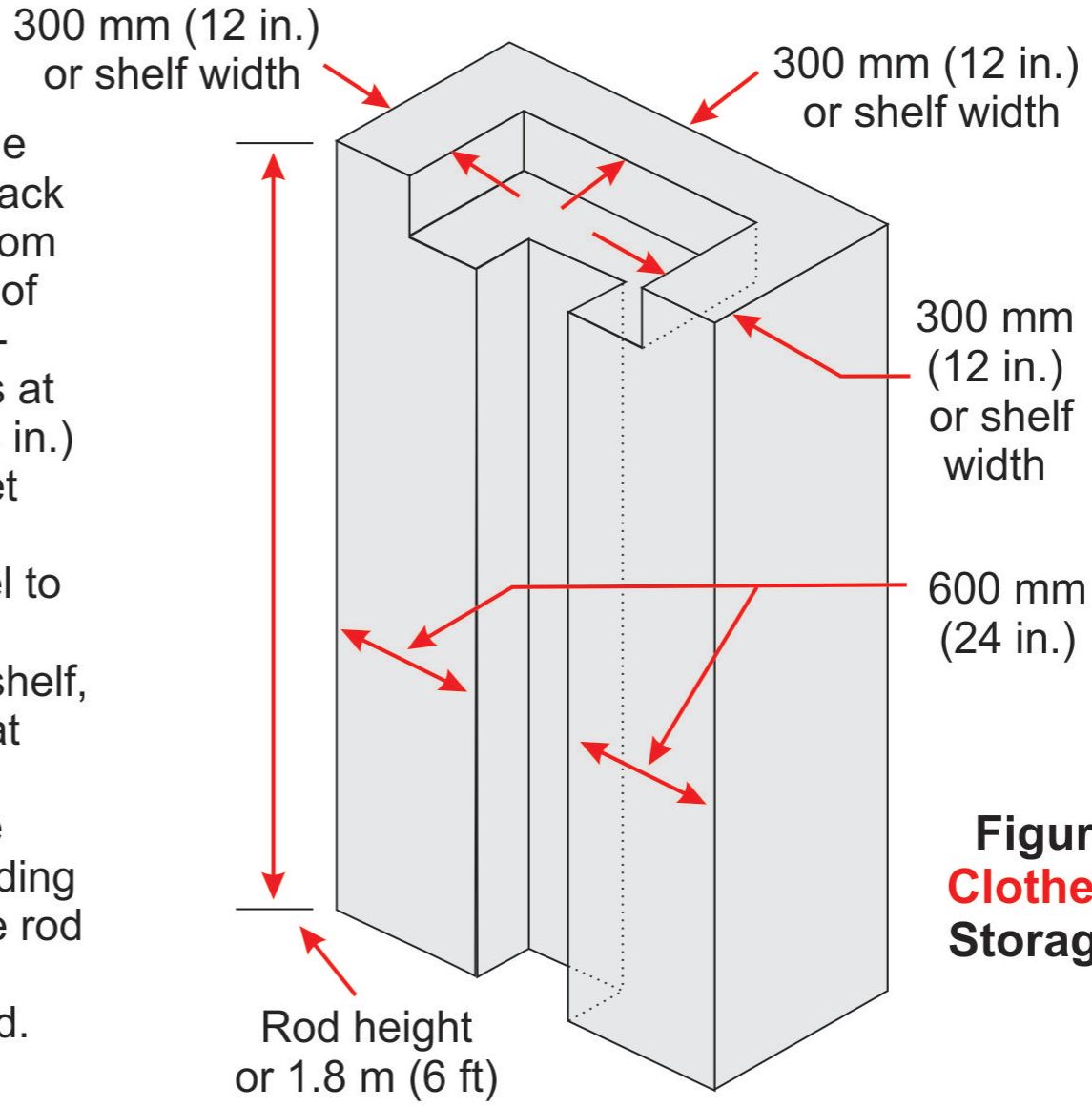
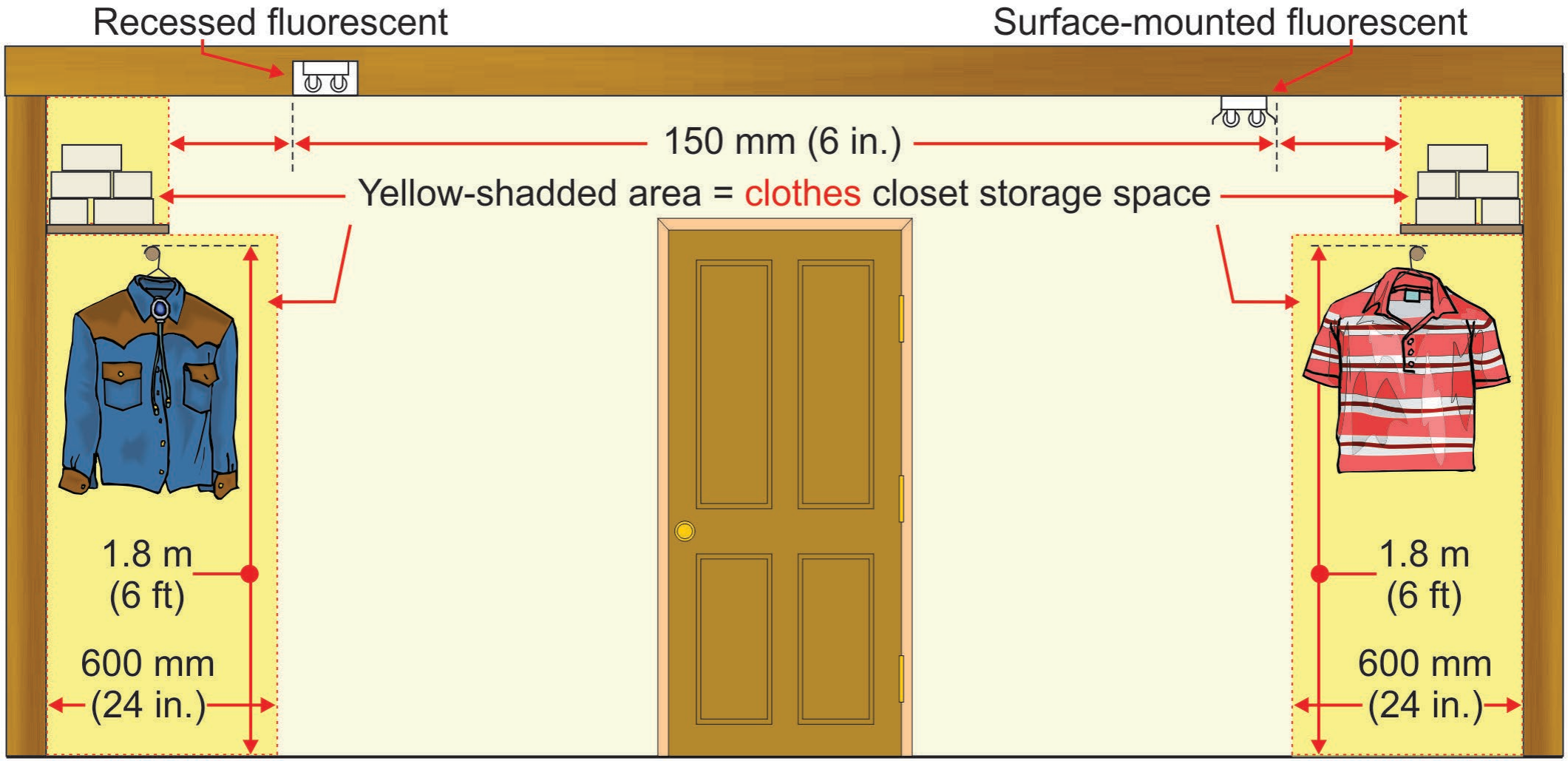


Figure 410.2
Clothes Closet Storage Space

410.2 Definitions: Clothes Closet Storage Space and 410.16 Luminaires in Clothes Closets



Surface-mounted fluorescent or LED luminaires permitted to be installed within the clothes closet storage space where identified for such use

410.36(A) Luminaires Supported By Outlet Boxes

- Revision illustrates that luminaires can be supported in accordance with **separable attachment fittings** and these outlet boxes are considered lighting outlets
- Outlet boxes or fittings installed as required by the support methods of 314.23 and complying with the provisions of **314.27(A)(1)** (vertical surface outlets) and **314.27(A)(2)** (ceiling outlets) permitted to support luminaires
- Luminaires are now also permitted to be supported in accordance with **314.27(E)** *(Separable Attachment Fittings)* and outlet boxes complying with 314.27(E) are considered lighting outlets
- Revised text clarifies that there is no requirement to add yet another lighting outlet with these 314.27(E) compatible devices

410.36(A) Luminaires Supported By Outlet Boxes *(cont.)*

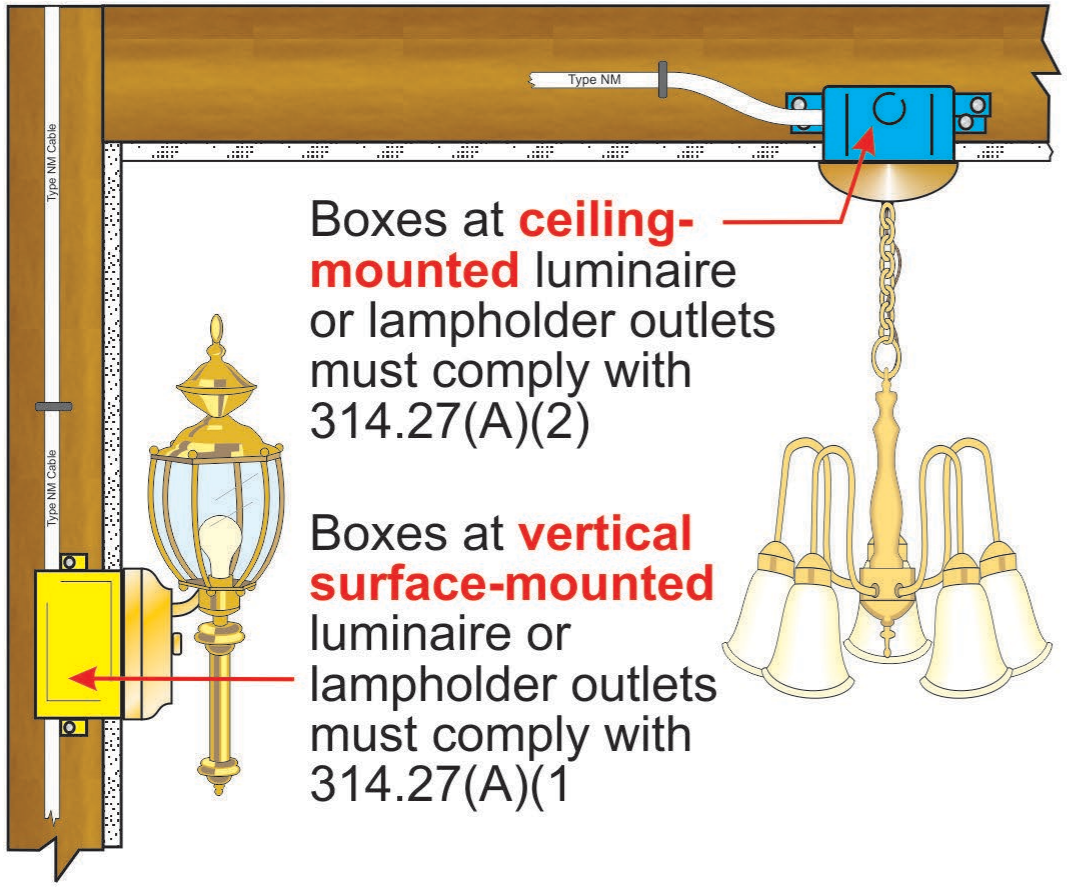
- Revision illustrates that luminaires can be supported in accordance with **separable attachment fittings** and these outlet boxes are considered lighting outlets *(cont.)*

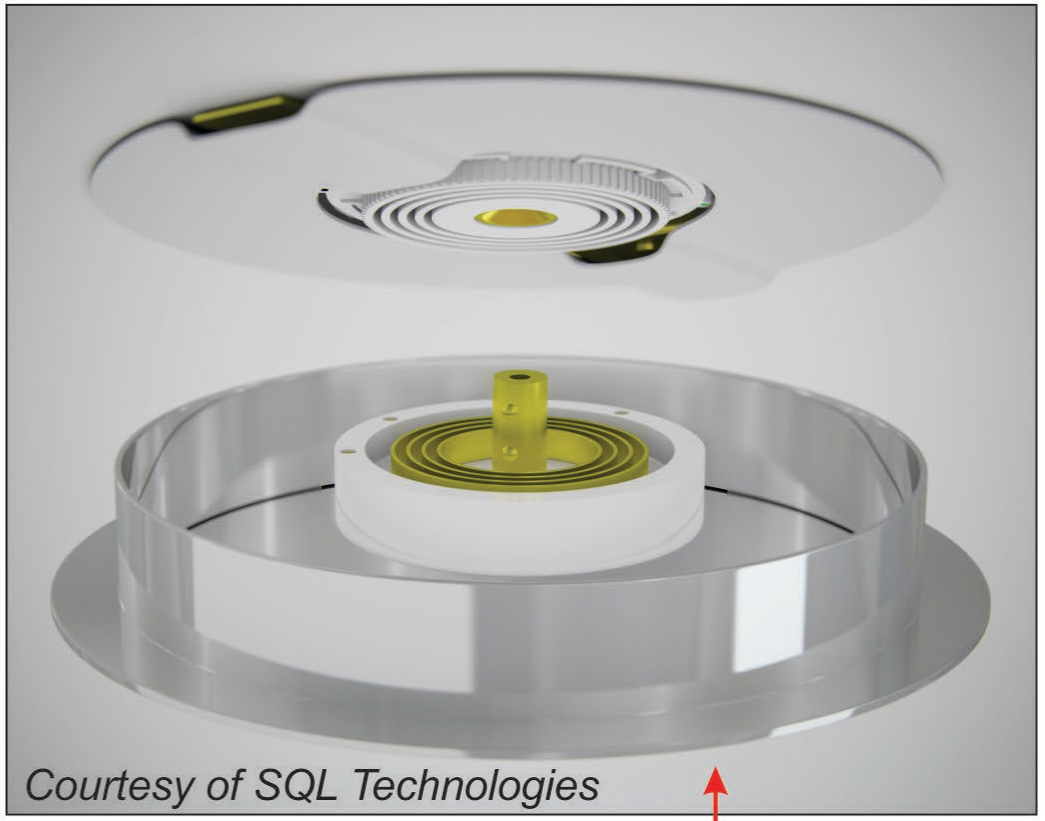
- **Separable attachment fittings** incorporate listed power supply devices and listed locking support and mounting receptacles and supporting means as an option for mounting and supporting luminaires, lampholders, and ceiling suspended (paddle) fans

- Same basic change at **new 422.22** for appliances and installing a ceiling suspended (paddle) fan

410.36(A) Luminaires Supported By Outlet Boxes

Outlet boxes or fittings installed as required by the support methods of 314.23 and complying with provisions of 314.27(A)(1) (vertical surface outlets) and 314.27(A)(2) (ceiling outlets) permitted to support luminaires





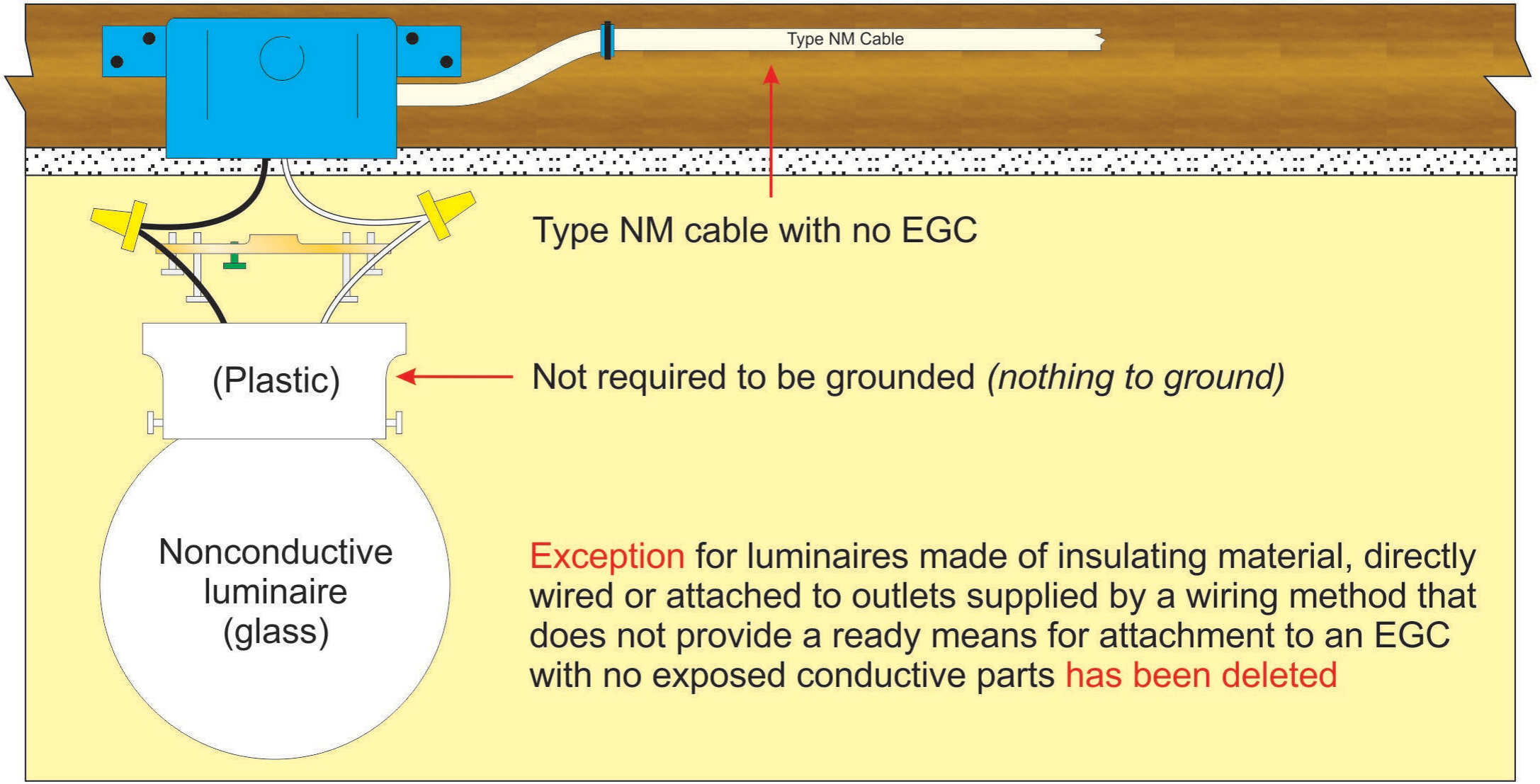
Luminaires also permitted to be supported per 314.27(E) (Separable Attachment Fittings) and outlet boxes complying with 314.27(E) are considered lighting outlets

410.44 Methods of Grounding Luminaires

- **Previous Ex. No. 1 to 410.44 was deleted** since there is no requirement for a luminaire with no accessible conductive parts, or a luminaire made of insulating material to be grounded
- Luminaires and equipment are generally required to be mechanically connected (grounded) to an equipment grounding conductor
- There are no *NEC* requirements for a luminaire with "no exposed conductive parts," or a luminaire "made of insulating material'" to be grounded *(connected to an equipment grounding conductor) (**no need to "exempt" such a luminaire** from the grounding requirements for a luminaire)*
- The term "**made of insulating material**" in the deleted exception was felt to be too broad of a term

410.44 Methods of Grounding Luminaires

Luminaires are generally required to be mechanically connected (grounded) to an equipment grounding conductor (EGC)



410.69 Identification of Control Conductors

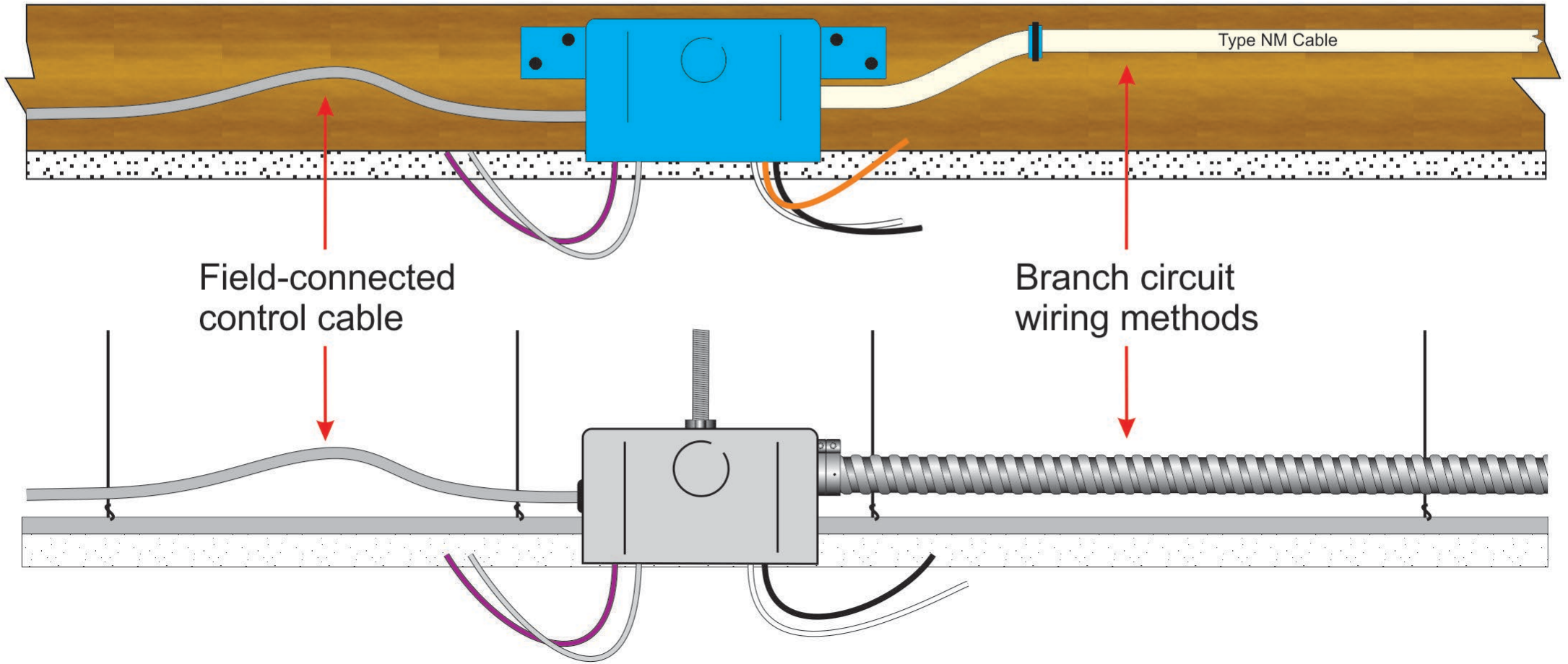
- New section added to prevent **lighting control conductors** from being installed using the **same color schemes** as the branch circuit grounded conductors and the equipment grounding conductor
- Future effective date of **January 1, 2022**
- Becoming more and more commonplace to control lighting with **low voltage** lighting control conductors and devices
- **Lighting control conductors** are used to communicate commands and other information between control devices in lighting system and the luminaire, etc.
- In today's modern social media society, for a more advanced functionality and flexible lighting system, **dedicated control wiring** may be needed

410.69 Identification of Control Conductors *(cont.)*

- New section added to prevent **lighting control conductors** from being installed using the **same color schemes** as the branch circuit grounded conductors and the equipment grounding conductor *(cont.)*
- This wiring is typically low voltage *(Class 2, 12–24-volt dc)*, providing a pathway for communication of analog or digital signals, such as incoming sensor input data *(lighting levels, occupancy sensing conditions, etc.)*
- Multiple **shock incidents** that have occurred and been reported involving the low voltage lighting control conductors being inadvertently spliced or connected to the grounded (neutral) conductor for the nominal voltage wiring system
- One very common lighting control conductor scheme is to use "**purple and gray**" colored lighting control conductors *("continuous white or gray outer finish" reserved for identification of grounded conductor systems)*

410.69 Identification of Control Conductor

Field-connected control conductor not permitted to utilize the same color identification scheme as reserved for the grounded branch-circuit conductor (white or gray) or the EGC (green) where control conductors are spliced, terminated, or connected in the same luminaire or enclosure as the branch-circuit conductors *(Future effective date of January 1, 2022)*



410.116(C) Recessed Luminaires Installed in Fire-Resistant Construction

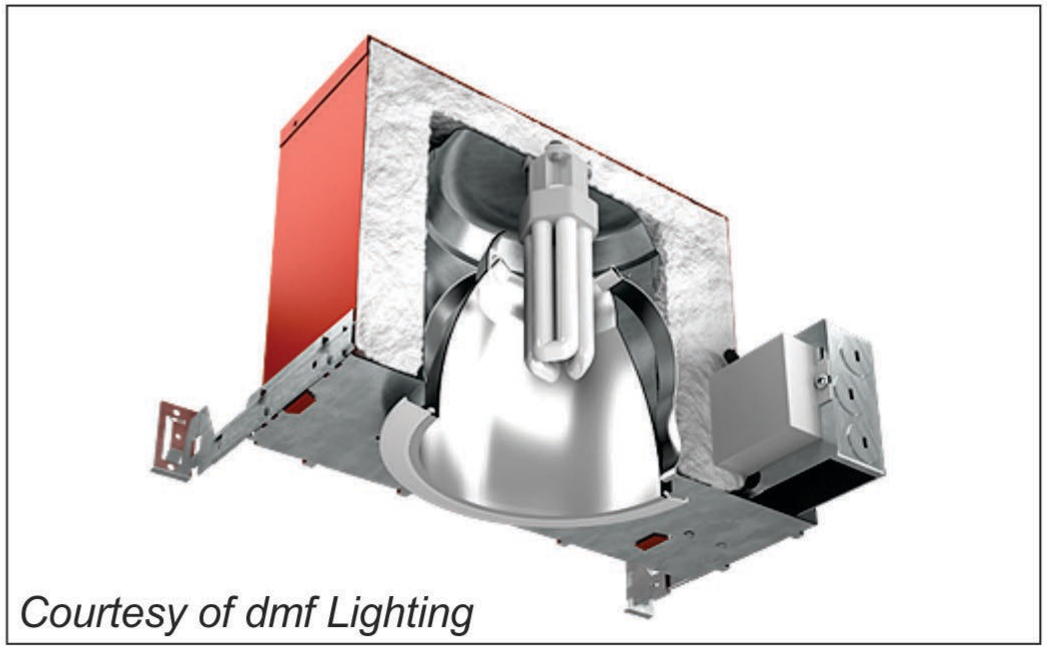
- The requirements for **recessed luminaires** installed in **fire-resistance construction** revised to be consistent with current listing options and relocated to 410.116(C)
- Recessed luminaires installed in fire-resistant construction must be **listed for use in a fire resistance-rated construction** and the recessed luminaire is required to be installed in or used with a **luminaire enclosure that is listed for use in a fire resistance-rated construction**
- Must also be installed in accordance with a tested **fire resistance-rated assembly**
- New text at 410.116(C) also recognizes the use of recessed **LED luminaires** of comparable construction for recessed installations in a building of fire-resistant construction

410.116(C) Recessed Luminaires Installed in Fire-Resistant Construction

Recessed luminaires installed in fire-resistant construction must be listed for use in a fire-rated construction and required to be installed in or used with a luminaire enclosure that is listed for use in a fire-rated construction

Must also be installed in accordance with a tested fire resistance-rated assembly

Recessed LED luminaires of comparable construction permitted for recessed installations in a building of fire-resistant construction



Courtesy of dmf Lighting

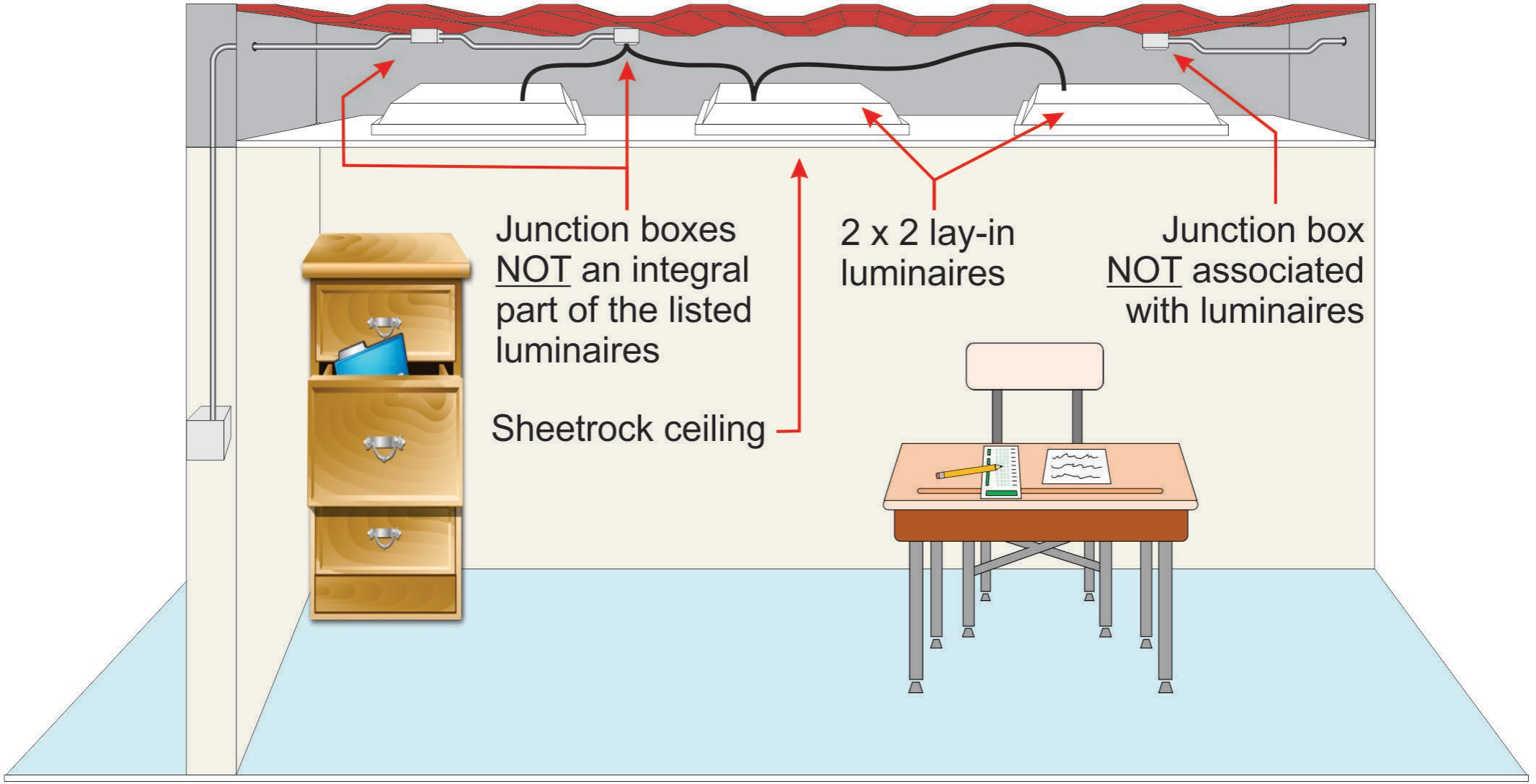
Luminaires marked "FOR USE IN NON-FIRE-RATED INSTALLATIONS" prohibited in fire-rated installations

410.118 Access to Other Boxes

- New section added to clarify that a luminaire cannot be used to access outlet, pull, or junction boxes or conduit bodies that are **not associated with** wiring for that luminaire
- Luminaires recessed in ceilings, floors, or walls are now prohibited from being used to access outlet, pull, or junction boxes or conduit bodies unless the box or conduit body is an **integral part of the listed luminaire**
- Previously selected installations involved recessed luminaires that were fastened to structural components of a dropped ceiling and designed and intended to be used to access junction boxes for wiring that was not associated with these recessed luminaires
- These installations involved fixed ceilings *(no removable ceiling tiles)*, with junction boxes **not visible or accessible** without the removal of the luminaire

410.118 Access to Other Boxes

Luminaires recessed in ceilings, floors, or walls shall not be used to access outlet, pull, or junction boxes or conduit bodies, unless the box or conduit body is an integral part of the listed luminaire.



410.118 Access to Other Boxes *(thru Luminaires)*

Article 410, Part XVI Special Provisions for Horticultural Lighting Equipment

- A new **Part XVI** was added to **Article 410** with special provisions for **Horticultural Lighting Equipment**
- These new requirements respond to rapidly increasing industry of indoor plant growing facilities
- Luminaires used for growing plants are very specialized
- Equipment installed in a horticultural environment is commonly exposed to dust, water spray, high humidity levels, and high ambient temperatures
- To maximize plant growth, horticultural lighting equipment can be designed with **flexible cord and plug supply connections** in lieu of a permanent connection to make the equipment adjustable
- Horticultural lighting equipment also produces **light wavelengths and intensities** different than that needed for general illumination and requires additional protection for users against light exposure

Article 410, Part XVI Special Provisions for Horticultural Lighting Equipment *(cont.)*

- A new **Part XVI** was added to **Article 410** with special provisions for **Horticultural Lighting Equipment** *(cont.)*
- New Part XVI will cover such things as listing requirements, installation and use, locations not permitted, general lighting requirements, flexible cord provisions, fittings and connectors, grounding requirements, GFCI protection provisions, supporting requirements and requirements for installations in hazardous (classified) locations
- While **Article 547** has requirements for **agricultural buildings**, horticultural lighting installations have **special considerations** not previously addressed by the *Code*
- These new *Code* requirements were needed to ensure safe installations and to facilitate inspection procedures

Article 410, Part XVI
Special Provisions for Horticultural Lighting Equipment

New Part XVI of Article 410 will cover such things as listing requirements, installation and use, locations not permitted, general lighting requirements, flexible cord provisions, fittings and connectors, grounding requirements, GFCI protection provisions, supporting requirements and requirements for installations in hazardous (classified) locations

422.5(A) GFCI Protection for Appliances

- The "**provided for public use**" condition has been removed from GFCI requirements for both **automotive vacuum machines** and **tire inflation machines**
  - With this phrase in place, GFCI protection for automotive vacuum machines and tire inflation machines that were NOT "provided for public use" was eliminated
- **Sump pumps** has been added to the list of appliances requiring GFCI protection
  - Previously, a sump pump might have been required to be GFCI protected, but only because of its location *(in an unfinished basement, etc.)*, not because it was a "sump pump"

422.5(A) GFCI Protection for Appliances

GFCI requirements for Appliances *(150 volts or less to ground and 60 amperes or less, single- or 3-phase)* shall be provided with Class A GFCI protection for personnel *(Multiple GFCI devices permitted but not be required)*

(1) Automotive vacuum machines ~~provided for the public~~; (2) Drinking water coolers and bottle fill stations; (3) Cord-and-plug-connected high-pressure spray washing machines; (4) Tire inflation machines ~~provided for the public~~; (5) Vending machines; (6) Sump pumps; (7) Dishwashers

422.5(A) GFCI Protection for Appliances

GFCI requirements for Appliances *(150 volts or less to ground and 60 amperes or less, single- or 3-phase)* shall be provided with Class A GFCI protection for personnel *(Multiple GFCI devices permitted but not be required)*

Automotive vacuum machines

Tire inflation machines

(1) Automotive vacuum machines ~~provided for the public~~; (2) Drinking water coolers and bottle fill stations; (3) Cord-and-plug-connected high-pressure spray washing machines; (4) Tire inflation machines ~~provided for the public~~; (5) Vending machines; (6) Sump pumps; (7) Dishwashers

422.5(A) GFCI Protection for Appliances

GFCI requirements for Appliances *(150 volts or less to ground and 60 amperes or less, single- or 3-phase)* shall be provided with Class A GFCI protection for personnel *(Multiple GFCI devices permitted but not be required)*

Drinking water coolers

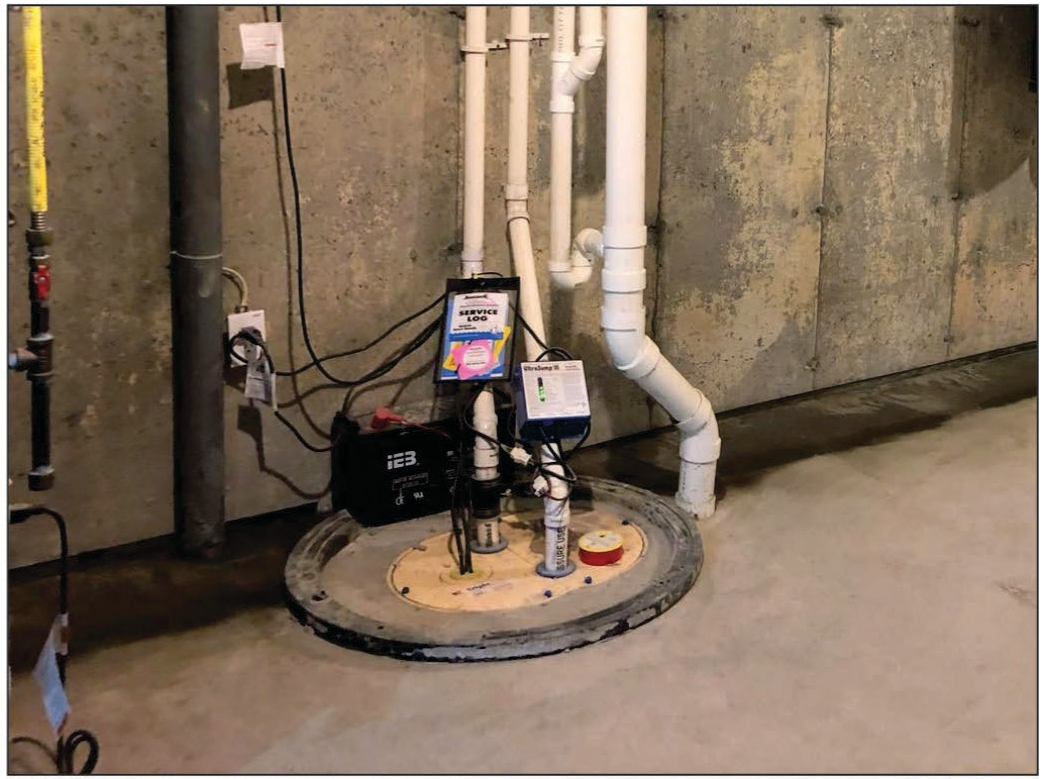
Bottle fill stations

(1) Automotive vacuum machines ~~provided for the public~~; (2) Drinking water coolers and bottle fill stations; (3) Cord-and-plug-connected high-pressure spray washing machines; (4) Tire inflation machines ~~provided for the public~~; (5) Vending machines; (6) Sump pumps; (7) Dishwashers

422.5(A) GFCI Protection for Appliances

GFCI requirements for Appliances *(150 volts or less to ground and 60 amperes or less, single- or 3-phase)* shall be provided with Class A GFCI protection for personnel *(Multiple GFCI devices permitted but not be required)*

Sump pumps



Sump pumps

(1) Automotive vacuum machines ~~provided for the public~~; (2) Drinking water coolers and bottle fill stations; (3) Cord-and-plug-connected high-pressure spray washing machines; (4) Tire inflation machines ~~provided for the public~~; (5) Vending machines; (6) Sump pumps; (7) Dishwashers

422.5(A) GFCI Protection for Appliances

GFCI requirements for Appliances *(150 volts or less to ground and 60 amperes or less, single- or 3-phase)* shall be provided with Class A GFCI protection for personnel *(Multiple GFCI devices permitted but not be required)*

Dishwashers (Dwelling units)

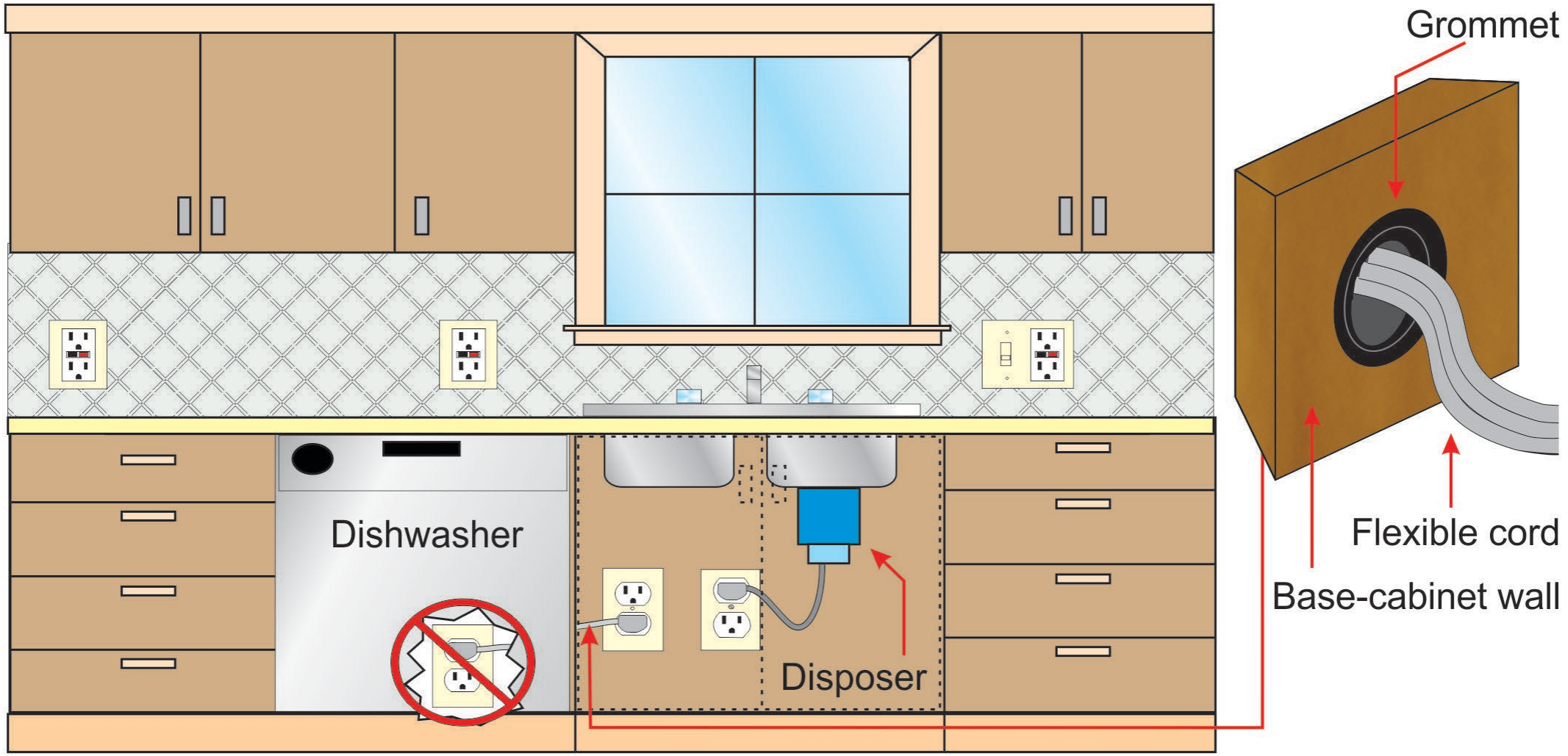
Dishwashers (Non-dwelling unit)

(1) Automotive vacuum machines ~~provided for the public~~; (2) Drinking water coolers and bottle fill stations; (3) Cord-and-plug-connected high-pressure spray washing machines; (4) Tire inflation machines ~~provided for the public~~; (5) Vending machines; (6) Sump pumps; (7) Dishwashers

422.16(B)(2) Flexible Cords for Built-in Dishwashers

- A flexible cord to an **adjacent space for a dishwasher** passing through an opening is now required to be protected in the form of a **bushing, grommet or other approved means**
- Dishwashers permitted to be cord-and-plug connected *(not required)*
- If cord-and-plug connected, receptacle outlet is required to be located in the **space adjacent to** the space occupied by the dishwasher with a maximum length of a cord for a built-in dishwasher of 2.0 m (6.5 ft)
- When the flexible cord passes through a **drilled or rough opening**, such as in a base-cabinet, these openings can sometimes cause **damage to the flexible cord** during installation or servicing potentially requiring additional protection

422.16(B)(2) Built-In Dishwashers



Receptacle outlet for cord-and-plug connected built-in dishwasher required to be located in the space adjacent to the dishwasher with the max. length of the cord 2.0 m (6½ ft)

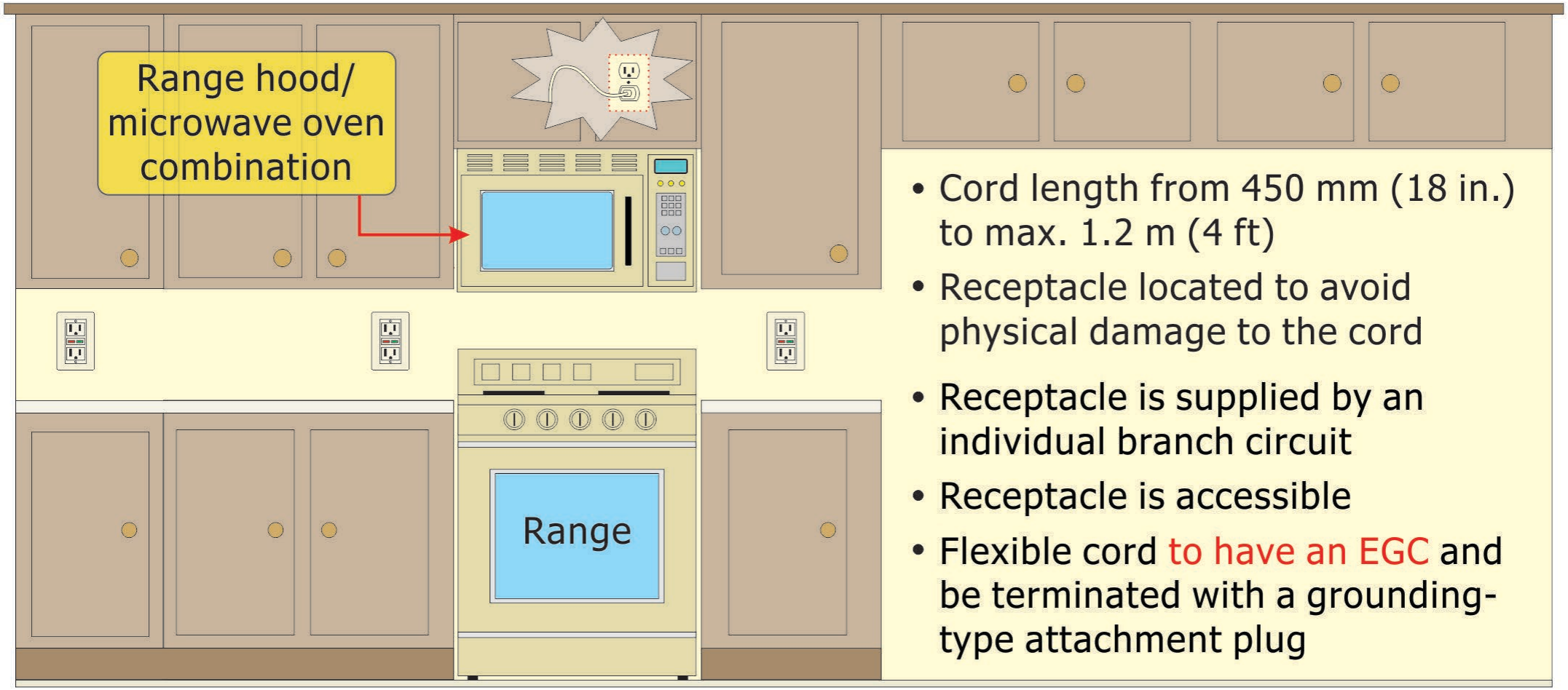
Flexible cord passing through an opening shall be protected against damage by a bushing, grommet, or other approved means

422.16(B)(4) Range Hoods and Microwave Oven/Range Hood Combinations

- Revision clarifies that the same conditions of **422.16(B)(4)** are applicable to cord-and-plug-connected, **over-the-range microwave ovens** incorporating range-hood as a range hood
- Previously, some would argue that 422.16(B)(4) did *NOT* apply because there was no mention of "**microwave ovens**" in the list item of 422.16(B)
- To remedy that incorrect interpretation of the *Code*, the title of 422.16(B)(4) was changed from simply “Range Hoods” to “**Range Hoods and Microwave Oven/Range Hood Combinations**” *(Code text changed as well)*
- The requirement for and **individual branch circuit** was originally incorporated to account for an ordinary range hood being replaced with a range hood/microwave oven combination *[see 422.16(B)(4)(3)]*

422.16(B)(4) Range Hoods and Microwave Oven/Range Hood Combinations

Range hoods and over-the-range microwave ovens with integral range hoods permitted to be cord-and-plug connected where identified on installation instructions by manufacturer and meets the following:

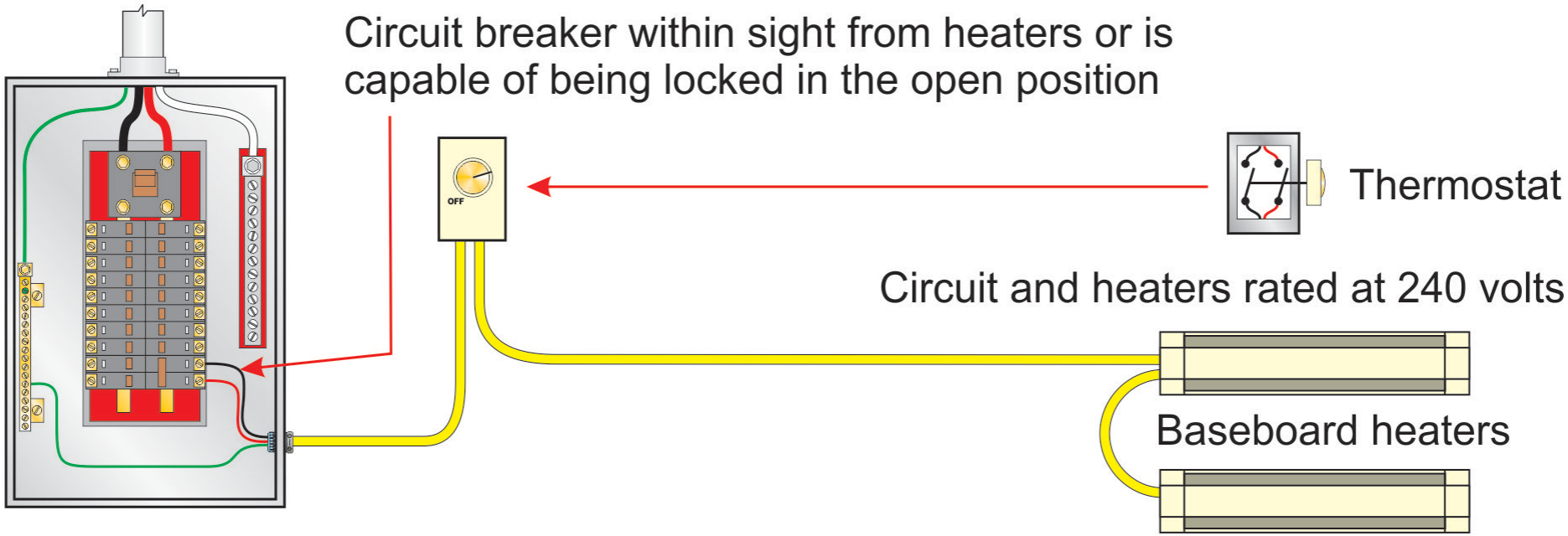


- Cord length from 450 mm (18 in.) to max. 1.2 m (4 ft)
- Receptacle located to avoid physical damage to the cord
- Receptacle is supplied by an individual branch circuit
- Receptacle is accessible
- Flexible cord to have an EGC and be terminated with a grounding-type attachment plug

424.20(A) Thermostatically Controlled Switching Devices Permitted as Disconnecting Means

- Revision requires thermostatically controlled switching devices and combination thermostats and manually controlled switches for fixed electric space-heating equipment (FESHE) to be located in an **accessible location**
- Thermostatically controlled switching devices and combination thermostats and manually controlled switches are **permitted to serve as both controllers and disconnecting means**, provided they meet five specific conditions of 424.20(A) *(including located in an accessible location)*
- Conditions include; provided with a marked “off” (open) position, they directly open all ungrounded (hot) conductors when manually placed in the “off” (open) position, designed so the circuit cannot be energized automatically after the device has been manually placed in the “off” (open) position, and located within sight of the heater(s) they control (see 424.19)

424.20(A) Thermostatically Controlled Switching Devices Permitted as Disconnect



Thermostat permitted to serve as both the controller and the disconnecting means as follows:

(1) It has a marked “OFF” position

(2) Directly opens all ungrounded (hot) conductors when placed in the “OFF” position

(3) Is designed so that the circuit cannot be energized automatically after the device is placed in the “OFF” position

(4) Thermostat located within sight from heater(s) *(see 424.19 and definition “of within sight from”)*

(5) Located in an accessible location

425.22(B) Resistance Elements *(Fixed Resistance and Electrode Industrial Process Heating Equipment)*

- **Resistance-type heating elements** in fixed industrial process heating equipment are now permitted to be **subdivided** into circuits **not exceeding 120 amperes** and protected at **not more than 150 amperes** under certain conditions
- One of the following conditions for the elements must be met:
  - (1) integral with and enclosed within a process heating surface
  - (2) completely contained within enclosure, identified as suitable for this use
  - (3) contained within an ASME-rated and stamped vessel
- Previously were required to be protected at not more than **60 amperes**
- Equipment rated **more than 48 amperes** and employing such elements were previously required to have the heating elements **subdivided** with each subdivided load **not exceed 48 amperes**

425.22(B) Resistance Elements *(Fixed Resistance and Electrode Industrial Process Heating Equipment)* *(cont.)*

- **Resistance-type heating elements** in fixed industrial process heating equipment are now permitted to be **subdivided** into circuits **not exceeding 120 amperes** and protected at **not more than 150 amperes** under certain conditions *(cont.)*
- Revisions are consistent with **422.11(F)(2)**, which deals with **electric heating appliances** employing resistance-type heating elements rated **more than 48 amperes**
- Large industrial facilities frequently have heating applications for hundreds of kilowatts or even megawatts of heat power into their process at low voltages
- Previous restriction of **48 amperes maximum** for subdivided loads in the industrial applications simply was **not practical**
- Adding significantly to the end user's capital equipment, operating, and maintenance costs during project execution and the lifetime of the equipment

425.22(B) Resistance Elements for Fixed Industrial Process Heating Equipment

430.2 Electronically Protected Motor

- A new definition for **“Electronically Protected (as applied to motors)”** was added to 430.2
- Electronically protected motors are becoming more and more common in use as stand-alone motors
- Several *Code* references to “EP” or “electronically protected motors” was added throughout Article 430
- New 430.7(A)(16) allows electronic protection of motors marked **“Electronically Protected”** or **“E.P.”** to be suitable for overload protection
- These motors can be found in applications such as heating, ventilation and air-conditioning (HVAC), pool pumps, and refrigeration
- These EP motors have typically been evaluated by third party testing agencies and should post little impact to installers


WARNING
ELECTRICAL SHOCK HAZARD
NO USER SERVICABLE PARTS INSIDE.
SERVICE BY QUALIFIED PERSONNEL ONLY:
REMOVE POWER AND WAIT A MINIMUM 5
MINUTES BEFORE SERVICING OR REMOVING
CONTROL AND/OR MOTOR.
EMERSON
ST. LOUIS, MO. U.S.A.
VARIABLE SPEED
POOL PUMP MOTOR
U.S. PAT. 7705502. OTHER U.S. PATS. PENDING.
CAT. NO. EVSS3
MODEL M63PWBLE-121
HP 3.0 S.F. 1.15 RPM 1035-3450
VOLTS 230 HZ 60
SF AMPS 14.0 PH 1 DUTY CONT
MFG# K10C FRAME 56Y INS CLASS B
CODE A AMB C° 50
ELECTRONICALLY PROTECTED
MADE IN MEXICO
E255002
SUITABLE FOR FIELD WIRING
USE COPPER CONDUCTORS ONLY
CONNECTIONS
GREEN/VERDE SCREW
GROUND
LINE
LINE
MOTOR TO OPERATE
CCW ROTATION SHAFT END
BLE-121
WARNING: MOTOR MUST BE GROUNDED IN ACCORDANCE WITH LOCAL AND NATIONAL ELECTRIC CODES. COMPONENT COVER MUST BE IN PLACE BEFORE OPERATING TO PREVENT ELECTRICAL SHOCK OR INJURY
WARNING
ELECTRICAL SHOCK HAZARD
DISCONNECT POWER BEFORE SERVICING UNIT.
HAZARDOUS VOLTAGE MAY STILL BE PRESENT WHEN USER INTERFACE SCREEN IS NOT ILLUMINATED.
WAIT 5 MINUTES MINIMUM AFTER DISCONNECTING POWER BEFORE OPENING OR SERVICING MOTOR. MOTOR AND CONTROL TO BE SERVICED BY QUALIFIED PERSONNEL ONLY.
AFTER APPLYING POWER TO THE CONTROL/MOTOR, THERE WILL BE A 2-3 SECOND DELAY BEFORE MOTOR STARTS OR RESTARTS LOAD.
THIS MOTOR SPECIFICALLY DESIGNED FOR USE WITH A DEDICATED CONTROL AND POWER SUPPLY. DO NOT BYPASS CONTROL OR CONNECT MOTOR LEADS DIRECTLY TO AC LINE. AC LINE SHOULD ONLY BE CONNECTED TO L1 AND L2 TERMINALS INSIDE CONDUIT BOX OF CONTROL. MOUNT WITH MOTOR CONDUIT BOX UP ONLY.
KEEP FOREIGN OBJECTS AWAY FROM MOVING PARTS AND OPENINGS.

430.122(B) Output Conductors for Adjustable-Speed Drive Systems

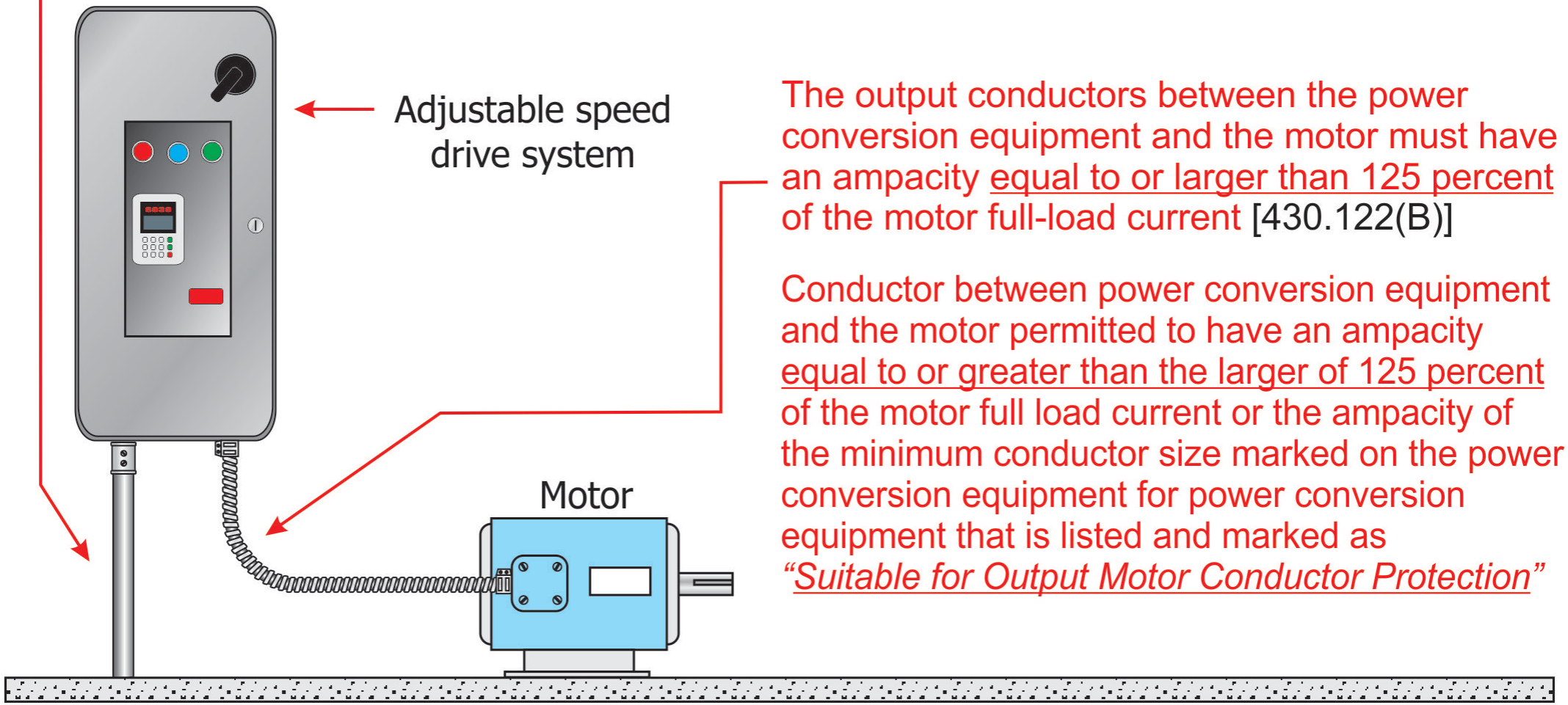
- New provisions added requiring **output conductors** between power conversion equipment and a motor to generally have an ampacity **equal to or larger than 125 percent** of the motor full-load current *(with one exception)*
- **Supply conductors** supplying power conversion equipment included as part of an adjustable-speed drive system are required to have an ampacity **not less than 125 percent** of the rated input current to the power conversion equipment
- New exception to 430.122(B) allows the conductor between the power conversion equipment and the motor to have an ampacity **equal to or greater than the larger of 125 percent** of the motor full load current as determined by 430.6(A) or (B) ***or*** the ampacity of the minimum conductor size marked on the power conversion equipment for power conversion equipment that is listed and marked as "**Suitable for Output Motor Conductor Protection**"

430.122(B) Output Conductors for Adjustable-Speed Drive Systems *(cont.)*

- Modern motor drive technology is capable of providing output conductor short-circuit and ground-fault protection
- New 430.122(B) permits the use of such a drive and separates the output conductor sizing **[430.122(B)]** from the branch-circuit short-circuit ground-fault protective device sizing **[430.122(A)]**
- Same basic change occurred at **430.130(A)(1)** where a new exception was added at this provision pertaining to branch-circuit short-circuit and ground-fault protection for single motor circuits containing power conversion equipment

430.122(B) Output Conductors-Adjustable-Speed Drive Systems

Branch circuit or feeder conductors supplying power conversion equipment included as part of an adjustable-speed drive system shall have an ampacity not less than 125 percent of the rated input current to the power conversion equipment [430.122(A)]



The output conductors between the power conversion equipment and the motor must have an ampacity equal to or larger than 125 percent of the motor full-load current [430.122(B)]

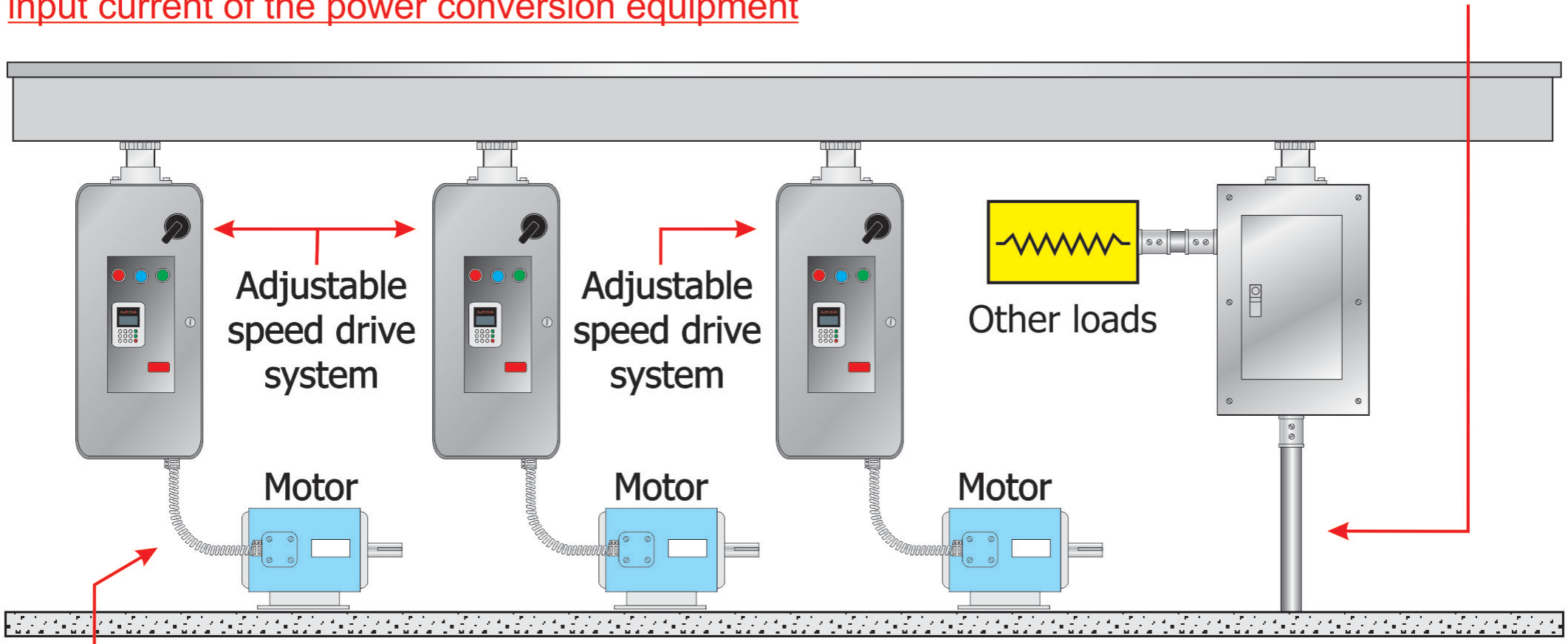
Conductor between power conversion equipment and the motor permitted to have an ampacity equal to or greater than the larger of 125 percent of the motor full load current or the ampacity of the minimum conductor size marked on the power conversion equipment for power conversion equipment that is listed and marked as *"Suitable for Output Motor Conductor Protection"*

430.122(D) Several Motors or a Motor and Other Loads

- New requirement clarifies sizing of conductors for **several motors or motor(s) and other load(s)** that include **adjustable-speed drive systems** and **power conversion equipment** needs to be based on the **rated input current** to the power conversion equipment in the calculations *(not HP rating of the motor on the output of the power conversion equipment)*
- Requirements for sizing motor circuit conductors for several motors or motor(s) and other load(s) are still found at 430.24
- Sizing of motor circuit conductors for several motors or motor(s) and other load(s) involving **adjustable-speed drive systems** and **power conversion equipment** is now addressed at new **430.122(D)**
- This material is appropriately located at **430.122**, which covers conductor sizing for adjustable-speed drive systems and power conversion equipment

430.122(D) Several Motors or Motor(s) and Other Load(s)-Adjustable-Speed Drive Systems With Power Conversion Equipment

Conductors supplying several motors or motor(s) and other load(s), including power conversion equipment, required to have calculated ampacity in accordance with 430.24, using the rated input current of the power conversion equipment



Output conductors between power conversion equipment and the motor must have an ampacity equal to or larger than 125 percent of the motor full-load current (w/ exception) [430.122(B)]


CHILLED WATER RETURN
CONDENSER WATER
ABB
WARNING
WARNING
WARNING
WARNING

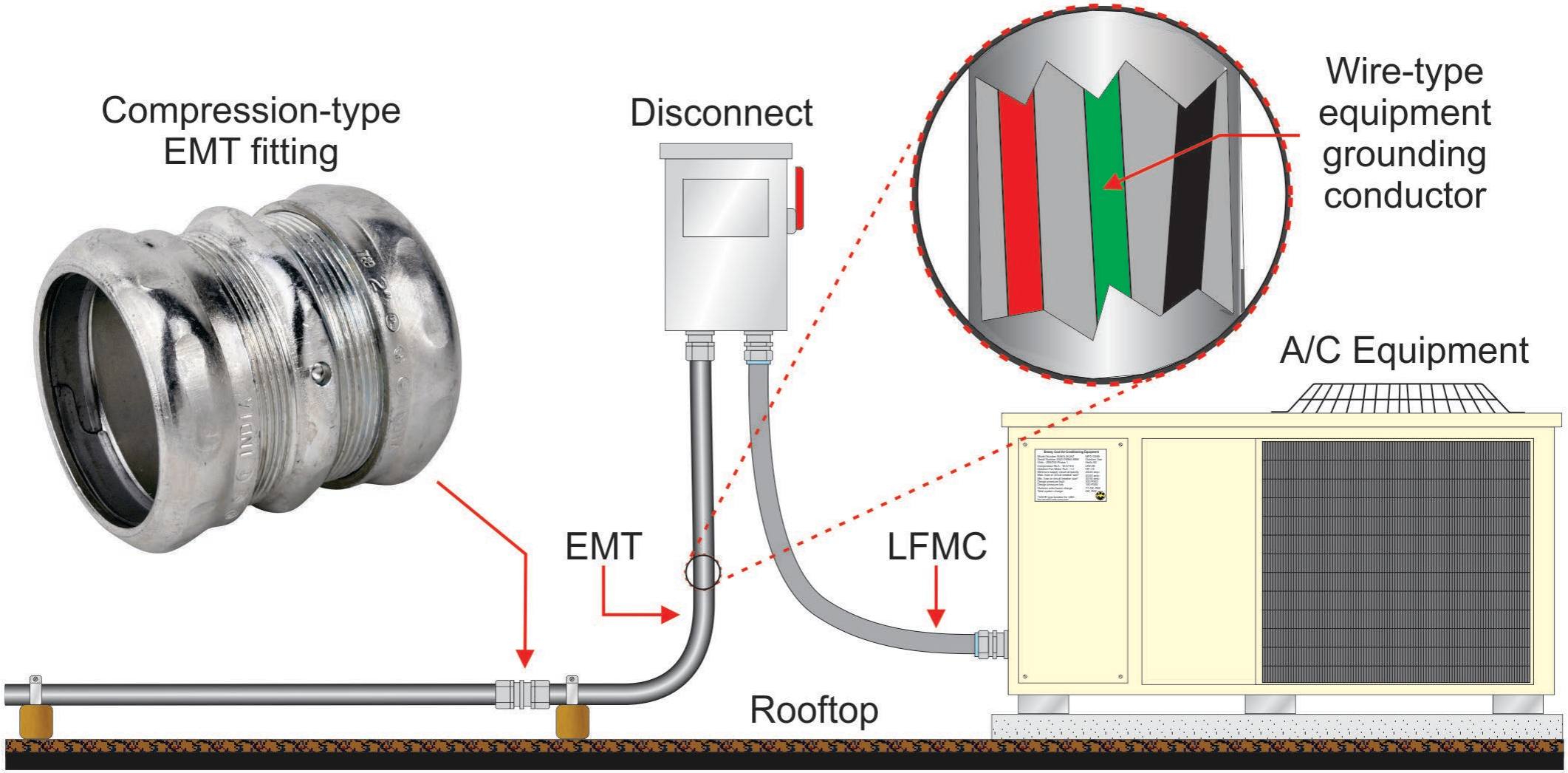
440.9 Grounding and Bonding – Rooftop HACR Equipment

- Outdoor metallic raceway systems that use "**compression-type fittings**" required to contain a **wire-type equipment grounding conductor (EGC)** when installed outdoors on a roof to supply heating, air-conditioning, and refrigeration (HACR) equipment
- Previously, outdoor portions of metallic raceway systems that use **non-threaded fittings** were required to contain a wire-type EGC when installed outdoors on a roof to supply multimotor and combination-load equipment
- 2017 *NEC* rule was intended to **not apply** to metallic raceway systems that utilize **threaded connections** at couplings and conduits, such as **RMC** and **IMC** as these fittings are unlikely to separate even under slight abuse or movement
- Intended for metallic wiring systems such as **electrical metallic tubing (EMT)** that utilize "**non-threaded fittings**"

440.9 Grounding and Bonding – Rooftop HACR Equipment *(cont.)*

- Outdoor metallic raceway systems that use "**compression-type fittings**" required to contain a **wire-type equipment grounding conductor (EGC)** when installed outdoors on a roof to supply heating, air-conditioning, and refrigeration (HACR) equipment *(cont.)*
- Problems arose as EMT compression-type fitting has threads *(not the type of threads that CMP-11 was referring to at 440.9)*, but threads none the less
- More appropriate term was needed here
- For the 2020 *NEC*, the term "**non-threaded fittings**" was replaced with "**compression-type fittings**" to give a **more appropriate description** of the type of fitting that is being targeted at 440.9 for a companion wire-type EGC to be installed in outdoor portions of metallic raceway systems

440.9 Grounding and Bonding-Rooftop HACR Equipment

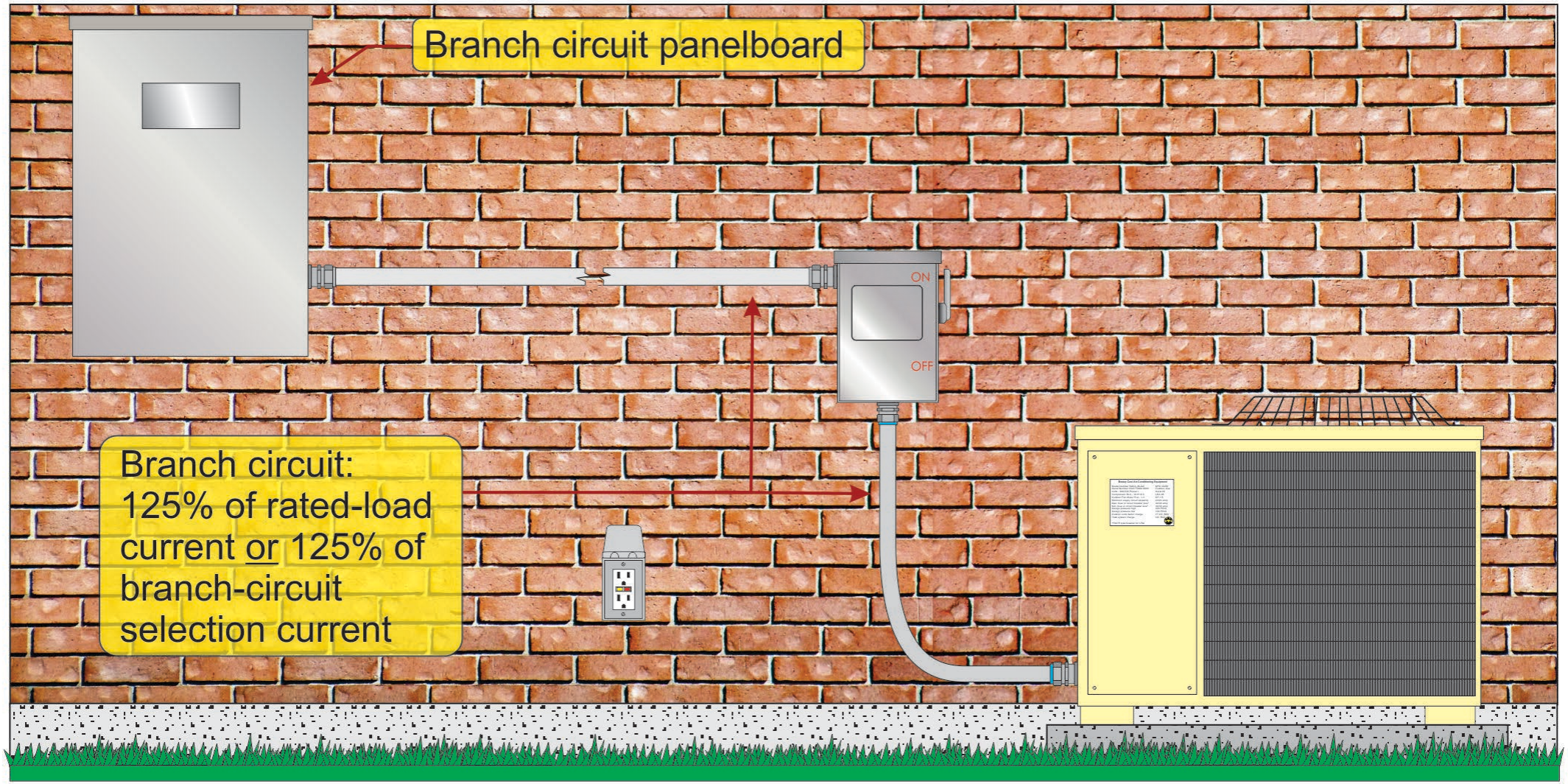


Where ~~multimotor and combination-load~~ equipment is installed outdoors on a roof, a wire type equipment grounding conductor is required to be installed in outdoor portions of metallic raceway systems that utilize ~~non-threaded~~ compression-type fittings

440.32 Single Motor-Compressor – Minimum Circuit Ampacity

- Revision clarifies that **125 percent** is to be applied to ***either*** the branch-circuit selection current ***or*** the rated load current, **whichever is greater** for the branch-circuit conductors supplying a single motor-compressor
- Incorrect assumption to assume that the 125 percent for sizing of the branch-circuit conductors supplying a single motor-compressor was only to apply to the full load compressor rated current and not the branch-circuit selection current
- Section was reformatted into a **list format** to help with the clarity
- This is a **clarification more than a revision** as this has been true since the **1971 *NEC*** when Article 440 *(Air-Conditioning and Refrigerating Equipment)* became part of the *NEC*

440.32 Single Motor-Compressor - Minimum Circuit Ampacity



Branch-circuit conductors supplying a single motor-compressor to have an ampacity not less than the greater of 125 percent of the motor-compressor rated-load current ***or*** 125 percent of the branch-circuit selection current

440.32 Single Motor-Compressor - Minimum Circuit Ampacity

Breezy Cool Air-Conditioning Equipment

Model Number RAKA-36JAZ	MFD 03/99
Serial Number 5340 F0994 8995	Outdoor Use
Volts - 208/230 Phase 1	Hertz 60
Compressor RLA - 18.0/18.0	LRA 96
Outdoor Fan Motor FLA - 1.3	HP 1/5
Minimum supply circuit ampacity	24/24 amp
Max. fuse or circuit breaker size*	40/40 amp
Min. fuse or circuit breaker size*	30/30 amp
Design pressure high	300 PSIG
Design pressure low	150 PSIG
Outdoor units factor charge	77 OZ. R22
Total system charge	OZ. R22

*HACR type breaker for USA

See instructions inside access panel

Listed by ABC Labs

Minimum Supply Circuit Ampacity - 18 A X 1.25 = 22.5 A + 1.3 A = 23.8 Amperes

445.6 Listing (Generators)

- New provisions added to require **stationary generators** of 600 volts and less to be **listed**
- Exception for **one-of-a-kind** or **custom manufactured generators** permitted to be field labeled by a field evaluation body
- Intentional efforts have been instituted for the last few *Code* cycles to put into place **listing requirements** for specific equipment, wiring methods, etc. throughout the *NEC*
- Addition of listing requirements for stationary generators will address **safety concerns** for both the electric and fuel control for stationary generators that are rated 600 volts and below
- The *International Building Code* requires all emergency and legally required standby generators to be listed

445.6 Listing Requirements for Stationary Generators

445.18(D) Emergency Shutdown at One- and Two-Family Dwelling Units

- New requirements added to require a readily accessible **outdoor emergency generator shutdown device** for generators *(other than cord-and-plug-connected generators)* installed at one- and two-family dwelling units
- This new requirement primarily based upon providing **first responders** an outdoor emergency generator shutdown device in an **emergency situation** such as a fire, gas leak, structural damage, or flooding
- Very challenging when the emergency generator shutdown device was installed in an **indoor location** of a dwelling unit area such as a basement
- New requirement will further enhance the safety of emergency responders
- New requirement for an outdoor emergency generator shutdown device is a **companion requirement** for an **emergency disconnecting means** for a one- or two-family dwelling be installed and located on the outside of the structure (see 230.85)

445.18(D) Emergency Shutdown Device at Dwelling Units

Can be *(but not required to be)* this

An outdoor emergency generator shutdown device is required for generators installed at one- and two-family dwelling units *(other than cord-and-plug-connected generators)*

450.9 Horizontal Transformer Top Prohibited as Storage

- New sentence added to **prohibit** horizontal top surfaces of transformers from being used as a **storage area**
- A **marking requirement** was added prohibiting such actions
- The top of a floor-mounted transformer seems to be a **“catch-all” storage shelf** and a convenient spot to store janitor supplies, rags, replacement parts, tools, etc. commonly found to electrical equipment rooms or closets
- Transformers are not designed, intended, identified, or listed for that type of an application
- Common problem encountered by both fire and electrical inspectors
- This new *Code* language will assist the enforcement community in requiring the tops of these transformers be kept clear of stored items and debris

450.9 Horizontal Transformer Tops Prohibited as Storage

Horizontal top surfaces of transformers are prohibited from being used as a storage area and a marking requirement was added prohibiting such actions

480.7(G) Identification of Power Sources (Storage Batteries)

- New requirements were added for **directory** and **identification of power sources** for storage batteries
- A disconnecting means is required to be provided for all ungrounded conductors derived from a stationary battery system with a **voltage over 60 volts dc**, installed readily accessible and located within sight of the battery system
- Similar to directories and identification of power sources required for such systems as **interconnected electric power production sources** *[see 705.10]*, **stand-alone systems** *[see 710.10]*, and **direct current microgrids** *[see 712.10]*
- These new directory provisions will address ongoing concerns expressed by fire service personnel and other **first responders**

480.7(G) Identification of Power Sources

CAUTION: MULTIPLE SOURCES OF POWER

BATTERY STORAGE DISCONNECT LOCATED AT NE CORNER OF BUILDING

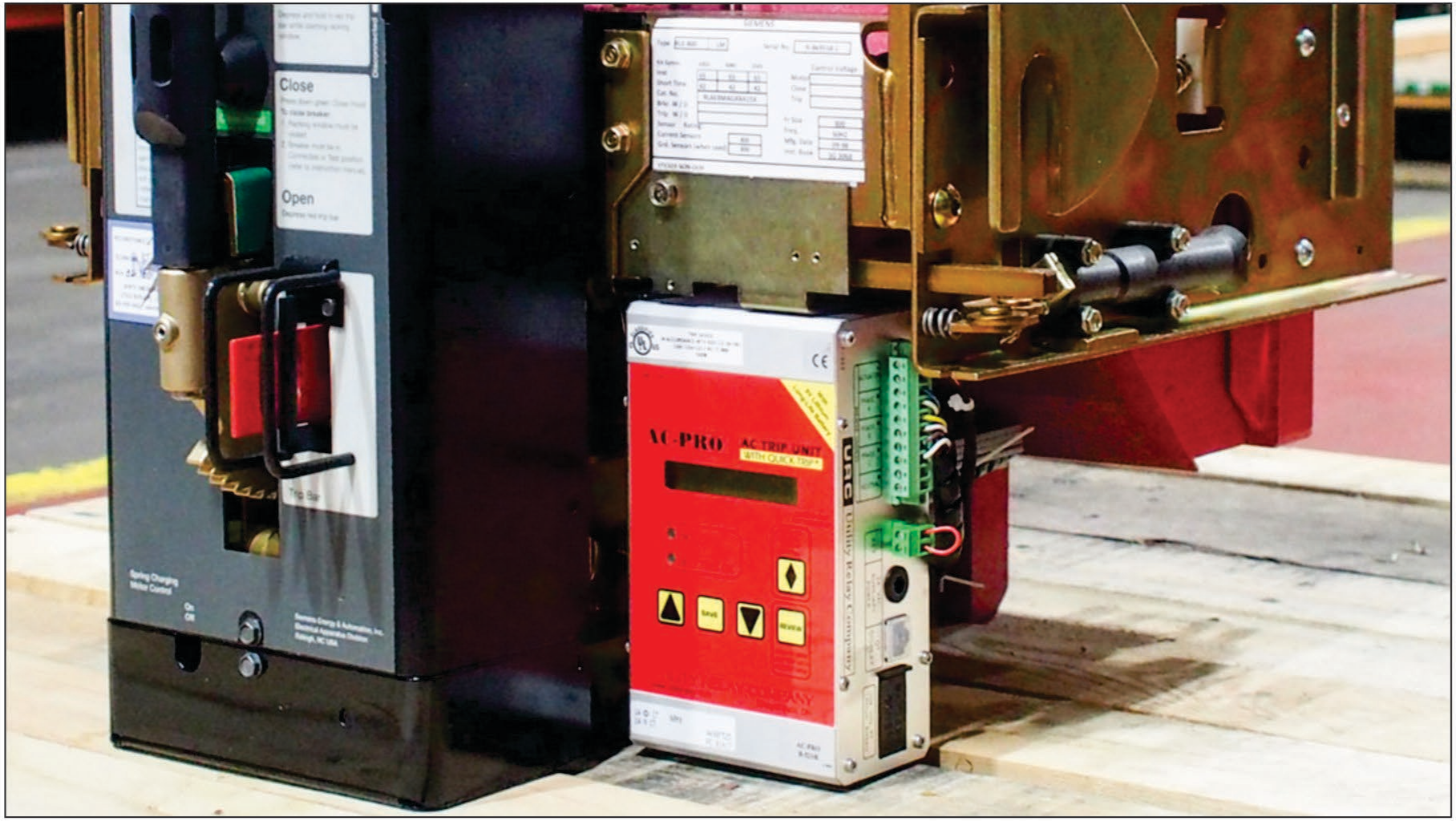
Facilities with utility services and battery systems required to display plaques or directories in accordance with 705.10 *(Interconnected Electric Power Production Sources)* and 712.10 *(Direct Current Microgrids)*

Facilities with stand-alone systems require a permanent plaque or directory to be installed in accordance with 710.10 *(Stand-Alone Systems)*

490.21(A)(5) Retrofit Trip Units - Interrupting Devices for *Equipment Over 1000 Volts, Nominal*

- **Retrofit trip units** are now required to be **listed for use** with the specific circuit breaker with which it is installed
- For circuit breakers and equipment rated over 1000 volts, nominal, retrofit trip units have become more commonplace over the past decade
- Retrofit trip units are designed to replace conventional electromechanical series overload trip devices, thermal magnetic overcurrent releases, and older style electronic trip devices to provide **greater accuracy, reliability, and functionality**
- Provides **life extension** of older circuit breakers at a fraction of the cost of a new circuit breaker without modifying the switchboard, switchgear, etc.
- Retrofit trip units are typically listed and evaluated for one manufacturer's particular circuit breaker

490.21(A)(5) Retrofit Trip Units
Circuit Breakers for Equipment Over 1000 Volts, Nominal



Retrofit trip units required to be listed for use with the specific circuit breaker with which they are installed

Analysis of Changes – 2020 *NEC*

Part 2 – NEC Chapters 5 through 9

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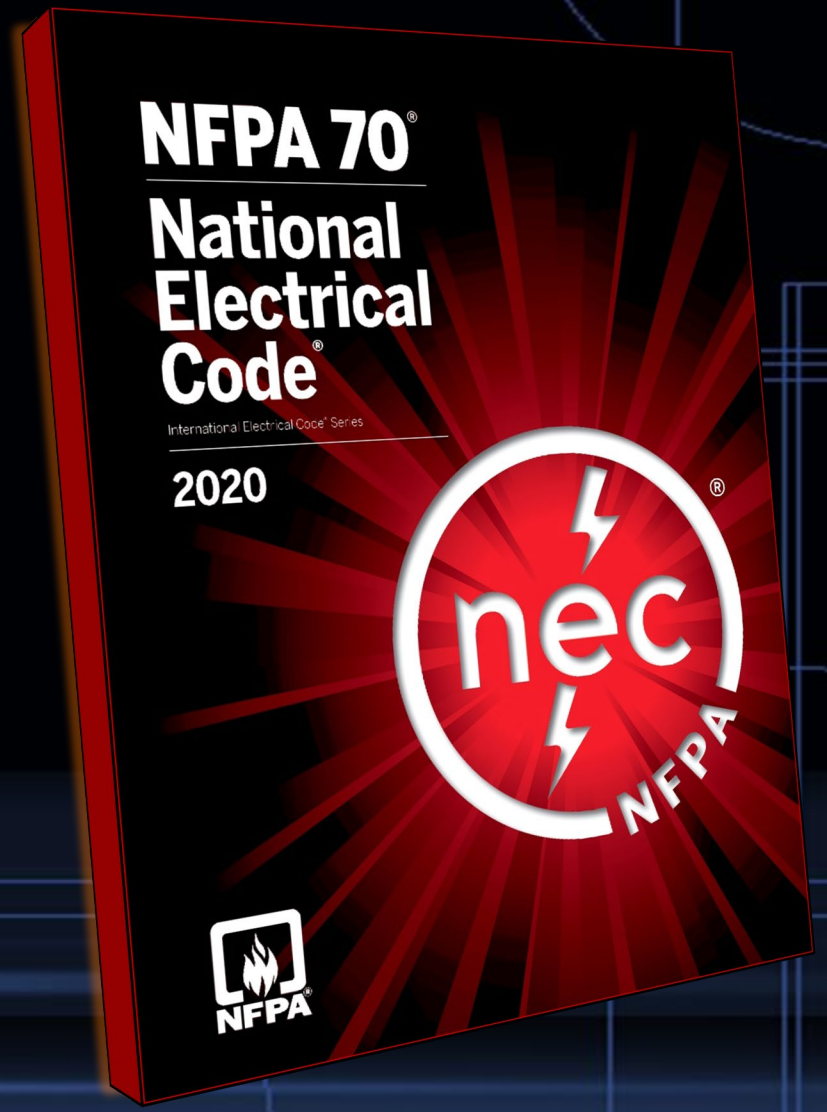
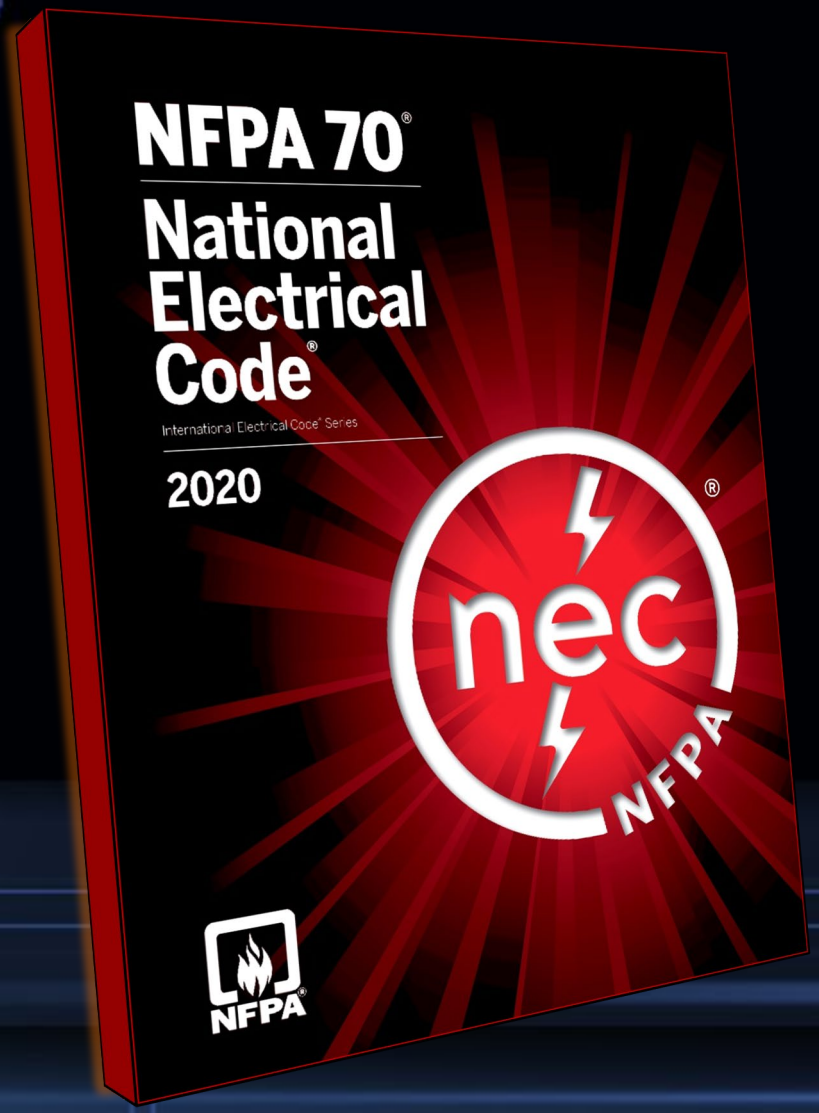
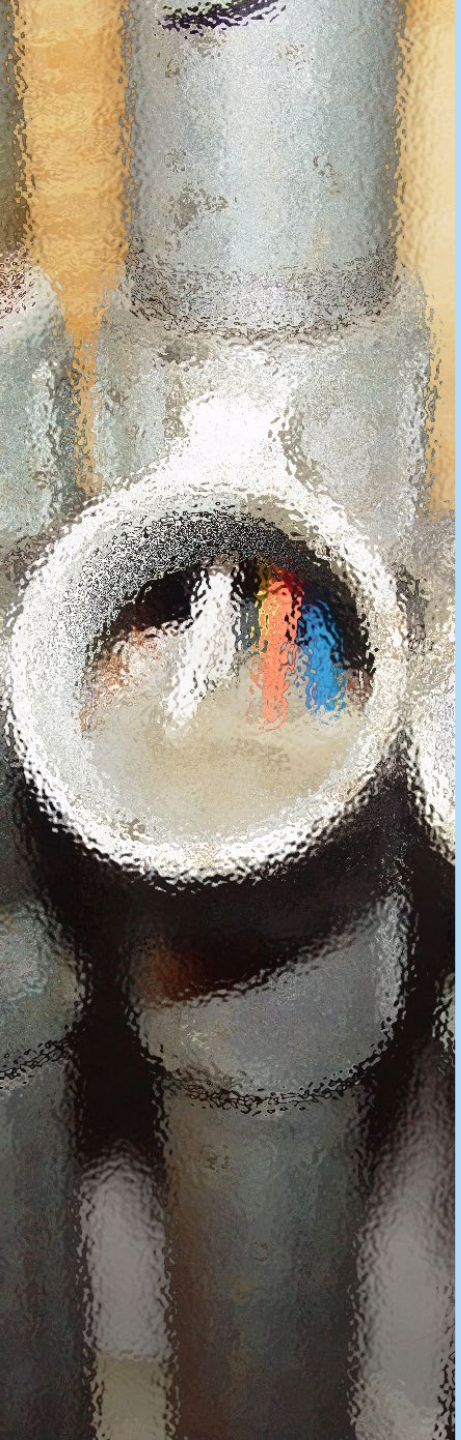


Analysis of Change-2020 *NEC*





Chapter Five
Special Occupancies

500.7(K) Combustible Gas Detection System

- The requirements for a **combustible gas detection system** as a **protection technique** was **sufficiently revised and expanded** to provide more specific detail for the installation and operation of a gas detection system
- Previous text at 500.7(K) did not provide specific requirements and the enforcement community would often encounter enforcement concerns
- At **500.7(K)(1)** for "**General**" requirements, information was relocated to this list item calling for the gas detection equipment used to be listed for Class I, Division 1 and listed for the detection of the specific gas or vapor to be encountered
- Under the heading of "**Inadequate Ventilation**," **500.7(K)(2)** was revised to permit a location, enclosed space, or building that is classified as a Class I, Division 1 location due to inadequate ventilation to utilize electrical equipment, installation methods, and wiring practices suitable for Class I, Division 2 installations as long as the space is provided with a combustible gas detection system

500.7(K) Combustible Gas Detection System *(cont.)*

- Revisions also occurred at **500.7(K)(3)** titled "**Interior of a Building or Enclosed Space**," which addresses any building or enclosed space that does not contain a source of flammable gas or vapors that is located in, or with an opening into, a Class I, Division 2 hazardous (classified) location that is provided with a combustible gas detection system

- **500.7(K)(4)** titled "**Interior of a Control Panel**" now states that inside the interior of a control panel containing instrumentation or other equipment utilizing or measuring flammable liquids, gases, or vapors, electrical equipment, installation methods, and wiring practices suitable for Class I, Division 2 installations are permitted when protected by combustible gas detection equipment

- Same change occurred at **505.8(I)** for **Zone 0, 1, and 2 locations**

500.7(K) Combustible Gas Detection System

These requirements surrounding a combustible gas detection system as a protection technique were appropriately revised and expanded to provide more sufficient detail to install and operate a gas detection system

500.7 Protections Techniques for Hazardous (Classified) Locations

- Four new **protection techniques** were added for protection of electrical and electronic equipment in hazardous (classified) locations
- The requirements of 500.7 now contained **(16) protection techniques** for electrical and electronic equipment in hazardous (classified) locations
- New protection techniques include:
  - 500.7(L) Inherently Safe Optical Radiation “op is”
  - 500.7(M) Protected Optical Radiation “op pr”
  - 500.7(N) Optical System With Interlock “op sh”
  - 500.7(O) Protection by Skin Effect Trace Heating “IEEE 844.1”

500.7 Protections Techniques for Hazardous (Classified) Locations *(cont.)*

- Four new **protection techniques** were added for protection of electrical and electronic equipment in hazardous (classified) locations *(cont.)*
- Three of these new protection techniques involves **optical radiation**
- **Optical radiation** is absorbed by surfaces or particles, causing them to heat up, and under certain circumstances this may allow them to attain a temperature which will ignite a surrounding explosive atmosphere
- These types of protection for **optical radiation** have been added based on UL Product Standard **UL 60079-28** *(Standard for Explosive Atmospheres - Part 28: Protection of Equipment and Transmission Systems Using Optical Radiation)*

500.7 Protections Techniques for Hazardous (Classified) Locations *(cont.)*

- Four new **protection techniques** were added for protection of electrical and electronic equipment in hazardous (classified) locations *(cont.)*
- The fourth new protection technique added at 500.7(O) pertains to protection by **skin effect trace heating**
- Skin effect heating is used specifically for providing indirect heat to longer runs of piping from a single electrical supply source
- Same **optical radiation protection techniques** were added at 505.9(G) for Zone 0, 1, and 2 locations and 506.9(G) for Zone 20, 21, and 22 locations
- Same **skin effect trace heating protection techniques** were added at 505.8(N) for Zone 1 or Zone 2 Locations and at 506.8(N) for Zone 21 or Zone 22 Locations

500.7 Protections Techniques for Hazardous (Classified) Locations

Technique	Location
(A) Explosionproof Apparatus	Class I, Division 1 or 2 locations
(B) Dust Ignitionprooff	Class II, Division 1 or 2 locations
(C) Dusttight	Class II, Div 2 or Class III Div 1 or 2 locations
(D) Purged and Pressurized	Any classified location for which it is identified
(E) Intrinsic Safety	Class I, II, or III, Division 1 or 2 locations
(F) Nonincendive Circuit	Class I or II, Div 2 or Class III, Div 1 or 2 locations
(G) Nonincendive Equipment	Class I or II, Div 2 or Class III, Div 1 or 2 locations
(H) Nonincendive Component	Class I or II, Div 2 or Class III, Div 1 or 2 locations
(I) Oil Immersion	Class I, Division 2
(J) Hermetically Sealed	Class I or II, Div 2 or Class III, Div 1 or 2 locations
(K) Combustible Gas Detection System	Class I, Division 1 or 2 *(industrial restricted)*
(L) Inherently Safe Optical Radiation	Class I or II, Division 1 or 2 locations
(M) Protected Optical Radiation	Class I or II, Division 2 locations
(N) Optical System With Interlock	Class I or II, Division 1 or 2 locations
(O) Protection by Skin Effect Trace Heating	Class I, II, or III, Division 2 *(for which it is listed)*
(P) Other Protection Techniques	Other protection techniques *(identified for use)*

501.10(A)(1) Wiring Methods – Class I, Division 1 Locations

- **Type TC-ER-HL cable** and **Type P cable** were added as two new wiring methods for Class I, Division 1 locations
- Wiring methods in a Class I, Division 1 location are now open to **(7) types** of wiring methods
- **Type TC-ER-HL cable** permitted where not subject to physical damage and terminated with fittings listed for the location
- **Type P cable** permitted with metal braid armor, with an overall jacket, terminated with fittings listed for the location
- Both Type TC-ER-HL cable and Type P cable are limited to **industrial establishments with restricted public access**, where the conditions of maintenance and supervision ensure that only qualified persons service the installation

501.10(A)(1) Wiring Methods – Class I, Division 1 Locations *(cont.)*

- **Type TC-ER-HL cable** and **Type P cable** were added as two new wiring methods for Class I, Division 1 locations *(cont.)*
- These wiring methods will allow new and innovative designs and materials technologies to be employed in these hazardous (classified) location applications, providing new solutions to existing, long standing, hazardous conditions
- Same wiring methods were accepted as identified wiring methods for a Class I, Division 2 location at 502.10(A)(1)(6) and (7); for a Class II, Division 1 location at 502.10(A)(2)(7) and (8); and for a Class II, Division 2 location at 502.10(B)(1)(1)
- Type TC-ER-HL cable and Type P cable were also recognized as identified wiring methods for Zone 1 and 2 locations at 505.15(B)(1), 505.15(C)(2), and 505.15(B)(2)

501.10(A)(1) Wiring Methods - Class I, Division 1 Locations

Two additional wiring methods have been incorporated into 501.10(A)(1) as acceptable wiring methods in Class I, Division 1 locations

Type TC-ER-HL cable where not subject to physical damage and terminated with fittings listed for the location

Type P cable with metal braid armor, with an overall jacket, terminated with fittings listed for the location

Both limited to industrial establishments with restricted public access, where the conditions of maintenance and supervision ensure that only qualified persons service the installation

Table 505.9(C)(2)(4) Equipment Suitability

- Table 505.9(C)(2)(4) Types of Protection Designation was replaced with an updated applicability table and is now **Table 505.9(C)(2)(4) Equipment Suitability**
- The headings are now (L to R), “Type of Protection,” “Marking,” and “Permitted Location”
- Equipment Protection Levels (EPL) were added to align with the introduction of this concept in the UL 60079 product standards
- EPL is rigidly aligned with the Zone and the varying of this relationship based on a risk assessment per the International Electrotechnical Commission (IEC) reference standard IEC 60079-14 is NOT included
- Same change occurred at **Table 506.9(C)(2)(3)** for Zone 20, 21, and 22 Locations

Table 505.9(C)(2)(4) Equipment Suitability *(in Part)*

Type of Protection	Marking	Permitted Location
Associated Apparatus for Zone 0	[ia]	Unclassified[1]
Associated Apparatus for Zone 1	[ib]	Unclassified[1]
Associated Apparatus for Zone 2	[ic]	Unclassified[1]
Associated Pressurization Equipment	[p]	Unclassified[1]
Equipment Suitable for Use in Zone 0		
Equipment Suitable for Use in Class I, Division 1		
Flameproof Enclosure	d; db	
Intrinsic Safety	ib	
Increased Safety	e; eb	
Pressurized Enclosure	p; px, pxb, py, pyb	
Encapsulation	m; mb	
Powder Filling	q; qb	Zone 1
Liquid Immersion	o, ob	
Electrical Resistance Trace Heating	60079-30-1, *with EPL Gb*[2]	
Skin Effect Trace Heating	IEEE 844.1, *with EPL Gb*[2]	
Optical Radiation, Inherently Safe	op is, *with EPL Gb*[2]	
Optical Radiation, with Interlock	op sh, *with EPL Gb*[2]	
Optical Radiation, Protected	op pr, *with EPL Gb*[2]	
EPL Gb, *with Suitable Type of Protection*[3]		

511.12 GFCI Protection at Commercial Garages, Repair and Storage

- Revision to 511.12 now points and aligns GFCI requirements for commercial garages to GFCI requirements of **210.8(B)**
- 210.8(B)(8) calls for ***all*** 125-volt, single-phase, 15- and 20-ampere receptacles installed in garages, service bays, and similar areas (*other than vehicle exhibition halls and showrooms)* to have GFCI protection for personnel *(not just those receptacles where electrical diagnostic equipment, electrical hand tools, or portable lighting equipment are to be used)*
- Previous 511.12 required all 125-volt, single-phase, 15- and 20-ampere receptacles installed in **areas where electrical diagnostic equipment, electrical hand tools, or portable lighting equipment** are to be used to shall have GFCI protection for personnel

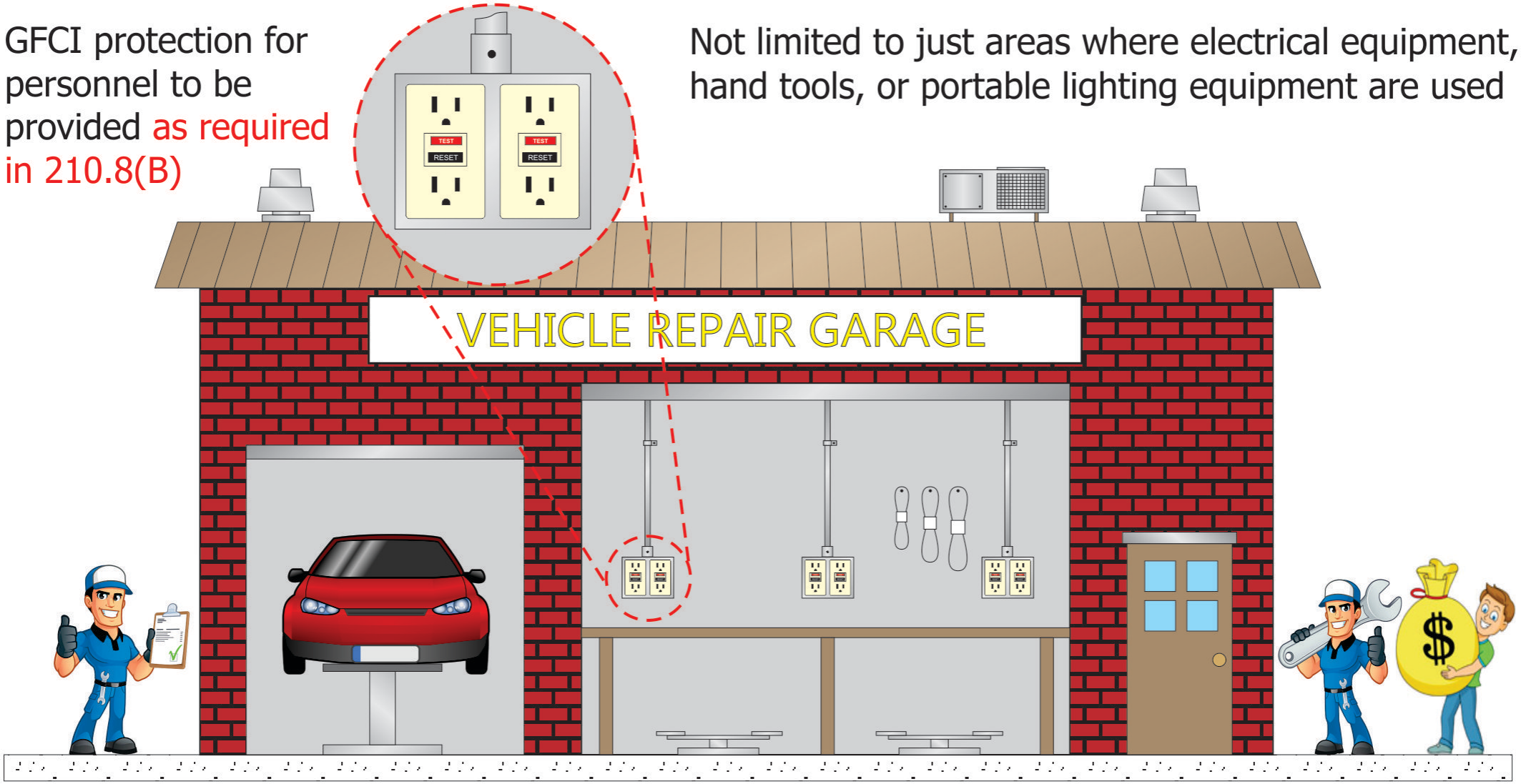
511.12 GFCI Protection at Commercial Garages, Repair and Storage *(cont.)*

- Revision to 511.12 now points and aligns GFCI requirements for commercial garages to GFCI requirements of **210.8(B)** *(cont.)*
- By simply pointing 511.12 back to 210.8(B), these two sections will be in alignment
- Same alignment of GFCI protection for ***all*** 125-volt, single-phase, 15- and 20-ampere receptacles for aircraft hangers occurred at **513.12** with a reference to 210.8(B)(8)

511.12 GFCI Protection at Commercial Repair and Storage Garages

GFCI protection for personnel to be provided as required in 210.8(B)

Not limited to just areas where electrical equipment, hand tools, or portable lighting equipment are used



GFCI protection for personnel required for ***ALL*** 125-volt, single-phase, 15- and 20-ampere receptacles installed in non-dwelling unit garages, service bays, and similar areas *(other than vehicle exhibition halls and showrooms)*


INTERNATIONAL ASSOCIATION
ELECTRICAL INSPECTORS

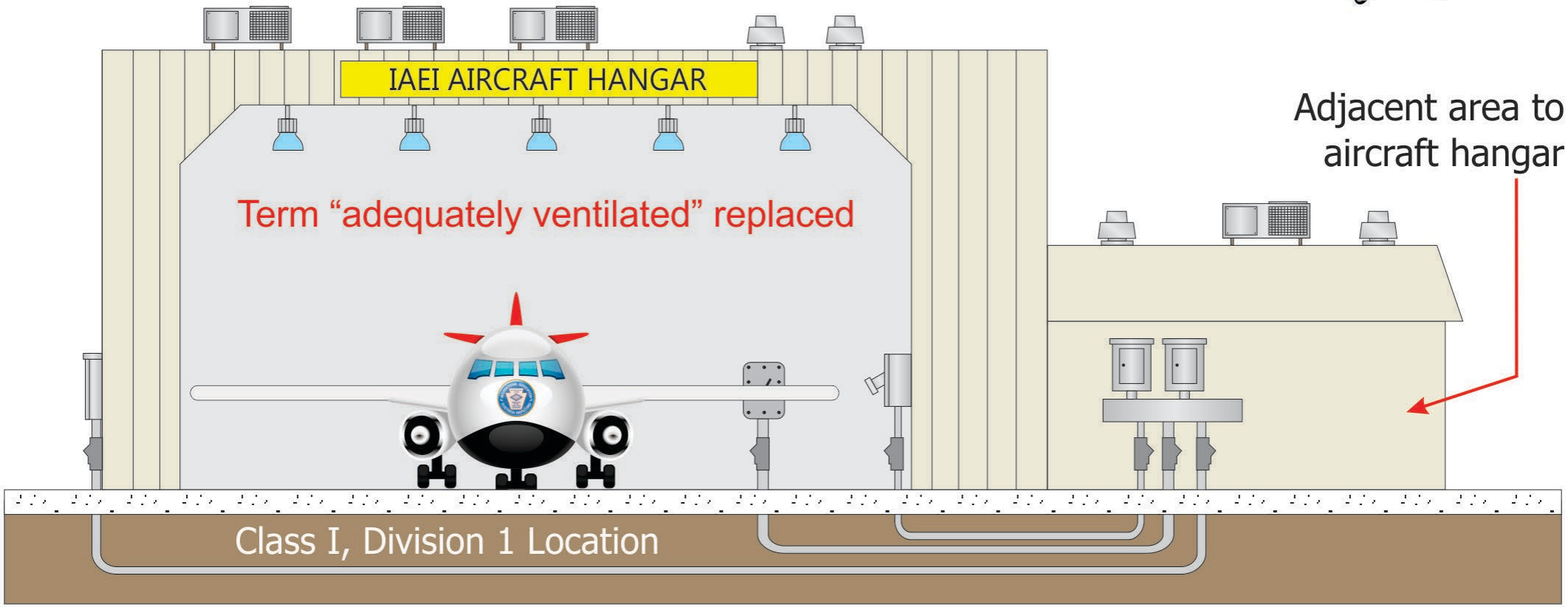
513.3(D) Areas Suitably Cut Off and Ventilated

- Revision clarifies what "**adequately ventilated**" means for an adjacent area of an aircraft hangar by replacing "adequately ventilated" with "**mechanically ventilated at a rate of four or more air changes per hour**"
- Previous language stated that "adjacent areas" in which flammable liquids or vapors are not likely to be released were permitted to be considered unclassified where the space was "adequately ventilated" *and* where effectively cut off from the hangar itself by walls or partitions
- Adjacent areas could include areas such as stock rooms, electrical control rooms, and other similar locations
- New *Code* language for **513.3(D)** was crafted and inspired by the existing *Code* language at **511.3(E)(1)** for adjacent areas at a commercial repair garage

513.3(D) Areas Suitably Cut Off and Ventilated

Adjacent areas of an aircraft hangar in which flammable liquids or vapors were not likely to be released *(such as stock rooms, electrical control rooms, and other similar locations)* permitted to be considered unclassified where any of the following occur:

- Mechanically ventilated at a rate of four or more air changes per hour ***or***
- Designed with positive air pressure ***or***
- Where effectively cut off from the hangar itself by walls or partitions

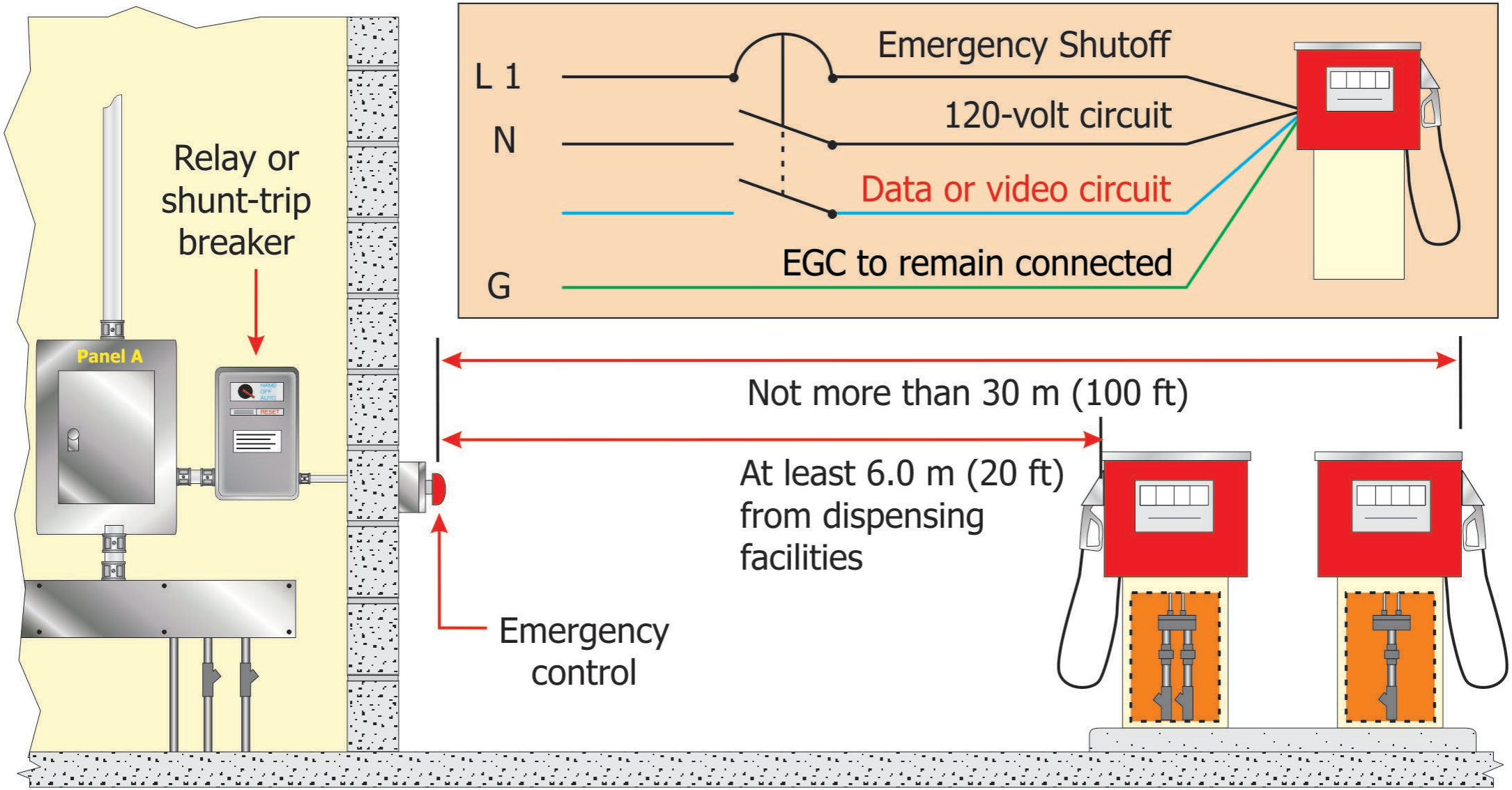


514.11(A) Emergency Electrical Disconnects for Motor Fuel Dispensing Facilities

- Revisions also make it clear that the **equipment grounding conductors (EGC)** should not be disconnected by the emergency disconnect
- **Grounded conductor** should be disconnected simultaneously with the all the other conductors when the emergency disconnect is activated
- Previously, some jurisdictions were requiring the EGC to be included as one of the required conductors that needed to be disconnected in order to fulfil the requirement of 514.11(A)
- New *Code* language added after NFPA 30A extracted text to say that the "**equipment grounding conductors shall remain connected**"
- Additional *Code* language will provide AHJ the clear *Code* language needed to enforce this emergency disconnect rule and allow installers to comply with this requirement

514.11(A) Emergency Controls for Fuel Dispensers

Emergency shutoff device shall disconnect simultaneously from the source of supply, all conductors of the circuits, including the grounded conductor *(EGCs to remain connected)*



517.10(B) Applicability (Health Care Facilities)

- New areas **not covered** by the wiring and protection methods of **Part II of Article 517** *[Intramuscular injections (immunizations), etc.]* have been added to 517.10(B)
- Areas used exclusively for intramuscular injections (immunizations), psychiatry and psychotherapy, alternative medicine, and optometry are areas **not applicable** to Part II of Article 517
- Part II of Article 517 means that the wiring methods in a **patient care space** must consist of a **metal raceway system** or a cable having a metallic armor or sheath assembly that qualifies as an as an EGC in accordance with 250.118 [517.13(A)] ***and*** an have **insulated copper EGC** installed with the metallic raceway [517.13(B)] *(sometimes referred to as a "redundant" grounding)*
- Shock hazards are greatly reduced with **no invasive procedures** performed and **no electro-medical equipment** connected to the body or patient

517.10(B) Not Covered - Wiring and Protection - Health Care Facilities

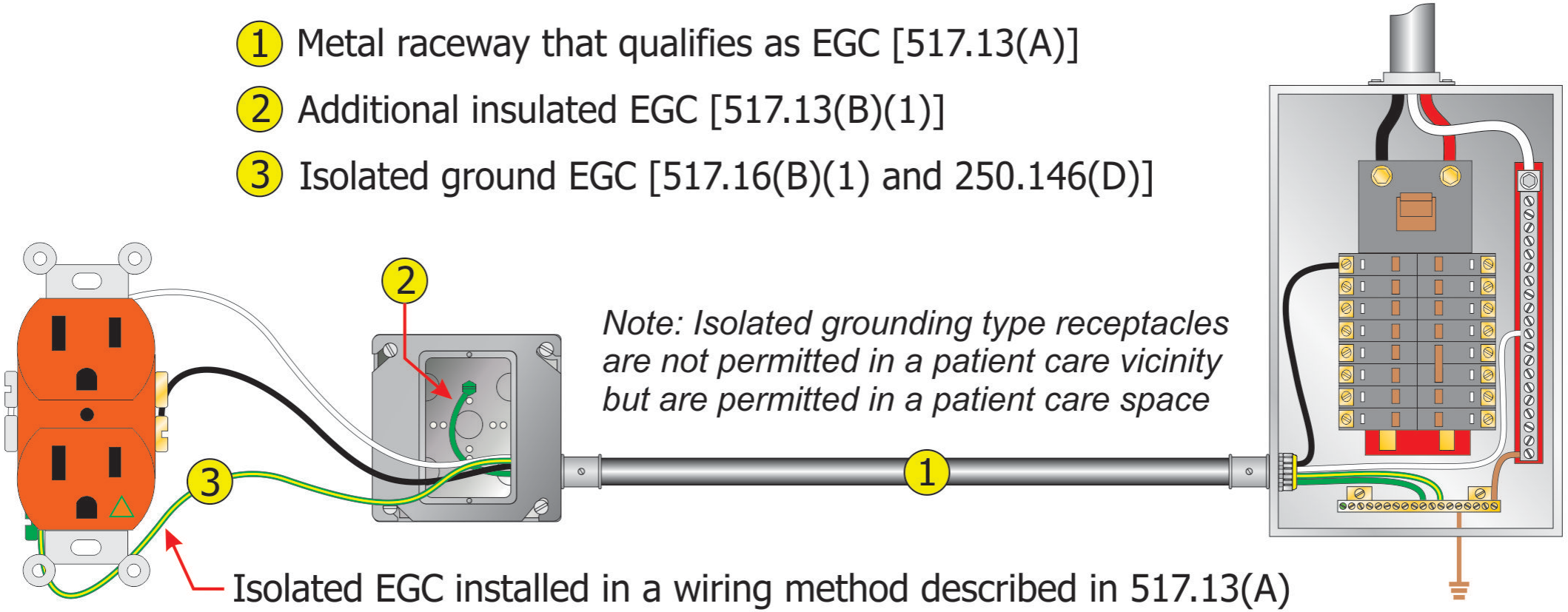
517.16 Use of Isolated Ground Receptacles for Health Care Facilities

- Further revision to 517.16 provides better explanation of use of **isolated receptacles outside the patent care vicinity**
- Where installed, an isolated ground receptacle **cannot eliminate** the **two equipment grounding paths** required by 517.13
- **517.16(B)(1)** revised for clarity to state that the equipment grounding terminals of isolated ground receptacles installed in a patient care space shall be connected to an isolated EGC ***AND*** this isolated EGC must be "**installed in a wiring method described in 517.13(A)**"
- Both grounding methods required in **517.13(A)** *(metal wiring method)* and **517.13(B)** *(wire-type insulated EGC)* must be present in wiring methods used for isolated grounding receptacles in addition to a separate EGC using a **green insulation with a yellow stripe** connected to the equipment grounding terminal of the isolated grounding receptacle terminal

517.16 Use of Isolated Ground Receptacles

An isolated ground receptacle *(if installed)* shall not defeat the purposes of the equipment grounding systems detailed in 517.13 *(two paths for equipment grounding in a patient care space)*

1. Metal raceway that qualifies as EGC [517.13(A)]
2. Additional insulated EGC [517.13(B)(1)]
3. Isolated ground EGC [517.16(B)(1) and 250.146(D)]



Note: Isolated grounding type receptacles are not permitted in a patient care vicinity but are permitted in a patient care space

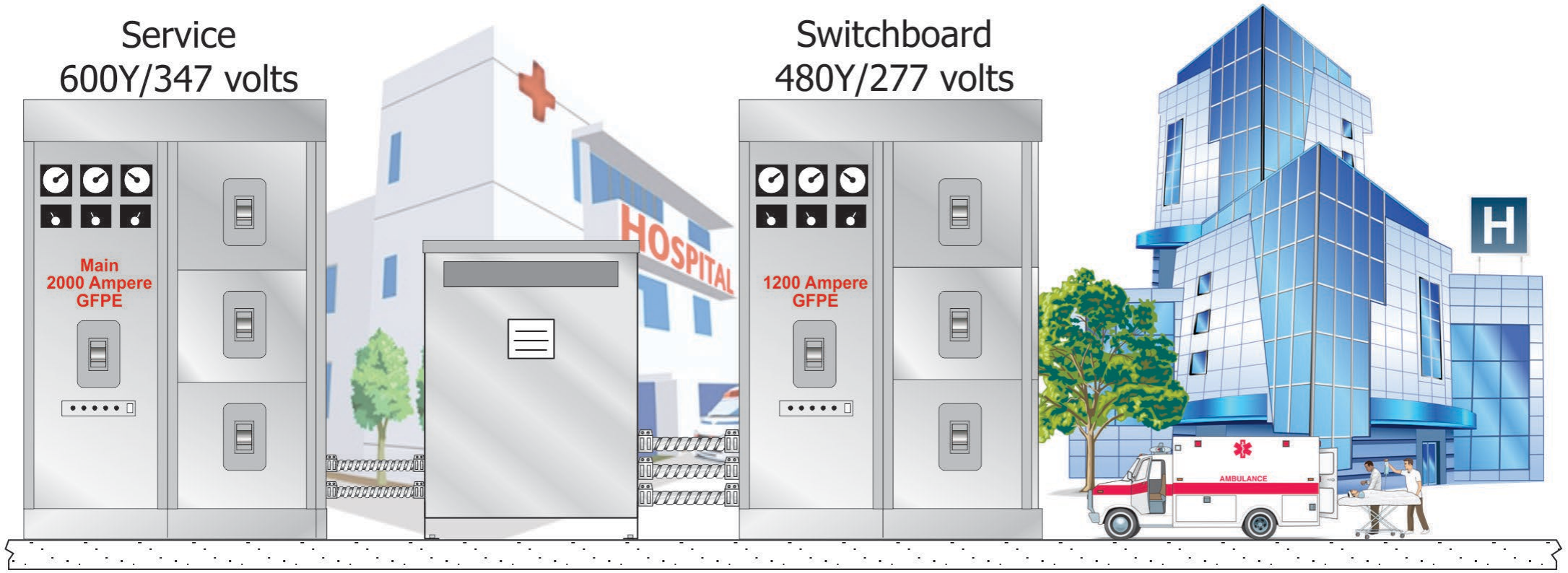
Equipment grounding terminals of isolated ground receptacles installed in a patient care space shall be connected to an isolated equipment grounding conductor AND this isolated equipment grounding conductor must be "installed in a wiring method described in 517.13(A)"

517.17(D) Performance Testing of GFP Equipment at Health Care Facilities

- Revision were made to provide clarity by requiring a **qualified person** *(written record)* to perform a **test process of GFP** primary current injection
- Previously, GFP systems were required to be performance tested when the equipment ground-fault protection was first installed with little detail
- This performance testing is now required to be conducted by a **qualified person(s)** using a test process in accordance with the **instruction** provided with the equipment and a **written record** of this testing must be kept and made available to the authority having jurisdiction
- Same *Code* language found at **230.95(C)** was inserted at 517.17(D) for performance testing of ground-fault protection systems of health care facilities

517.17(D) Performance Testing of GFP Systems at Health Care Facilities

When ground-fault protection of equipment is first installed, each level required to be performance tested to ensure compliance with 517.17(C) *(selectively coordinated)*



Testing to be conducted by a qualified person(s) using a test process in accordance with the instruction provided with the equipment

Written record of this testing to be kept and made available to the authority having jurisdiction

517.26 Application of Other Articles (Health Care Facilities)

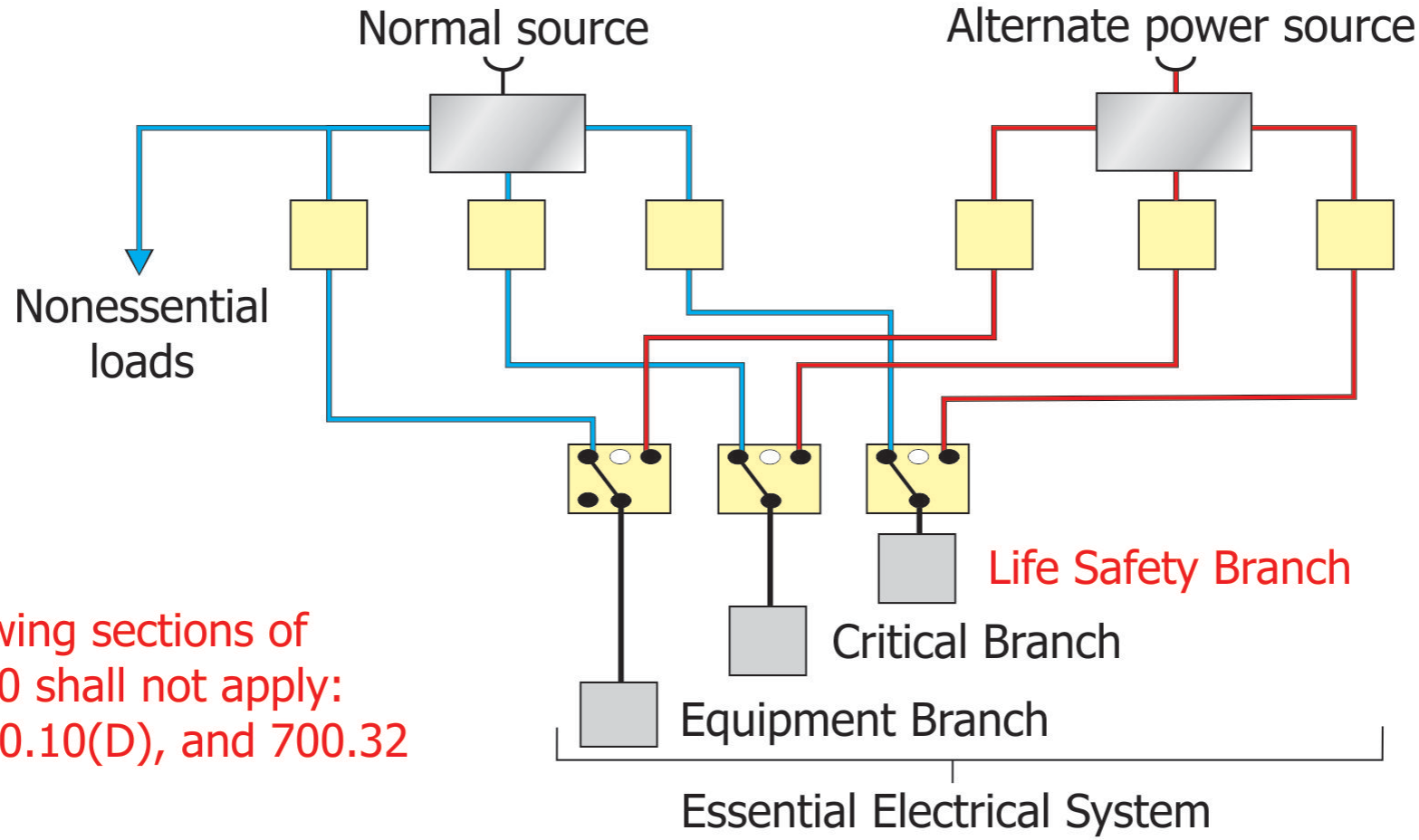
- New text was added to give needed guidance to what parts of Article 700 that Article 517 amends
- Revision added **four specific amendments** to Article 517 from requirements of Article 700 that does not apply to the **life safety branch** of the **essential electrical system** of a health care facility
  - **700.4** *(emergency system equipment required to be suitable for the available fault current)* does not apply
  - **700.10(D)** *(fire protection)* does not apply
  - **700.17** *(Branch Circuits for Emergency Lighting)* has been **replaced** with a provision that states that branch circuits that supply emergency lighting is required to be installed to provide service from a source complying with 700.12 *(Sources of Power)* when normal supply for lighting is interrupted or where single circuits supply luminaires containing secondary batteries
  - **700.32** *(selective coordination)* is also “amended” from Article 517

517.26 Application of Other Articles (Health Care Facilities) *(cont.)*

- New text was added to give needed guidance to want parts of Article 700 that Article 517 amends *(cont.)*
- Revisions brought about as a result of the work of the **NFPA 99 Electrical Systems Technical Committee**
- Changes meant to improve the **correlation** between NFPA 99 *(Health Care Facilities Code)* and the *NEC*
- NFPA 99 has jurisdiction over **performance requirements** for electrical systems in health care facilities while the *NEC* has jurisdiction over the **installation requirements**
- Life safety branch of the essential electrical system of a health care facility is required to conform to Article 700 with the exception of the performance requirements as described earlier

517.26 Application of Other Articles (Health Care Facilities)

Life safety branch of the essential electrical system shall meet the requirements of Article 700, except as amended by Article 517



The following sections of Article 700 shall not apply: 700.4, 700.10(D), and 700.32

Branch circuits that supply emergency lighting shall be installed to provide service from a source complying with 700.12 when normal supply for lighting is interrupted or where single circuits supply luminaires containing secondary batteries (amended from 700.17)

517.30(B)(3) Sources of Power – Battery Systems

- **Battery systems** are now permitted to serve as the **alternate source** for all or part of an **essential electrical system** of a health care facility
- **Two independent sources of power** required with one being the normal power source *(typically a utility supplied source of power)* and one or more alternate power sources for use when the normal power source is interrupted
- Battery systems are a recognized essential electrical system source by **NFPA 99** *(Health Care Facilities Code)*
- 2014 *NEC* recognized a battery system located on the premises as an acceptable alternate source of power for an essential electrical system
- Battery systems can supply power to critical life-support equipment until the main power can be restored


EXIT
DANGER
DANGER

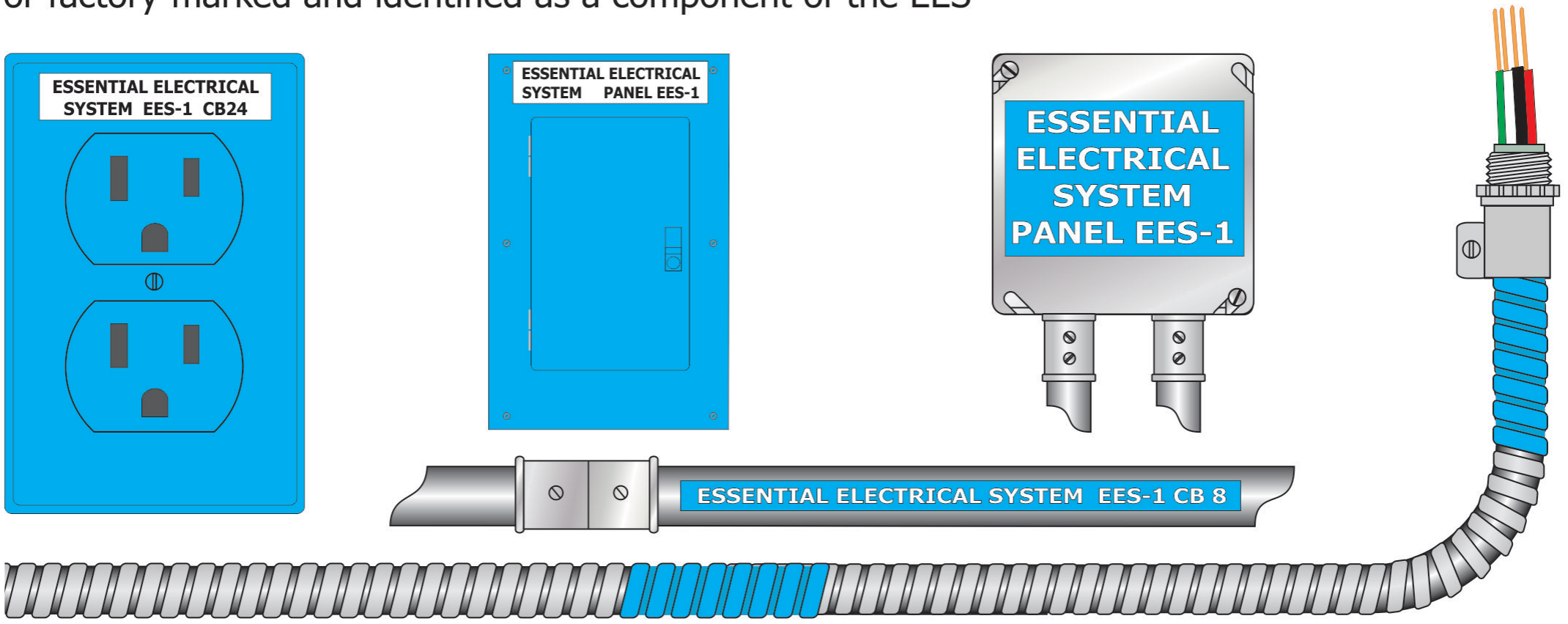
517.31(C)(1)(a) Identification of Essential Electrical Systems

- **Identification and marking requirements** for the life safety branch and critical branch of **essential electrical systems** was added to 517.31(C)(1)(a)
- Raceways and cables required to be **field- or factory-marked** as components of the essential electrical system at intervals **not to exceed 7.6 m (25 ft)**
- Raceways, cables, or enclosures of the life safety and critical branch of the essential electrical systems of a health care facility required be "**readily identified**" as a component of the essential electrical system (EES)
- **No specific color-coding, etc.** specified for "readily identifying" the EES
- This added identification marking requirement correlates 517.31 with the identification requirements for emergency systems in **700.10**

517.31(C)(1)(a) Identification of Essential Electrical Systems

Raceways, cables, or enclosures of the life safety and critical branch shall be readily identified as a component of the essential electrical system (EES)

Boxes and enclosures (including transfer switches, generators, and power panels) shall be field- or factory-marked and identified as a component of the EES



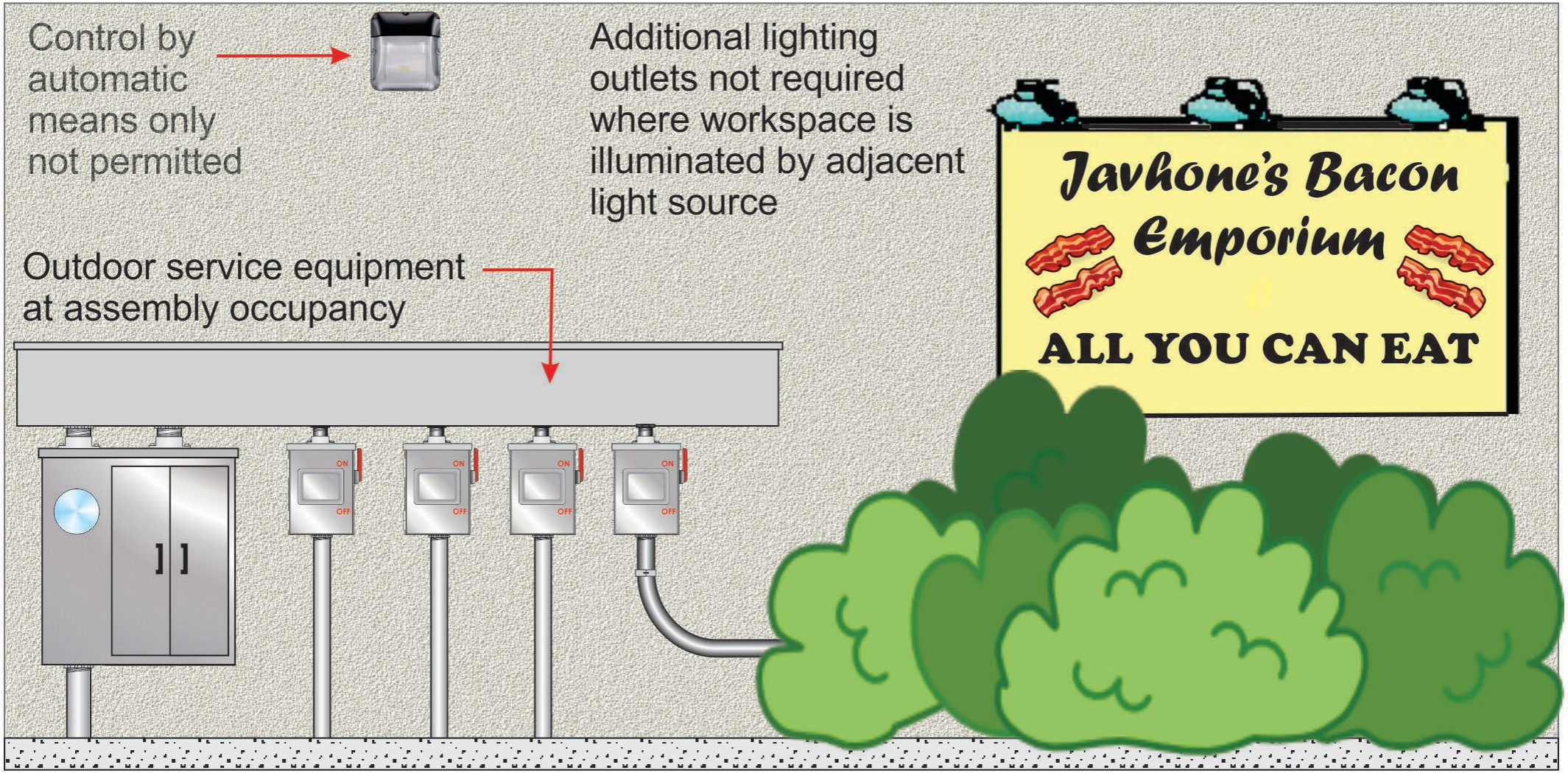
Raceways and cables shall be field- or factory-marked as a component of the EES at intervals not to exceed 7.6 m (25 ft)

518.6 Outdoor Illumination (Assembly Occupancies)

- New section added to require the working space pertaining to **outdoor fixed service equipment** at **assembly occupancies** to be provided with **proper illumination**
- Includes all working spaces about fixed service equipment, switchboards, switchgear, panelboards, or motor control centers installed outdoors that serve assembly occupancies
- Similar to the requirements of 110.26(D) and 110.34(D), this illumination **cannot be controlled by an automatic means** only *(must have manual override)*
- Lighting specifically for the illumination of this outdoor equipment is not required where the outdoor workspace is illuminated by an **adjacent light source** such as outdoor parking lot lighting
- Assembly occupancies can include, but not be is not limited to places like auditoriums, conference centers, exhibition halls, gymnasiums, churches, restaurants, etc. *(see 518.2)*

518.6 Outdoor Illumination - Assembly Occupancies

Illumination required for working spaces about fixed service equipment, switchboards, switchgear, panelboards, or motor control centers installed outdoors that serve assembly occupancies

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FIRE RISER ROOM
2850

520.25 Dimmers - Theaters, Television Studios, Etc.

- **Resistance- and reactor-type dimmers** for theatrical use have been deleted as a recognized dimmer option
- Two types of dimmers for theatrical use; **autotransformer-type dimmers** and **solid-state dimmers**
- According to industry experts, resistance- and reactor-type dimmers for theatrical use have not been manufactured or produced, much less installed for at least 50 years
- A dimmer switch for theatrical use allows technicians and stagehands to have more control over the lighting on stage than just a simple on/off

520.25 Dimmers - Theaters, Television Studios, Etc.

Resistance- and reactor-type dimmers for theatrical use have been deleted from 520.25

Resistance- and reactor-type dimmers for theatrical use have not been manufactured or installed for at least 50 years

520.68(A)(2) Listed Hard Usage Cords in Protected Applications

- **Listed hard usage cords or cables** *(rather than extra-hard usage cords or cables)* permitted for use with portable stage equipment in **protected applications**
- Listed, hard usage (junior hard service) cord or cable is permitted where (1) **protected from physical damage**, (2) protected by an overcurrent protective device rated at **not over 20 amperes**, and (3) does not exceed **30 m (100 ft) in length**
- As far back as the **1996 *NEC***, listed hard usage cord has been allowed in limited applications in Article 520 theatrical type occupancies
- Listed hard usage cord has a **proven track record** and performs safely in limited applications where not subject to physical damage
- No longer a reason to require extra-hard usage cord only in these protected applications

520.68(A)(2) Listed Hard Usage Cord in Protected Applications

Listed hard usage (junior hard service) cords or cables *(rather than extra-hard usage cords or cables)* permitted for use with portable stage equipment in protected applications

The cord or cable must be protected from physical damage, protected by an overcurrent protective device rated at not over 20 amperes, and the cord or cable does not exceed 30 m (100 ft) in length

525.20(G) Protection of Flexible Cords or Cables at Carnivals, Circuses, Fairs, and Similar Events

- **Non-conductive matting** for flexible cords or cables accessible at carnivals, etc. must be **secured to in place to the walkway surface** to minimize tripping hazard
- This section now allows either **secured matting** or an **approved alternate protection method**
- Previously, the nonconductive matting could create a **greater tripping hazard** than the uncovered cables
- Burying a cable to prevent a tripping hazard is also an option *(cable does not have to comply with the burial depth requirements of 300.5)*
- Wiring methods at carnivals, circuses, and county fairs should not be given the same latitude given temporary construction sites because they are **open to the public** unlike a construction jobsite

525.20(G) Protection of Flexible Cords or Cables

Flexible cords or cables accessible to the public shall be arranged to minimize tripping hazards

Flexible cords or cables permitted to be covered with nonconductive matting secured to the walkway surface *or* protected with another approved cable protection method

The matting or other protection method cannot constitute a greater tripping hazard than the uncovered cables

Article 545 Manufactured Buildings and Relocatable Structures

- A new Part II was added to Article 545 for "**Relocatable Structures**" with a definition of same added at 545.2
- **Relocatable Structures:** A factory-assembled structure or structures transportable in one or more sections that are built on a permanent chassis and designed to be used as other than a dwelling unit without a permanent foundation.
- Mobile office units, mobile classrooms, etc. are typically a factory-assembled structure and are not constructed and assembled on site, they are mobile and towed to the site much like a mobile home *(but they are not a "home")*
- There was a need for a **new approach** to properly install and maintain electrical supply and equipment to these mobile structures that **did not properly fit into any of the existing articles** in Chapter 5 of the *NEC*

Article 545 Manufactured Buildings and Relocatable Structures *(cont.)*

- A new Part II was added to Article 545 for "**Relocatable Structures**" with a definition of same added at 545.2 *(cont.)*
- In previous editions of the *Code*, any attempt to fit these relocatable structures under Article 550 was **difficult and ill-fitting at best**
- Quite often there were Article 550 requirements that were **impracticable or unnecessary** but not excluded while trying to apply Article 550 to these mobile units
- The previous requirements for "mobile homes used as other than dwelling units," formally covered at 550.4 in Article 550, have been incorporated into **new Part II of Article 545**
- The term "**relocatable structures**" was chosen as it is already a **commonly used industry term** that still identifies the portable nature of these units


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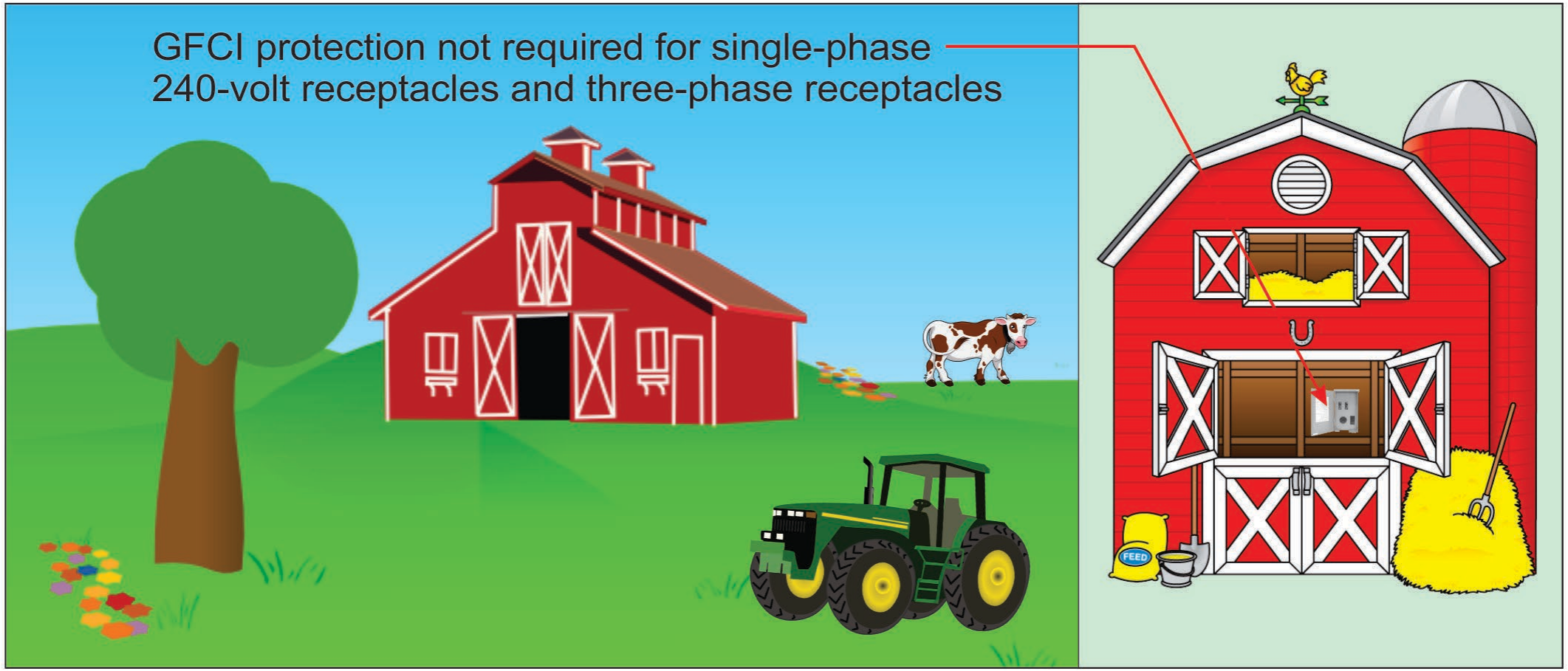
547.5(G) GFCI Protection at Agricultural Buildings

- Revision eliminates GFCI protection for receptacles rated **above 125-volt, single-phase, 20-ampere** *(240-volt and 3-phase receptacles)* at agricultural buildings
- GFCI protection is now required to be provided as required in 210.8(B), which would cover areas like bathrooms, rooftops, sink areas, etc.
- GFCI protection is only required for **125-volt, 15- and 20-ampere receptacles** installed in areas having an equipotential plane, outdoors, damp or wet locations, and dirt confinement areas for livestock
- Equipment such as portable air compressors, welders, milk pumps, feed augers and conveyors often cause **unintended or unwanted tripping of GFCI protective devices**, which can create a hazard or cause property damage

547.5(G) GFCI Protection at Agricultural Buildings

Ground-fault circuit-interrupter (GFCI) protection at agricultural buildings shall be provided as required in 210.8(B)



GFCI protection shall not be required for other than 125-volt, 15- and 20-ampere receptacles

547.9 Electrical Supply from a Distribution Point (Agricultural Buildings)

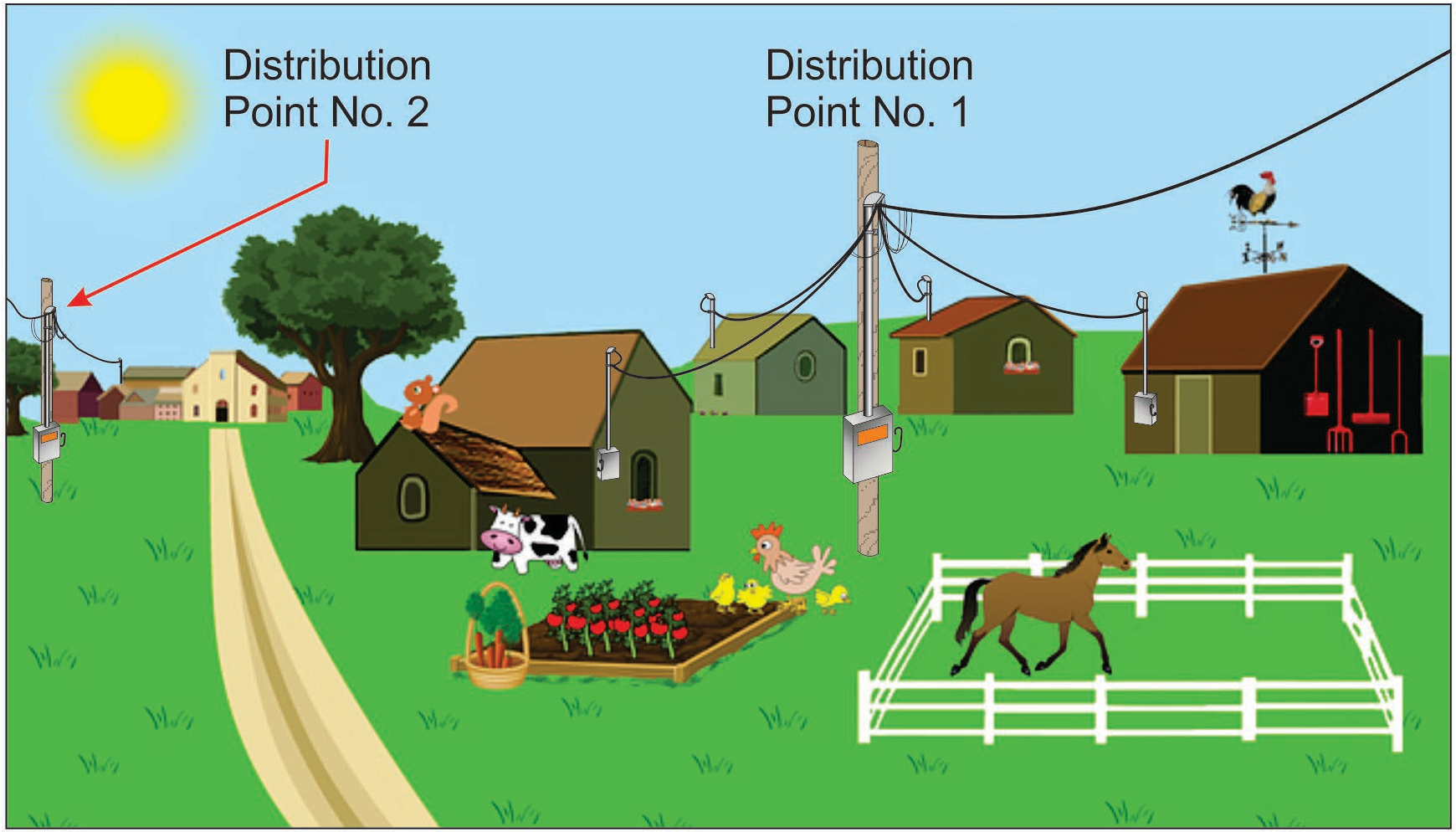
- Revision provides clarity that a **distribution point** is required for livestock agricultural buildings and structures
- A "**Distribution Point**" by Article 547 standards is defined as "an electrical supply point from which service drops, service conductors, feeders, or branch circuits to buildings or structures utilized under single management are supplied"
- Branch circuits and feeders to agricultural buildings required to be supplied through a **distribution point** and **overcurrent protection required** for all underground feeder and branch circuit installations
- More than one distribution point on the same premises permitted

547.9 Electrical Supply from a Distribution Point (Agricultural Buildings) *(cont.)*

- Revision provides clarity that a **distribution point** is required for livestock agricultural buildings and structures *(cont.)*
- Service disconnecting means and overcurrent protection for each set of feeders or branch circuits required to be located at the distribution point
- Service disconnecting means required to be installed in accordance with **Part VI of Article 230**
- Feeders or branch circuits supplied to buildings or structures to comply with the provisions of **250.32** and **Article 225, Parts I and II**
- In previous editions of the *Code*, any building or structure located on the same premises was "**permitted**" to be supplied by a distribution point *(not required)*

547.9 Electrical Supply from a Distribution Point

Any agricultural building or structure for livestock located on the same premises is *required* to be supplied from a distribution point *(previously "permitted" to be supplied from a distribution point)*



Existing agricultural building or structure (for other than livestock) and any existing non-Article 547 buildings or structures is permitted to be supplied in accordance with 250.32(B)(1) Ex. No. 1

550.13(B) GFCI Protection for Mobile and Manufactured Homes

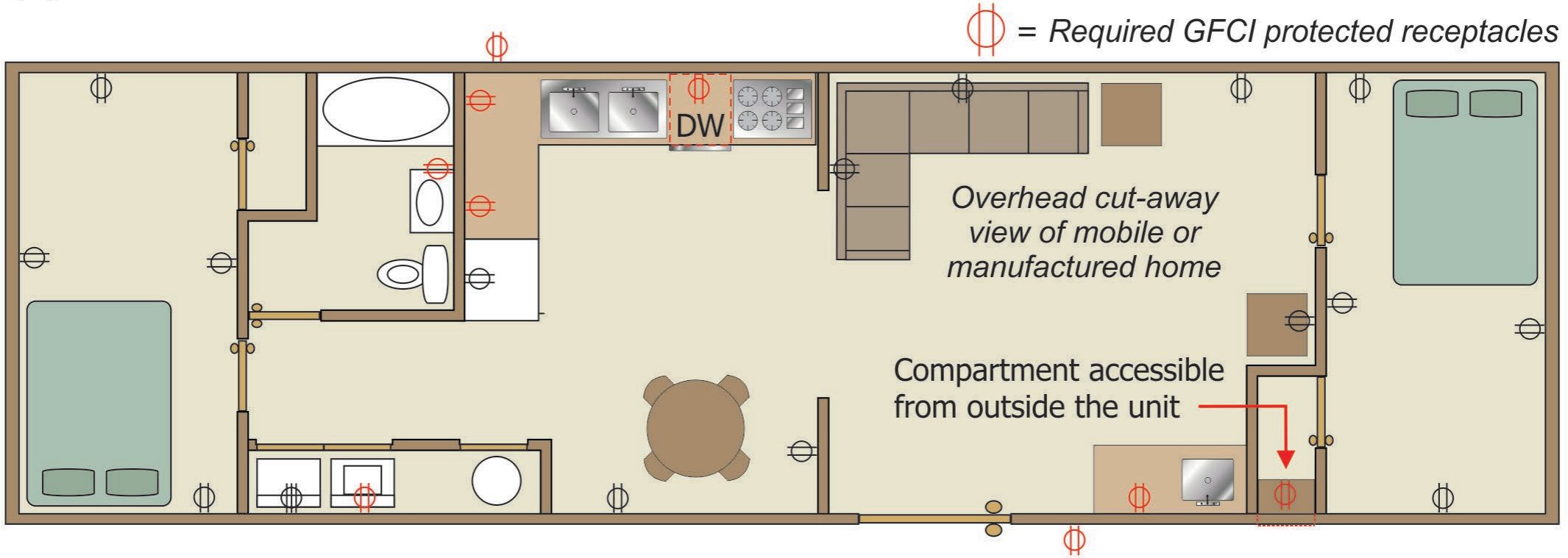
- Language was revised to include **210.8(A)**, which will provide GFCI protection to those additional locations at a dwelling covered in 210.8(A) for a mobile or manufactured home such as a **detached garage**
- **210.8(A)** revelation will allow CMP-7 *(purview over Article 550)* to stop "**chasing the tail**" of CMP-2 *(purview over Article 210)* every time CMP-2 makes a change to the GFCI protection requirements for conventional dwelling units at 210.8(A)
- Revision also **eliminates GFCI protection** for receptacles rated above 125-volt, single-phase, 20-ampere ***(240-volt and 3-phase receptacles)***
- These revisions are a step in the right direction in equaling GFCI protection for mobile or manufactured homes with GFCI protection at a conventional dwelling unit

550.13(B) GFCI Required for Mobile and Manufactured Homes

Ground-fault circuit-interrupter (GFCI) protection shall be provided as required in 210.8(A)

GFCI protection not required for other than 125-volt, 15- and 20-ampere receptacles installed within a mobile or manufactured home in the following areas:

(1) Compartments accessible from outside the unit
(2) Bathrooms (including receptacles in luminaires)
(3) Kitchens, where receptacles are installed to serve countertop surfaces
(4) Sinks, where receptacle(s) are installed within 1.8 m (6 ft) of the outer edge of a sink
(5) Dishwashers



550.32(E) Supply Receptacles for Mobile or Manufactured Homes

- Revisions clarify that a **supply receptacle providing power** to a mobile or manufactured home in accordance with 550.10 **need not be provided with** ground-fault circuit-interrupter protection **(GFCI) protection**
- Receptacles located **outside** a mobile or manufactured home are required to be provided with **GFCI protection as specified by 210.8(A)**
- Revision in the 2017 *NEC* at **210.8(B)** resulted in the expansion of GFCI protection for non-dwelling unit receptacles to include all **single-phase receptacles** rated **150 volts to ground or less**, **50 amperes or less**; and **three-phase receptacles** rated **150 volts to ground or less**, **100 amperes or less**
- 210.8(A) for the 2020 *NEC* will now encompass GFCI protection requirements for receptacle outlets rated at **125-volt through 250-volt** supplied by **single-phase** branch circuits rated **150 volts or less to ground**

550.32(E) Supply Receptacles for Mobile or Manufactured Homes *(cont.)*

- Part of the argument against GFCI protection for supply outlets and supply cords to a mobile or manufactured home pertains to a **branch circuit** verses a feeder
- The definition of a **feeder assembly** at 550.2 and 550.10 clarifies that the power supply cord to a mobile home is **considered a feeder**
- GFCI protection typically associated with a branch circuit rather than a feeder
- The supply cord to a mobile home is the **main power to the unit**
- The argument is rarely if ever made for the need for GFCI protection on the **main power feeder** to a **conventional dwelling unit**

550.32(E) Supply Receptacles for Mobile or Manufactured Homes

Receptacles located outside mobile or manufactured homes required to be provided with GFCI protection as specified by 210.8(A)

Receptacles providing power to mobile or manufactured homes in accordance with 550.10, are not required to be provided with GFCI protection

551.40(D) Reverse Polarity Devices for RVs

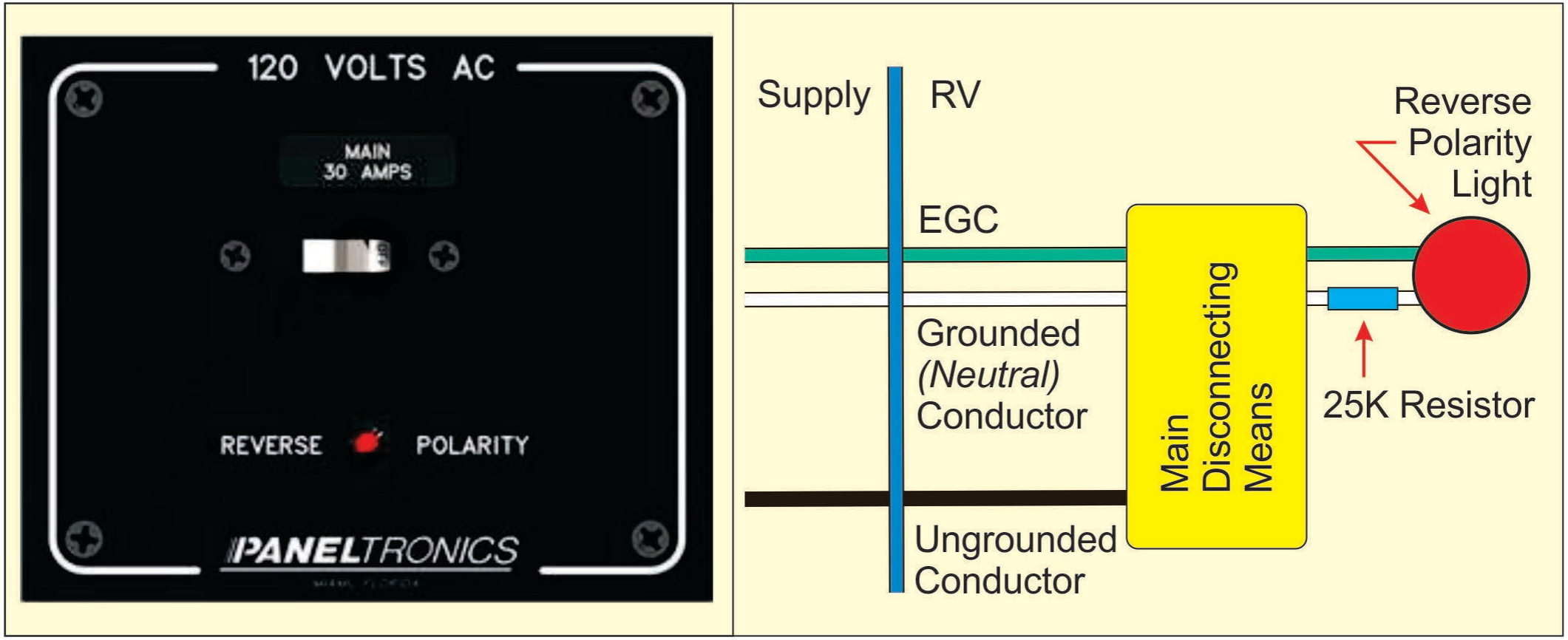
- New requirements added for a **reverse polarity indicating device** *(providing a **continuous visible or audible signal**)* to be installed in newly manufactured recreational vehicles (RV)
- Required to respond to the **reversal of the ungrounded and the grounded conductors** in a 120-volt ac system
- **Reverse polarity** at a recreational vehicle (RV) is a **known cause** of many incidents of people receiving an **electrical shock** from the RV itself
- Chance of having reverse polarity to an RV is increased as RVs are often plugged in at locations other than an RV campground
- Reverse polarity incidents are also more prevalent due to customers using adaptors to turn a 30-ampere receptacle into a 15-ampere receptacle that can be inserted backwards at the pedestal receptacle

551.40(D) Reverse Polarity Devices for RVs *(cont.)*

- New requirements added for a **reverse polarity indicating device** *(providing a **continuous visible or audible signal**)* to be installed in newly manufactured recreational vehicles (RV) *(cont.)*
- Reverse polarity indicating devices are **readily available** as they are currently required for 30-ampere power supplies on **marine vessels**
- Requiring these devices could significantly **reduce shock incidents**, all of which are technically a potential electrocution in the RV world

551.40(D) Reverse Polarity Device for RVs

A reverse polarity indicating device providing a continuous visible or audible signal is now required to be installed in recreational vehicles in accordance with the installation instructions



The reverse polarity indicating device shall respond to the reversal of the ungrounded and the grounded conductors in a 120-volt ac system

555.2 Definitions: (Marinas. Boatyards, Floating Buildings, and Commercial and Noncommercial Docking Facilities)

- **New definitions** were added to Article 555 for clarity as these terms were **previously not defined**
- Several new definitions were extracted from **NFPA 303**-2016 (Fire Protection Standard for Marinas and Boatyards)
- Section 555.2 of Article 555 now contains **fourteen definitions**
- One of the new definitions (**Floating Building**) was relocated from previous Article 553 for floating buildings
- This previous article was deleted from the 2020 *NEC* and information relocated to Article 555, Part III

555.2 Definitions: (Marinas. Boatyards, Floating Buildings, and Commercial and Noncommercial Docking Facilities)

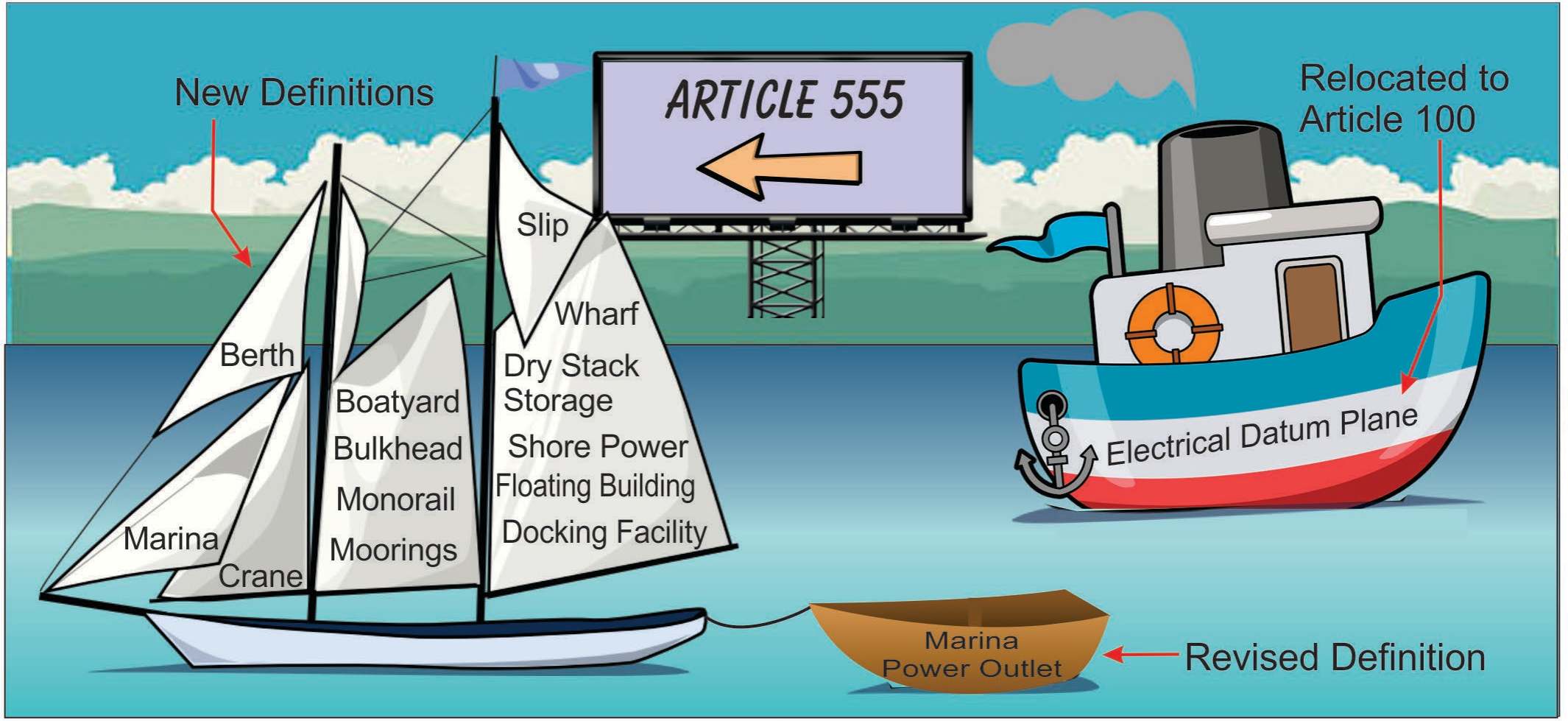
- Section 555.2 of Article 555 now contains **fourteen definitions**

Berth
Boatyard
Bulkhead
Crane
Docking Facility
Floating Building
Marina
~~Marine~~ Marina Power Outlet
Monorail
Mooring(s)
Shore Power
Slip
Storage, Dry Stack
Wharf

~~Electrical Datum Plane~~ *(Previous definition at 555.2 moved to 682.2) (New definition for Electrical Datum Plane added to Article 100 and assigned to CMP-7)*

555.2 Definitions - Marinas, Boatyards, Etc.

New definitions were added to Article 555 for clarity as these terms were previously not defined



Several new definitions were extracted from NFPA 303-2016 *(Fire Protection Standard for Marinas and Boatyards)*

555.13 Bonding of Non-Current-Carrying Metal Parts (Marinas, Boatyards, Etc.)

- All metal parts in contact with the water, all metal piping, and all non-current-carrying metal parts that are **likely to become energized** shall be connected to the grounding bus in the panelboard using solid copper conductors; insulated, covered, or bare; not smaller than 8 AWG
- Connections to bonded parts shall be made in accordance with **250.8**
- Comparable with equipotential bonding grid of **680.26**
- Same issues with **voltage gradients** (differences) is present at marinas, boatyards, floating buildings, and commercial and noncommercial docking facilities
- The marine environment associated with marinas, floating buildings, docking facilities, etc. is **harsh and less compatible** with electrical equipment than most conditions presented to electrical installations

555.13 Bonding of Non-Current-Carrying Metal Parts (Marinas, Boatyards, Etc.) *(cont.)*

- All metal parts in contact with the water, all metal piping, and all non-current-carrying metal parts that are **likely to become energized** shall be connected to the grounding bus in the panelboard using solid copper conductors; insulated, covered, or bare; not smaller than 8 AWG *(cont.)*
- Electrical equipment and metal parts in these marine environments are exposed to wet conditions, lightning, unusual movement, rough use by the public, extreme temperature changes, and significant UV exposure
- Combination of this environment and the normal use of these marine facilities result in conditions where equipment **failure is significant** and bonding for equipment and metal parts is critically important
- This bonding provision was located at **553.11** *(Floating Building)* in the 2017 *NEC*

555.13 Bonding of Non-Current-Carrying Metal Parts at Marinas, Etc.

All metal parts in contact with the water, all metal piping, and all non-current-carrying metal parts that are likely to become energized shall be connected to the grounding bus in the panelboard

Solid copper conductors; insulated, covered, or bare; not smaller than 8 AWG required to be used with connections to bonded parts made in accordance with 250.8

555.35 GFP of Equipment and GFCI Protection (Marinas, Boatyards, Etc.)

- Ground-Fault Protection of Equipment (GFPE) and Ground-Fault Circuit-Interrupter (GFCI) Protection divided into three parts:
  - **555.35(A)** addresses **shore power receptacles** *(not to exceed **30 mA**)*
  - **555.35(B)** addresses **15- and 20-ampere receptacles** for other than shore power *[GFCI protection (**4 to 6 mA**)]*
  - **555.35(C)** addresses **feeder and branch-circuit conductors** that are installed on docking facilities *(not to exceed **100 mA**)*
- Previous *Code* language required the overcurrent protective devices that supplied marinas, boatyards, and commercial and noncommercial docking facilities to have GFP **not exceeding 30 mA** *(see 555.3 for the 2017 NEC)*
- This **30 mA** maximum GFP requirement proved to be **unreliable** and **impracticable**

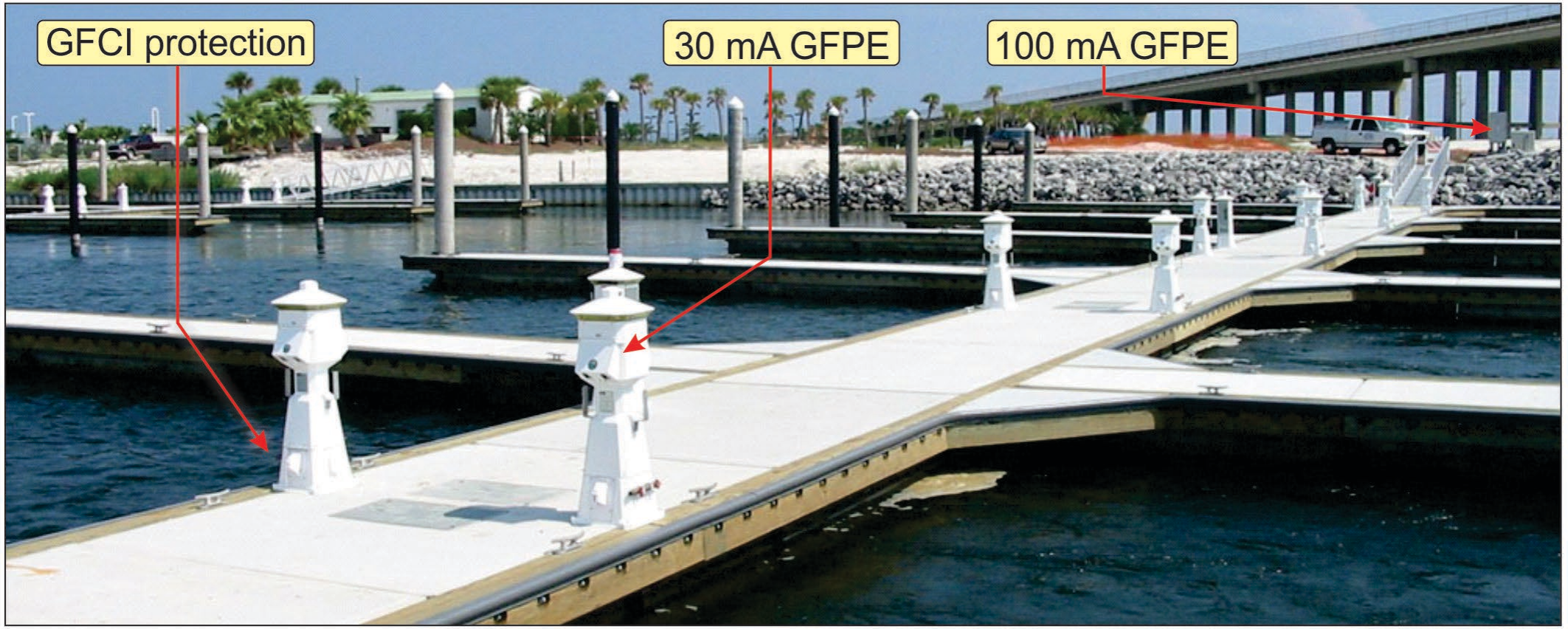
555.35 GFP of Equipment and GFCI Protection (Marinas, Boatyards, Etc.) *(cont.)*

- Through a culminative effect, it did not take but a few boats leaking current into the water around a marina before the 30 mA level was exceeded
- **Exception** added which would exempt **transformer secondary conductors** of a separately derived system *[not exceed 3 m (10 ft)]* installed in a raceway from this GFPE protection
- *Code* language added to require **leakage current measurement devices**
- Where **more than three receptacles** supply shore power to boats, a **leakage current measurement device** required to be available and be used to determine leakage current **from each boat** that will utilize shore power
- Test data has shown that a great deal of the **stray current in the water** around marinas comes from the boats (vessels) themselves

555.35 GFPE and GFCI Protection at Marinas, Boatyards, Etc.

Shore power receptacles shall have individual GFPE not exceeding 30 milliamperes [555.35(A)(1)]

All 125-volt, single-phase, 15- and 20-ampere receptacles *(other than shore power)* shall be provided with Class A GFCI protection [555.35(A)(2)]



Feeder and branch-circuit conductors installed on docking facilities shall be provided with GFPE set to open at currents not exceeding 100 milliamperes with downstream GFPE coordination permitted at the feeder overcurrent protective device [555.35(A)(3)]

GFP Device at Marina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CT4
CT5
CT6
CT7
CT8
CT9
CT10
CT11
CT12
RESET
EATON

555.35(B) Leakage Current Measurement Device at Marinas, Etc.

Where more than three receptacles supply shore power to boats, a leakage current measurement device shall be available and be used to determine leakage current from each boat that will utilize shore power

Photo courtesy of Marina Electrical Equipment (MEE)

Leakage current measurement will provide the capability to determine when an individual boat has defective wiring or other problems contributing to hazardous voltage and current

The use of a test device will allow the facility operator to identify a boat that is creating problems

The use of a test device will also help the facility operator prevent a particular boat from contributing to hazardous voltage and current in the marina area

Article 555 Part III – Floating Buildings

- Previous **Article 553 (Floating Buildings)** was deleted and requirements incorporated into **new Part III of Article 555**
- Incorporating the requirements for floating buildings into Article 555 is a **natural fit** as the two articles *(previous Article 553 and Article 555)* were **similar in nature**
- Previously, Article 555 had no parts *(it now has **3 parts**)*
- Title and scope of Article 555 updated to reference **floating buildings**
- Addition of floating buildings to Article 555 will **enhance electrical safety** and usability of the *NEC*
- Significant change occurred at **555.4** (Location of Service Equipment) *(formerly 555.7)* requiring the service equipment for a floating building, dock, or marina to be located **on land adjacent to the structure served** *(not on or in the structure itself or any other floating structure)*


Lighthouse Store
ICE

590.4(G), Ex. No. 2 – Splices at Temporary Installations

- On construction sites, a **new exception** to 590.4(G) permits branch-circuits that are **permanently installed** in framed walls and ceilings to be used for **temporary power or lighting** *(with GFCI protection)*
- Previously, no provisions existed in Article 590 to allow a permanent wiring method *(branch circuits)* to be used as temporary construction lighting circuits without covers on boxes, etc.
- On a typical construction jobsite, temporary lighting becomes an issue in individual rooms leaving these rooms in the dark after drywall finishes applied
- Very common method employed to get temporary lighting in those individual rooms and areas is to string **Type NM cable** through doorways and through each room in each unit *(unsafe and unreliable)*
- These permanent wiring methods (branch circuits) used as temporary construction lighting circuits to be **GFCI protected** through the duration of the temporary installation

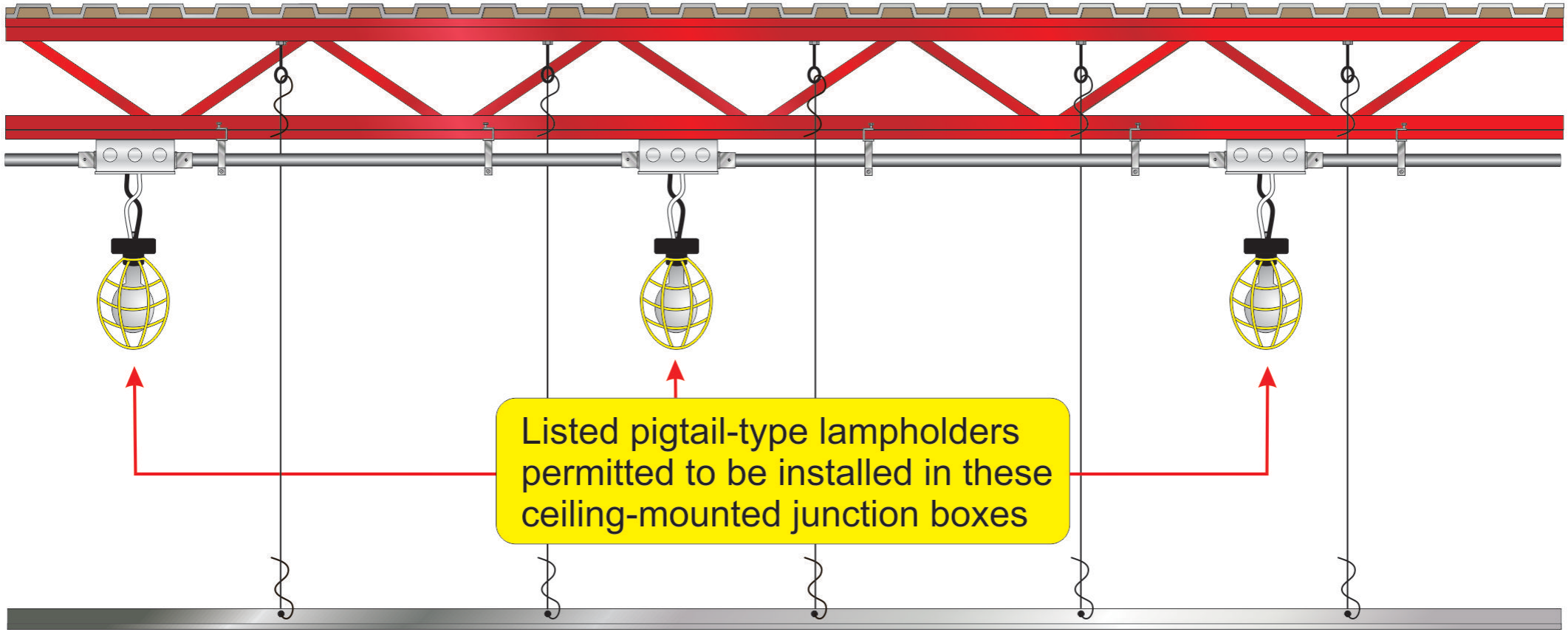
590.4(G), Ex. No. 2 – Splices at Temporary Installations *(cont.)*

- On construction sites, a **new exception** to 590.4(G) permits branch-circuits that are **permanently installed** in framed walls and ceilings to be used for **temporary power or lighting** *(with GFCI protection) (cont.)*
- Viable solution is to **temporarily energize** one or more of the **permanently installed branch circuit(s)** to provide temporary lighting in each room, bathroom, etc.
- This method requires splices in junction boxes typically located above the suspended drop-in ceiling tile *(installed at a later date)* without covers to energize temporary listed lighting pig tails
- **New exception** stipulates that a **cover is not required** for splices installed completely inside of junction boxes with plaster rings and that **listed pigtail-type lampholders are permitted** to be installed in these ceiling-mounted junction boxes with plaster rings

590.4(G), Ex. No. 2 Splices at Temporary Installations

A box, conduit body, or other enclosure *(with a cover installed)* generally required at all splice points

By exception, permanent wiring in framed walls and ceilings permitted to be used to supply temporary power or lighting with no cover for splices installed completely inside of junction boxes with plaster rings



Permanent wiring methods *(branch circuits)* used as temporary construction lighting circuits to be GFCI protected through the duration of the temporary installation

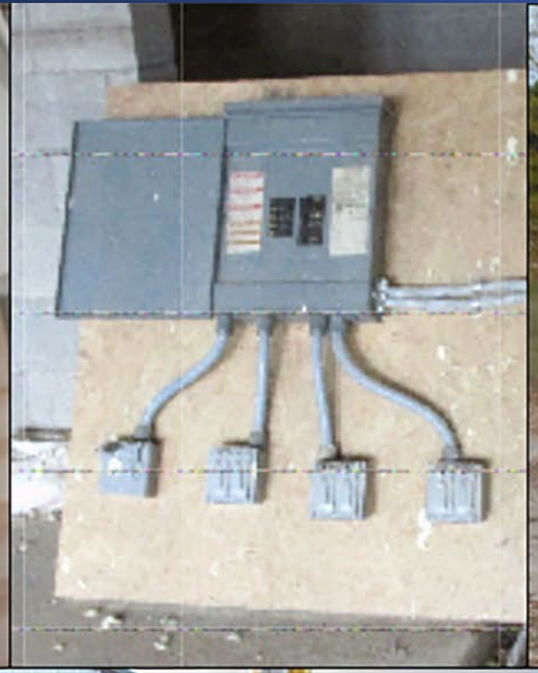
590.8 Overcurrent Protective Devices (Temporary Installations)

- New section added to provide guidance in the **reuse of overcurrent protective devices** in temporary installations and the use of **current limiting overcurrent protective devices** required for solidly grounded wye electrical services of more than 150 volts to ground but not exceeding 1000 volts phase-to-phase in temporary installations
- When equipment is re-used, and that equipment has previously been subjected to environments, uses, and conditions that may not be visibly obvious, approval of that equipment is difficult in many cases
- The re-used equipment, such as overcurrent protective devices is more than likely listed equipment but could very well have been **previously used or exposed to conditions outside the scope of its listing certification**

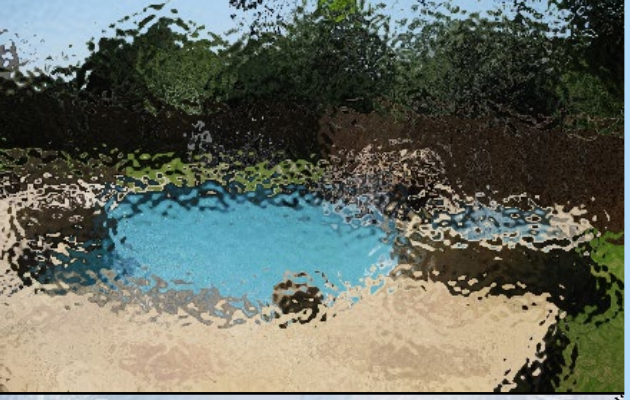
590.8 Overcurrent Protective Devices (Temporary Installations) *(cont.)*

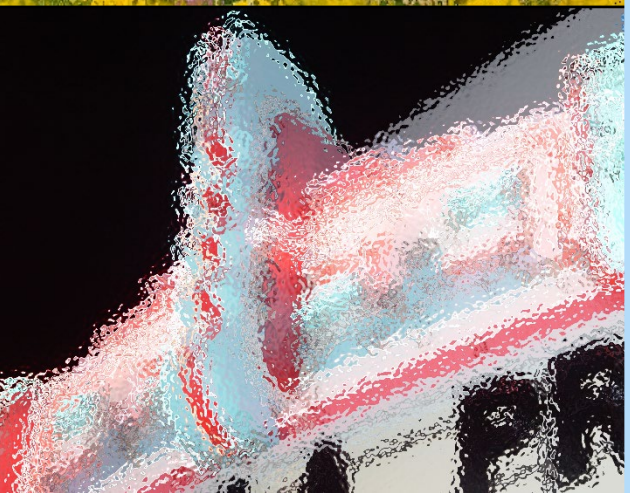
- New **590.8(A)** mandates that overcurrent protective devices be examined to ensure that these devices have been "**properly installed**," "**properly maintained**," and there is "**no evidence of impending failure**" whenever these overcurrent protective devices have been previously used are installed in a temporary installation
- New **590.8(B)** addresses overcurrent protective devices used as part of the service equipment in temporary installations, calling for overcurrent protective devices for **solidly grounded wye electrical services** of **more than 150 volts to ground** but **not exceeding 1000 volts phase-to-phase** to be of the "**current limiting**" type
- **Current-Limiting Overcurrent Protective Device**: "A device that, when interrupting currents in its current-limiting range, reduces the current flowing in the faulted circuit to a magnitude substantially less than that obtainable in the same circuit if the device were replaced with a solid conductor having comparable impedance."


DANGER
PELIGRO
ADVERTENCIA




DANGER
HIGH VOLTAGE
9





Chapter Six Special Equipment

600.2 Definitions – Electric Signs and Outline Lighting

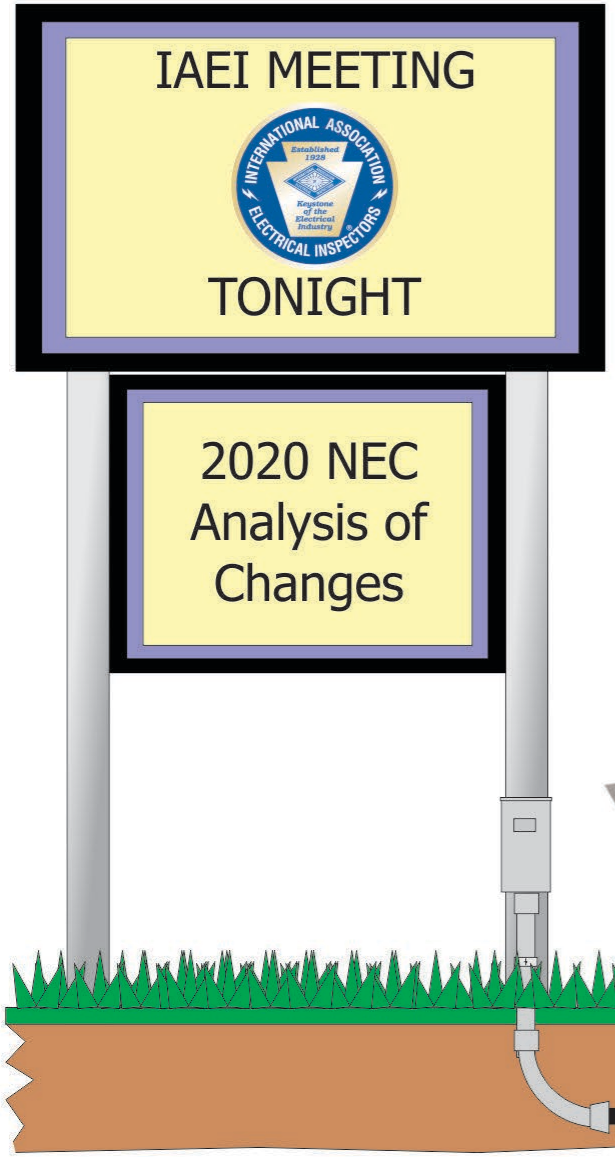
- **Four new definitions** were added to 600.2 pertaining to **retrofit kits for signs** (1) Host Sign, (2) Retrofit Kit, General Use, (3) Retrofit Kit, Sign Specific, (4) Subassembly
- Luminaires are typically standardized and are typically mass produced, whereas **signs** are typically **custom made** and have **distinctly different structural and illumination characteristics**, including multi-location corporate signage programs which are dissimilar in size
- A retrofit kit for a sign typically has **more "moving parts"** to deal with than a retrofit kit for a luminaire
- Concentrated efforts has been pursued in the sign industry to upgrade signs to achieve **greater energy efficiency** by replacing in-place illumination systems such as florescent with light emitting diodes (LED) technology

600.2 Definitions – Electric Signs and Outline Lighting *(cont.)*

- **Four new definitions** were added to 600.2 pertaining to **retrofit kits for signs** (1) Host Sign, (2) Retrofit Kit, General Use, (3) Retrofit Kit, Sign Specific, (4) Subassembly *(cont.)*
- An upgrade of the sign typically involves **field modifications** of the sign
- Proper adherence to **developed protocols** for these field conversions, such that when done within the testing laboratory parameters, ensures these field conversion “retrofit kits” do not compromise the safety profile of the listed sign
- These **added definitions** will aid the installer and the inspector in assuring the right retrofit kit is used with the correct host sign

600.2 Definitions. (Electric Signs and Outline Lighting)

Four new definitions were added to 600.2 pertaining to retrofit kits for signs



Host Sign. A sign or outline lighting system already installed in the field that is designated for field conversion of the illumination system with a retrofit kit.

Retrofit Kit, General Use. A kit consisting of primary parts, which does not include all the parts for a complete subassembly but includes a list of required parts and installation instructions to complete the subassembly in the field.

Retrofit Kit, Sign Specific. A kit consisting of the necessary parts and hardware to allow for field installation in a host sign, based on the included installation instructions.

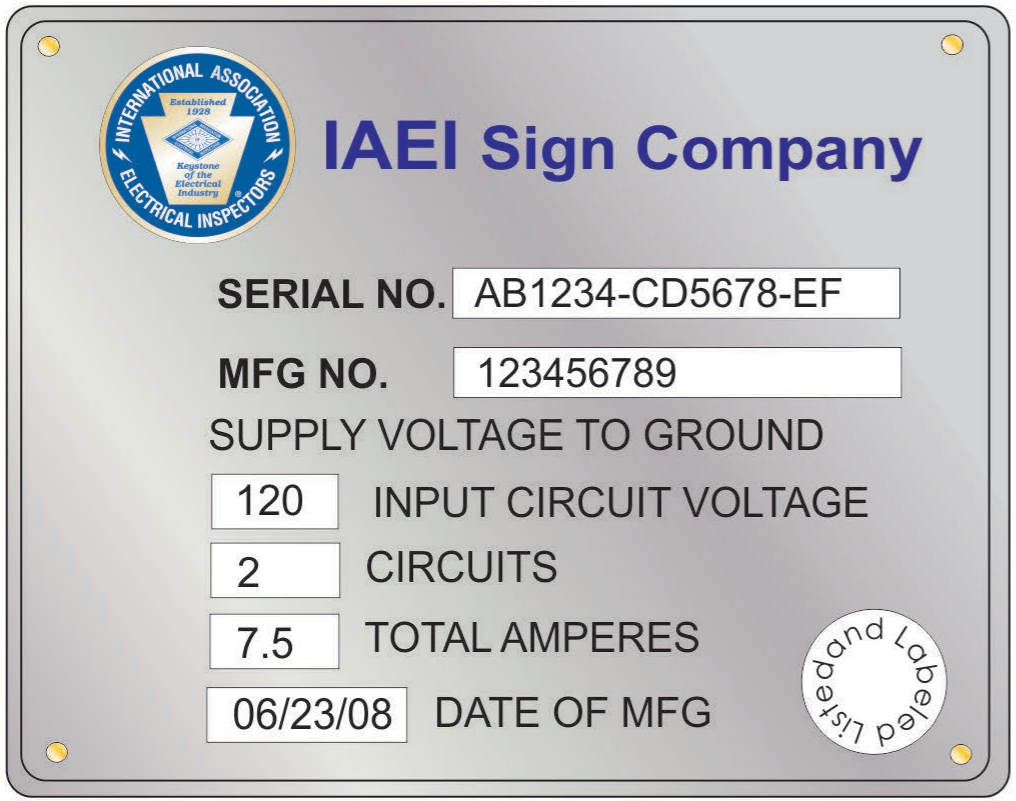
Subassembly. Component parts or a segment of a sign, retrofit kit, or outline lighting system that, when assembled, forms a complete unit or product.

600.4(D) Visibility of Markings for Electric Signs and Outline Lighting

- Revisions now require **visibility of markings** at the time of installation, inspection, and prior to servicing, but can be installed in a location **not viewed by the public**
- Previously, 600.4(A) markings and listing labels were not required to be visible after installation, but were required to be permanently applied in a location **visible during servicing** *(rather than **prior to servicing**)*
- This marking would include such things as manufacturer's name, trademark, maximum allowable lamp wattage, input voltage, and current rating
- New *Code* text was added to clarify that "***visible after installation***" does not necessarily mean visible in a location viewed by the public
- When an installer or inspector first approaches a sign, they should be able to identify **input voltage** and **current rating** prior to opening the sign

600.4(D) Visibility of Markings - Electric Signs and Outline Lighting

Signs and outline lighting systems required to be marked with such things as manufacturer's name, trademark, input voltage and current rating, maximum allowable lamp wattage per lampholder, and other means of identification [600.4(A) and (C)]



Markings and listing labels are required to be visible after installation and must be permanently applied in a location visible prior to servicing

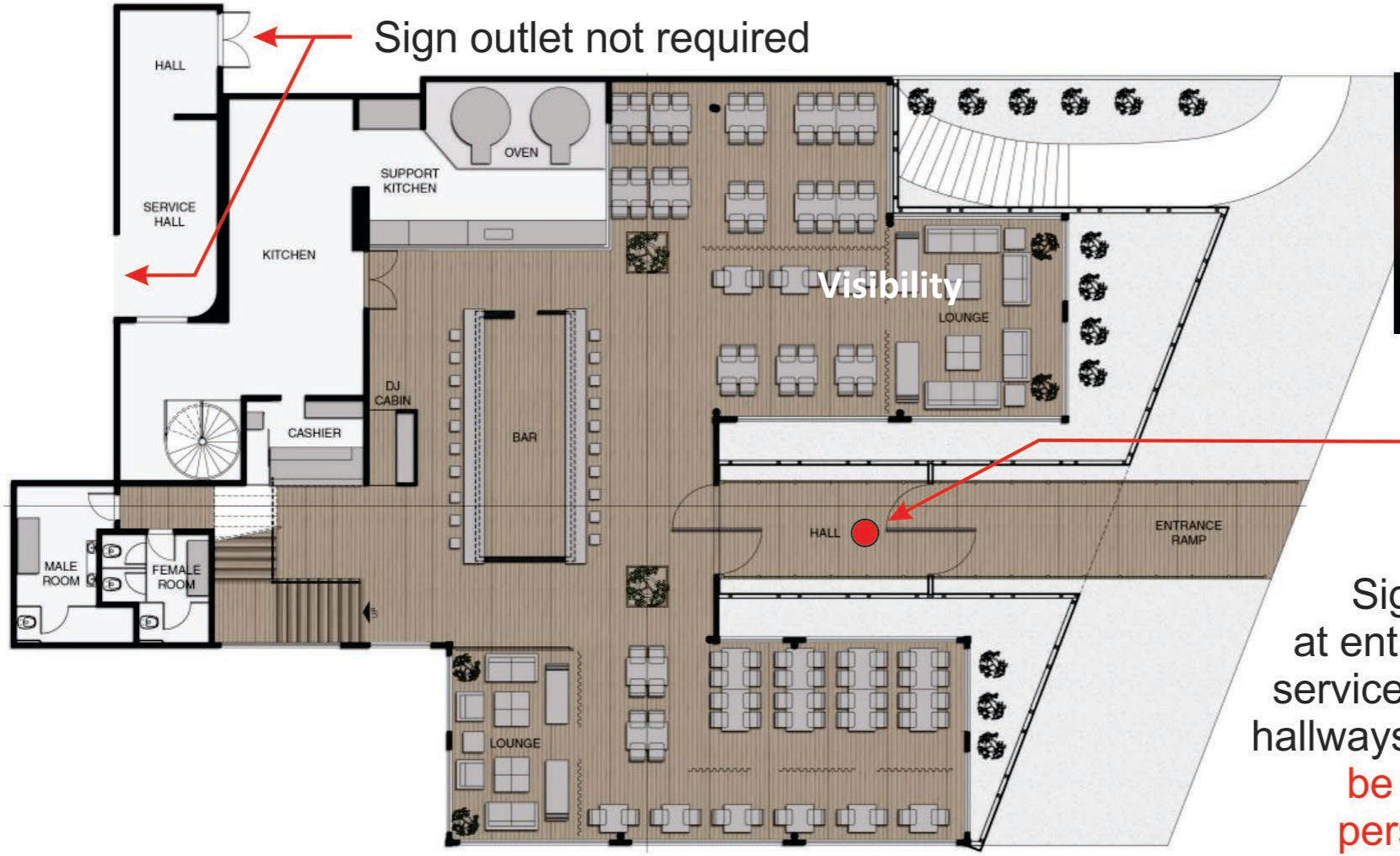
Marking permitted to be installed in a location not viewed by the public

600.5(A) Required Branch Circuit for Electric Signs and Outline Lighting

- Revision clarifies that **entrances not accessible to customers**, such as delivery doors, **do not require a sign outlet**
- At each commercial building and each commercial occupancy accessible to pedestrians, at least one outlet *(located in an accessible location)* is required to be installed at each entrance to each tenant space for a sign or outline lighting system
- A sign or outline lighting outlet **not required** at entrances for deliveries, service corridors, or service hallways that are intended to be used only by service personnel or employees
- Clarification was needed to distinguish what entry doors did and did not require this required sign outlet

600.5(A) Required Branch Circuit for Electric Signs/Outline Lighting

At each commercial building and each commercial occupancy accessible to pedestrians, at least one outlet is required to be provided at an accessible location for each entrance to each tenant space for a sign or outline lighting system *(required to be supplied by a 20-ampere branch circuit with no other loads)*



Sign outlet not required at entrances for deliveries, service corridors, or service hallways that are intended to be used only by service personnel or employees

600.5(B) Marking Requirements at Sign Disconnects

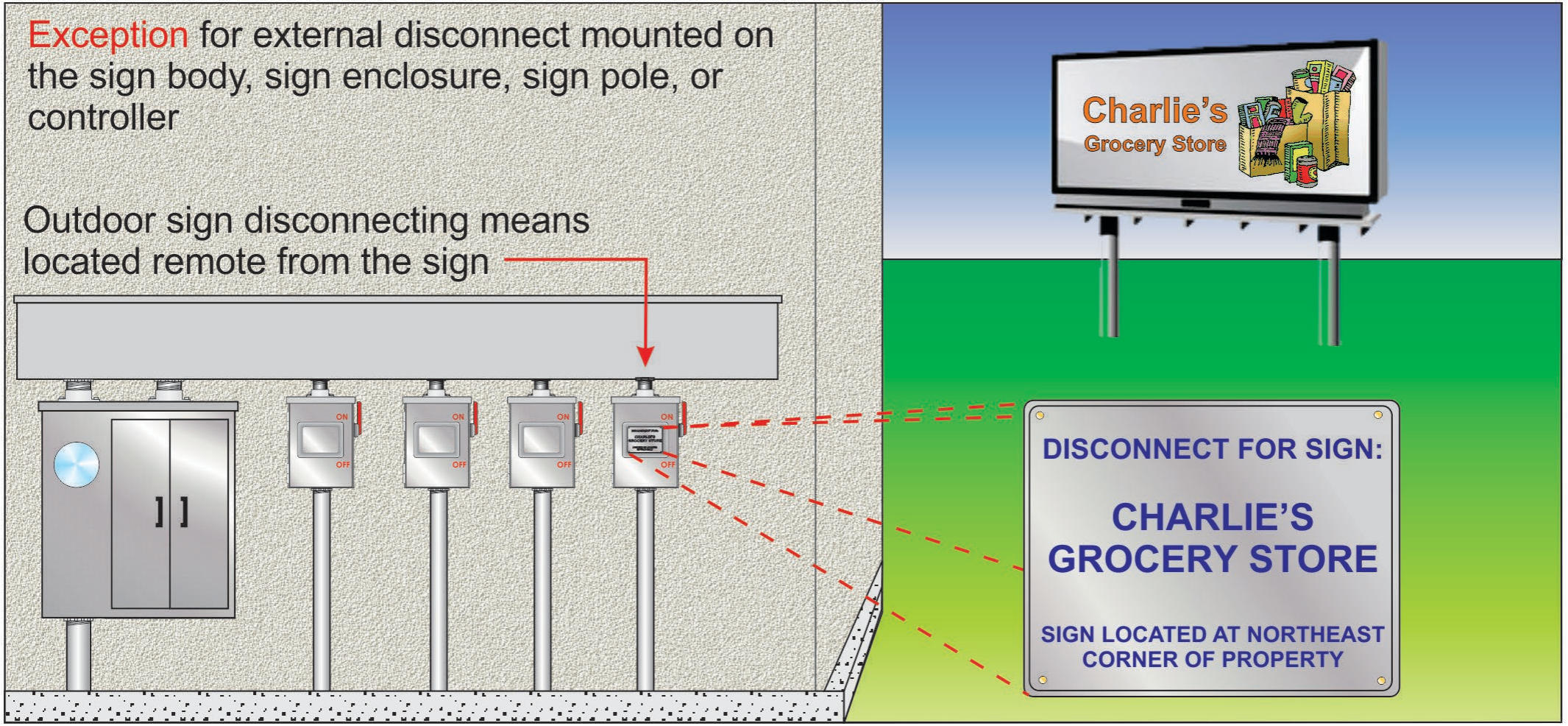
- Disconnecting means for a sign, outline lighting system, or controller now required to be **marked to identify** sign, outline lighting system, or controller it controls
- **Exception** for external disconnect mounted on the sign, etc.
- If **located remote**, disconnect required to be mounted at an **accessible location** available to first responders and service personnel
- Previous provisions required a permanent field-applied marking identifying the location of the disconnecting means applied to a sign in a location visible during servicing identifying the location of the disconnecting *means [see 600.6(A)(2)]*
- No provisions existed *(until now)* in Article 600 requiring a marking or label at the disconnection means for a sign, outline lighting system, or controller identify the sign, outline lighting system, or controller it controls

600.5(B) Marking Requirements at Sign Disconnects *(cont.)*

- Disconnecting means for a sign, outline lighting system, or controller now required to be **marked to identify** sign, outline lighting system, or controller it controls *(cont.)*
- Without a marking or label identifying the sign it controls, a remote disconnecting means might not be recognized or identified as controlling the sign, outline lighting system or controller by anyone other than the service technician
- Sign service employees and maintenance personnel, and in particular **emergency responders** have a **need to know** what utilization equipment the disconnect(s) is designated for where it is not mounted on the sign, outline lighting system or controller
- This new marking requirement at **600.5(B)** can be tied to **new remote location provision at 600.6(A)(4)**, which calls for the sign disconnecting means *(if located remote from the sign, sign body, or pole)* to be mounted at an **accessible location available to first responders and service personnel**

600.5(B) Marking Requirements at Disconnect

Disconnecting means for a sign, outline lighting system, or controller is now required to be marked to identify the sign, outline lighting system, or controller it controls



The disconnecting means *(if located remote from the sign, sign body, or pole)* shall be mounted at an accessible location available to first responders and service personnel *[See 600.6(A)(4)]*

600.35 Retrofit Kits for Electric Signs and Outline Lighting

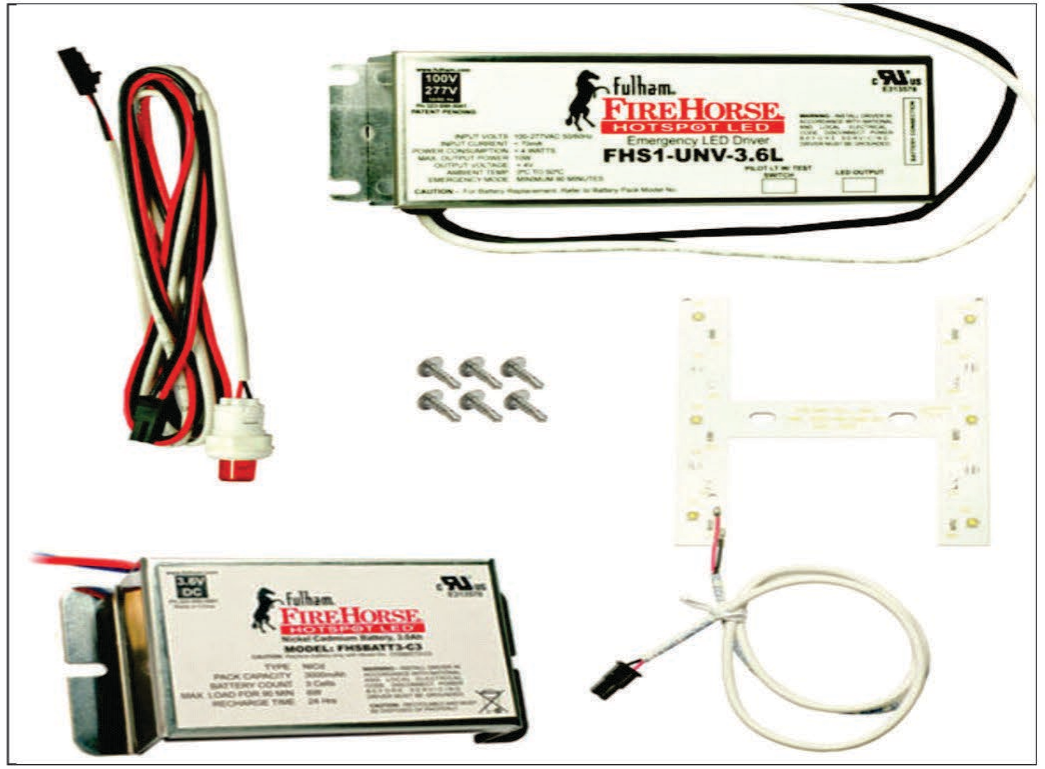
- New section added pertaining to "**Retrofit Kits**" for signs and outline lighting systems
- New **600.35** gives **specific and needed installation instructions** for **retrofit kits** for signs and outline lighting systems
- **Retrofit Kit**: "A general term for a complete subassembly of parts and devices for field conversion of utilization equipment."
- To some in the electrical industry *(particularly the sign industry)* the term "**complete**" in the definition of "**Retrofit Kit**" was deemed **subjective** and felt more information was needed to install and enforce requirements for a **sign retrofit kit**

600.35 Retrofit Kits for Electric Signs and Outline Lighting *(cont.)*

- New *Code* rules will provide the impetus for implementation of retrofit kits and its "**complete subassembly**" intended to applied to signs and outline lighting retrofit kits, with each listed retrofit kit mandated to include "**all the necessary parts**" for field conversion of a "**host sign**" *(see new definitions at 600.2)*
- Retrofit kits are now required to be "**listed and labeled**," which will bring some consistency to these retrofit kits
- Installation instructions for **field conversions** are **distinguishable** for use in the host sign
- New *Code* requirements for sign retrofit kits harmonize with **UL 879A** *(Standard for LED Sign and Sign Retrofit Kits)*, enabling the installer to identify the correct replacement parts and devices needed for a **safe conversion** and facilitates the AHJ's approval process

600.35 Retrofit Kits

New 600.35 gives specific installation instructions for retrofit kits for signs and outline lighting systems



General-use or sign-specific retrofit kits for sign or outline lighting systems to include installation instructions and requirements for field conversion of a host sign

Retrofit kits shall be listed and labeled

All parts that are not replaced by a retrofit kit shall be inspected for damage

605.1(A) and (B) Covered and Not Covered (Office Furnishings)

- The scope of Article 605 was clarified to specify items that are **not covered** by Article 605
- Previously, the scope of Article 605 only told the user of the *Code* what was **covered** by the article
- New *Code* text at **605.1(B)** states that Article 605 **does not apply to** "individual office furnishings not connected to a system, such as chairs, freestanding desks, tables, storage units, and shelving units"
- Some jurisdictions have improperly applied Article 605 to **individual free-standing furnishings**, such as **motorized adjustable workstations**, which are not intended to be covered by this article
- New provisions should clarify the products intended to be **covered** and **not covered** by Article 605

605.1(A) and (B) Covered and Not Covered (Office Furnishings)

605.1(A) Covered. This article covers electrical equipment, lighting accessories, and wiring systems used to connect, contained within, or installed on office furnishings.

COVERED

NOT COVERED

605.1(B) Not Covered. This article does not apply to individual office furnishings not connected to a system, such as chairs, freestanding desks, tables, storage units, and shelving units.

620.6 GFCI Protection in Elevator Pits, Etc.

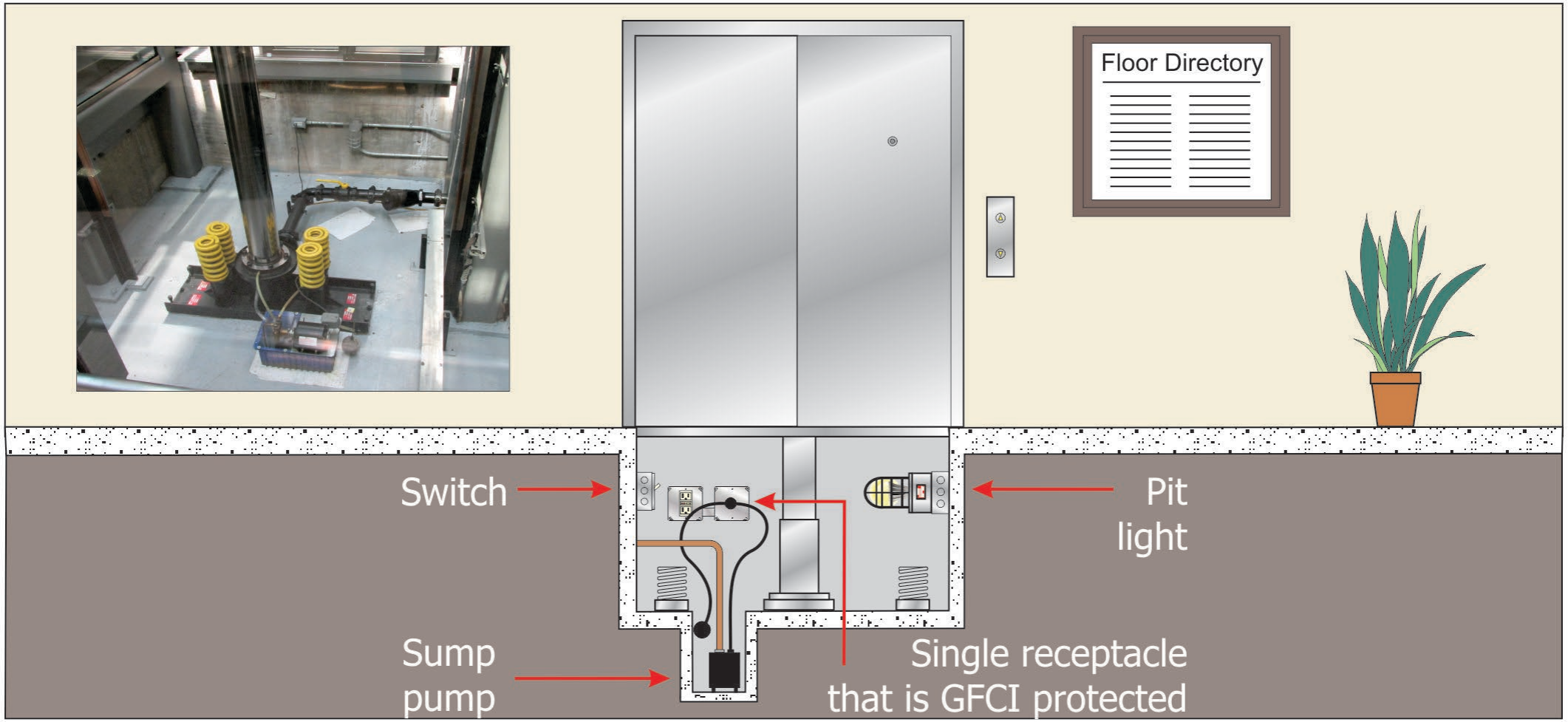
- Revision clarifies that any receptacle in a pit must be **GFCI protected**
- GFCI protection **not required** for a **hard-wired** sump pump
- Permanently installed sump pump is now required to be ***either*** permanently wired ***or*** must be supplied by a **single receptacle** that is **GFCI protected** *(no GFCI protection required in previous Code)*
- **Complete reversal** for the GFCI provisions for a single receptacle supplying a permanently installed sump pump in something like an elevator pit since the 1996 *NEC*
- These GFCI rules were moved to **Part I** of Article 620 as these GFCI rules were more appropriately located in Part I (General Requirements) *(was 620.85)*

620.6 GFCI Protection in Elevator Pits, Etc. *(cont.)*

- This is one of the few places in the entire *Code* where the **GFCI protection** is required to be delivered in the form of a **receptacle outlet-type GFCI protection** (at the outlet) rather than GFCI overcurrent protection in the form of a circuit breaker or a GFCI receptacle located remote
- In an elevator pit or similar pit, **GFCI protection** is called upon to be **located at the receptacle outlet** in the pit so that GFCI device can be reset if tripped without service personnel having to climb out of the pit to reset the GFCI device *(see first sentence at 620.6)*
- This revision is similar to revision that occurred at **422.5(A)(6)** *(GFCI protection now required on **all** **150 volts or less to ground** and **60 amperes or less**, **single- or 3-phase sump pumps** (hard wired or cord-and-plug connected)*
- For the sump pump in an elevator pit, one would have to rely on **90.3** to take precedence and indicate that rules in Chapter 6 [620.6] would "**supplement or modify**" the rules in Chapter 4 [422.5(A)(6)]

620.6 GFCI Protection in Elevator Pits, Etc.

All 125-volt, single-phase, 15- and 20-ampere receptacle installed in pits, for hoistways, elevators, dumbwaiters, escalators, etc. are required to be of the GFCI receptacle type



Permanently installed sump pumps required to be either permanently wired or must be supplied by a single receptacle that is GFCI protected

620.65 Signage for Selective Coordination

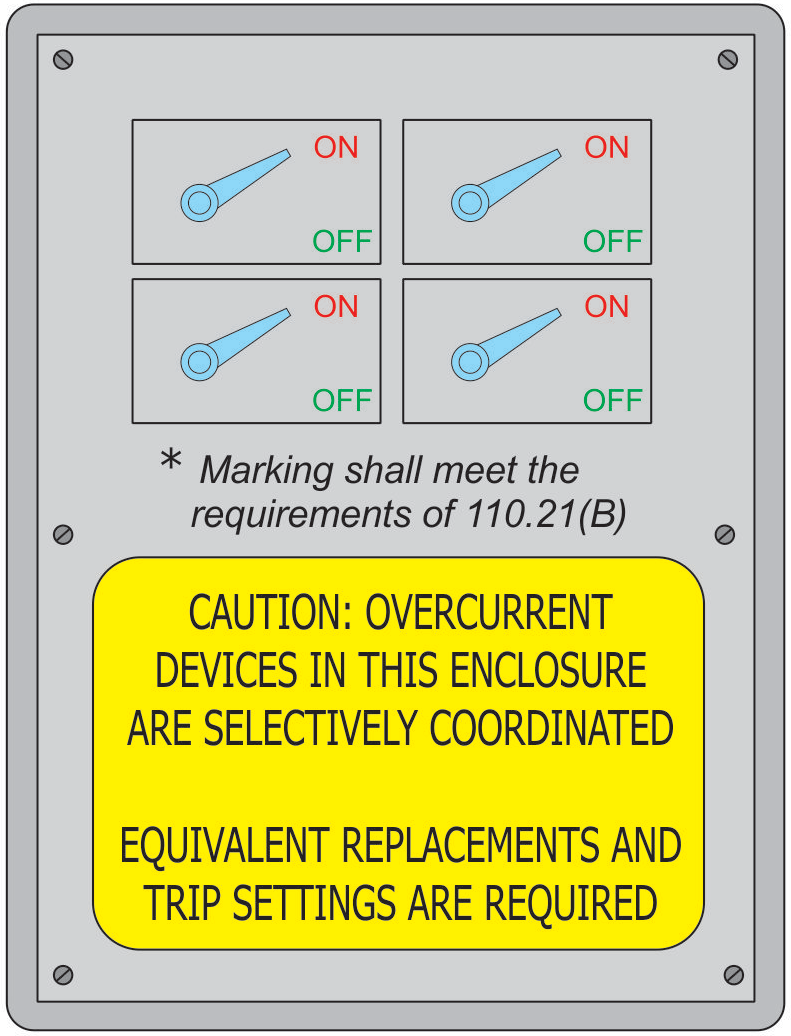
(Elevators, Dumbwaiters, Escalators, Moving Walks, Platform Lifts, and Stairway Chairlifts)

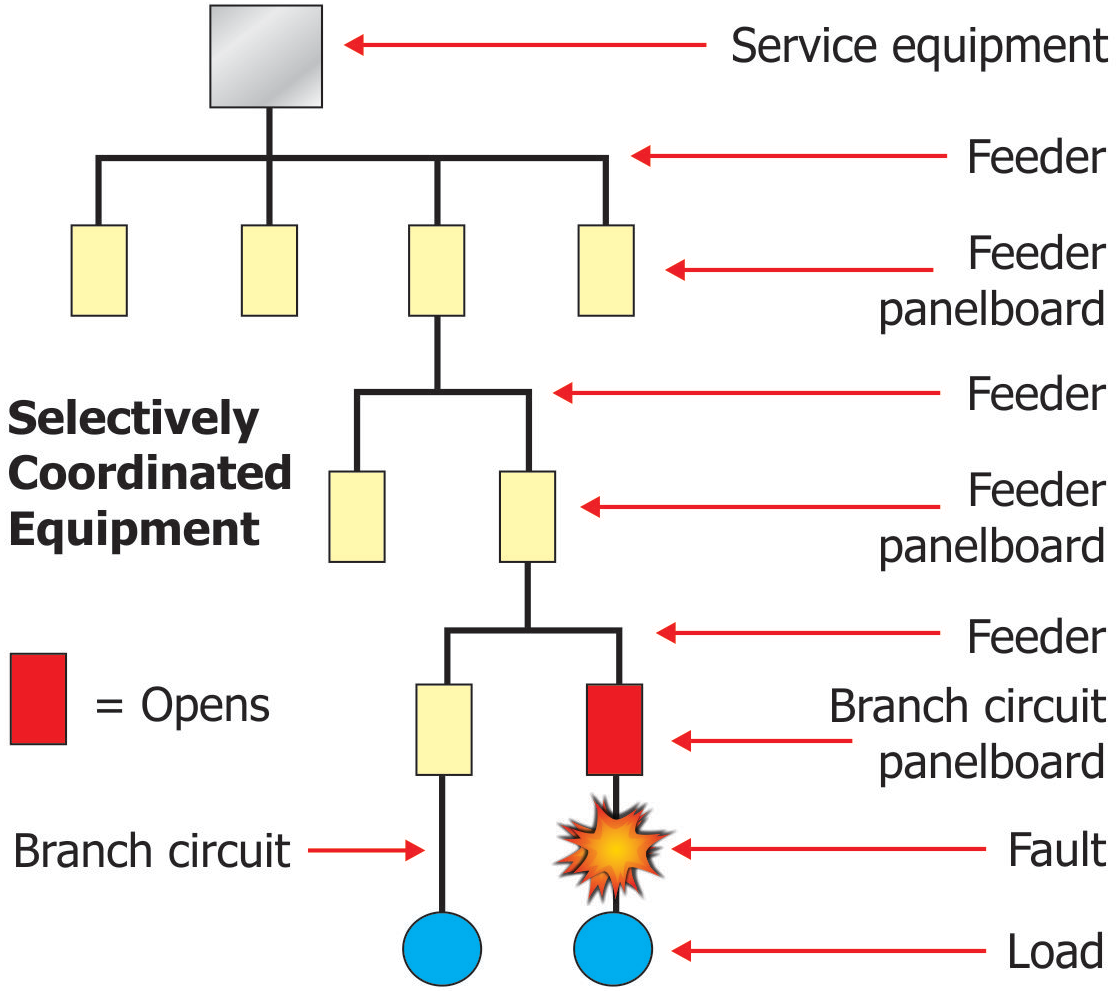
- New section added to require **equipment enclosures** for elevators, etc. containing **selectively coordinated** overcurrent devices to **be legibly marked in the field**
- More than one driving machine disconnecting means for elevators, escalators, etc. were **required to be selectively coordinated** with any other supply side overcurrent protective devices when supplied by a single ***feeder (but no marking was required)***
- Field marking will alert those who are authorized to maintain, inspect or work on the system that the overcurrent devices are selectively coordinated and provide a **higher level of safety**
- Change will also aid in enforcement by making information readily available to the AHJ

620.65 Signage for Selective Coordination

(Elevators, Dumbwaiters, Escalators, Moving Walks, Platform Lifts, and Stairway Chairlifts)

Equipment enclosures containing selectively coordinated overcurrent devices required to be legibly marked in the field to indicate that the overcurrent devices are selectively coordinated





Article 625 and 625.1 Electric Vehicle ~~Charging~~ Power Transfer Systems

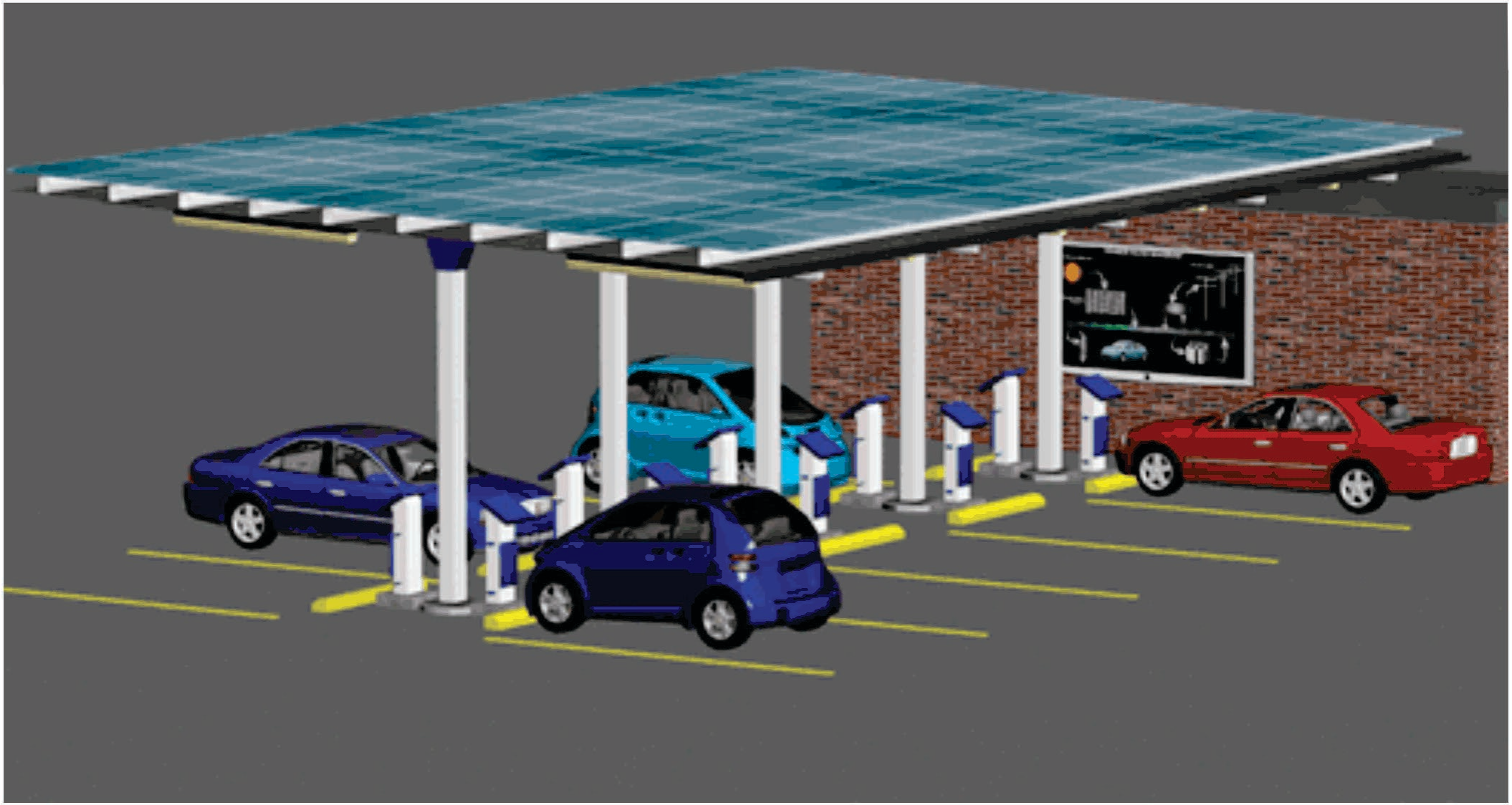
- With the addition of **power export equipment** and **bidirectional current flow equipment**, a change to the title and scope of Article 625 was needed for clarify
- Previous scope of Article 625 covered “the electrical conductors and equipment external to an electric vehicle that connect an electric vehicle to a supply of electricity by conductive, inductive, or wireless power transfer *(contactless inductive charging)* means, and the installation of equipment and devices related to electric vehicle charging”
- Scope now covers “the electrical conductors and equipment connecting an electric vehicle **to premises wiring** for the purposes of **charging**, **power export**, or **bidirectional current flow**”
- Significant changes to Article 625 occurred last *Code* cycle when the **wireless power transfer technology** was introduced to the article

Article 625 and 625.1 Electric Vehicle ~~Charging~~ Power Transfer Systems *(cont.)*

- Another significant change is being incorporated into Article 625 this *Code* cycle with the introduction of rules pertaining to **power export equipment** and **bidirectional current flow equipment**
- **Power export equipment** and **bidirectional current flow equipment** provisions are being added to a couple of definitions ***[Electric Vehicle Power Export Equipment (EVPE)*** *and* ***Electric Vehicle Supply Equipment (EVSE)]***
- These terms are also being added at **625.41** (Overcurrent Protection), **625.43** (Disconnection Means), and **625.48** (Interactive Systems)
- **Power export equipment** and **bidirectional current flow equipment** can cover a wide range of devices, **including but not limited to**: an inverter regardless of off-board or on-board, an EVSE that works for reverse power flow from a vehicle, an AC outlet regardless of off-board or on-board, a dc 12 volt outlet, and a USB socket as a 5 volt power outlet

Article 625 and 625.1 Electric Vehicle ~~Charging~~ Power Transfer Systems

This article covers the electrical conductors and equipment connecting an electric vehicle to premises wiring for the purposes of charging, power export, or bidirectional current flow.




GREEN VEHICLE SHOWCASE
PLUG-IN VEHICLE ONLY
PERMIT PARKING ONLY
PERMIT NO. 64
AT ALL TIMES
VIOLATORS SUBJECT TO TOWING
zipcars
live here

Article 625, Part II – EV Equipment Construction

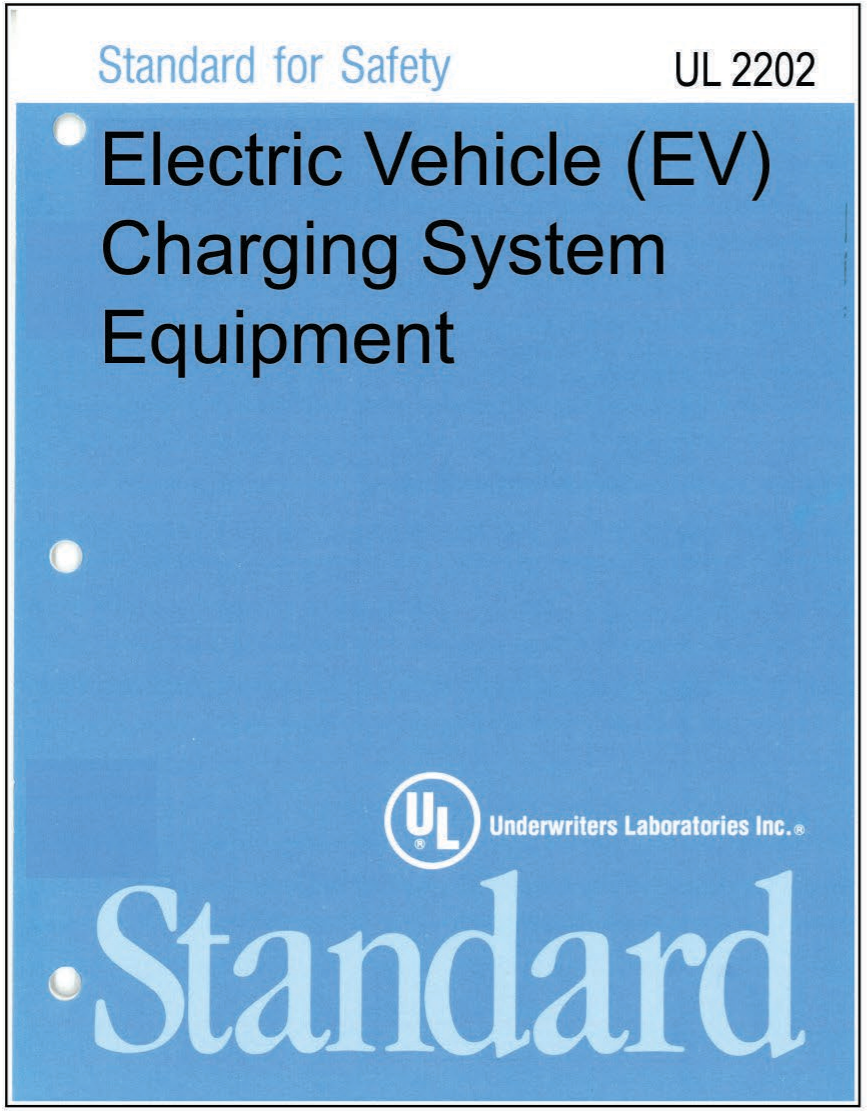
- **Product construction requirements** in Part II of Article 625 were deleted from Article 625
- Previously, Part II of Article 625 contained **several product construction requirements** that are **better suited in one of the product standards** for EV equipment
- ***All*** **product construction requirements** in Part II of Article 625 addressing product features that are an **integral part of the listing requirements** *(required by 625.5)* for the product were **removed from Article 625**
- Equipment construction requirements were **developed and added to the 1999 *NEC*** at a time when there were **no existing published product safety standards** specifically covering electric vehicle charging or supply equipment

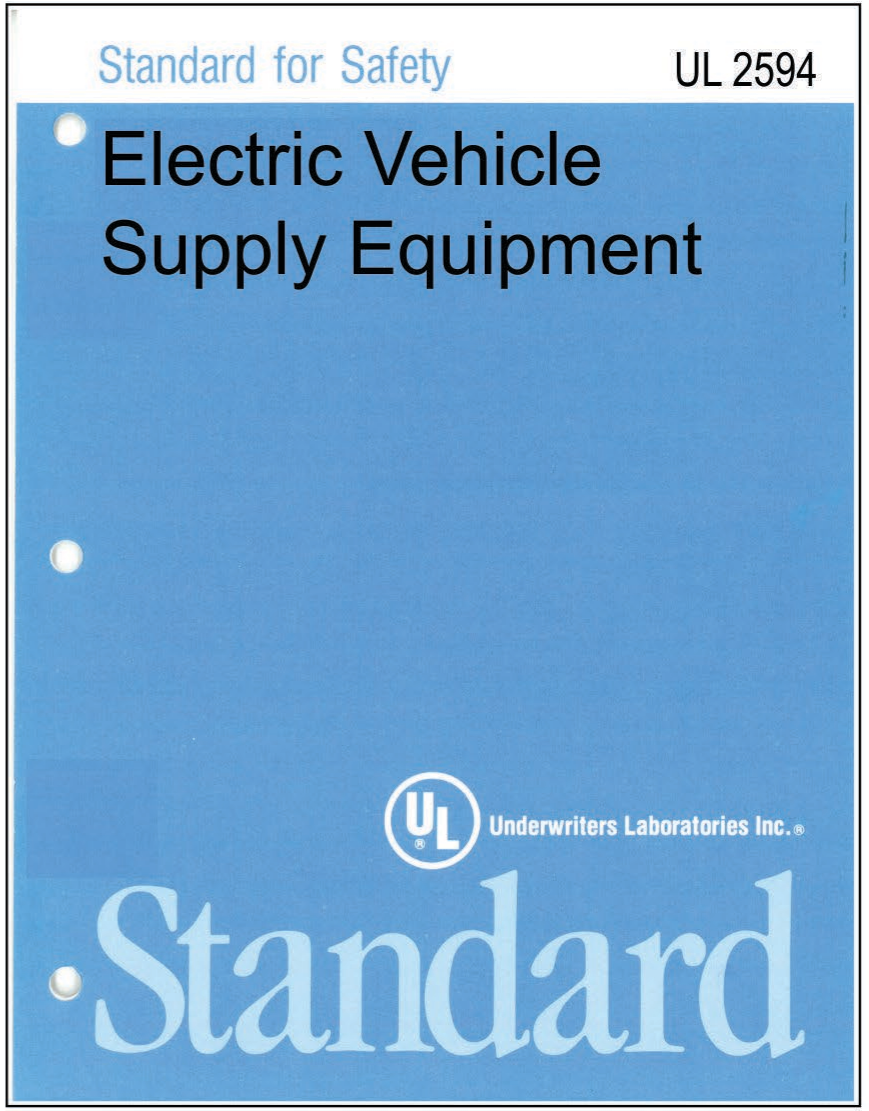
Article 625, Part II – EV Equipment Construction *(cont.)*

- **Product construction requirements** in Part II of Article 625 were deleted from Article 625 *(cont.)*
- Since that time, **several product safety standards** covering electric vehicles and electric vehicle supply equipment with associated product listing programs **available** from several of the nationally recognized testing laboratories (NRTL) have been **developed and implemented** in the electric vehicle world
- All of these product standards are included in **Informative Annex A** *(see 90.7, Informational Note No. 3)*
- With the elimination of these sections, **two definitions** that are not used elsewhere in the Article are also **removed** *(**Electric Vehicle Coupler** and **Electric Vehicle Inlet**)*

Article 625 - Part II EV Equipment Construction

All product construction requirements in Part II of Article 625 addressing product features that are an integral part of the listing requirements for EV product were removed from Article 625





625.17(B) Output Cable to Electric Vehicles

- Revision allows the **output cable** to an electric vehicle to be an **integral part of listed electric vehicle supply equipment**
- Previously, Type EV, EVJ, EVE, EVJE, EVT, or EVJT flexible cable were the **only permitted output cables** to an electric vehicle
- Output cable to an electric vehicle now permitted to be **listed** Type EV, EVJ, EVE, EVJE, EVT, or EVJT flexible cable as specified in Table 400.4 ***or*** an output cable that is an **integral part of listed electric vehicle supply equipment**
- Introduction of **multiple long range, mass-market priced electric vehicles** requires **exponential growth** in the number of fast charge stations accessible to the public
- Due to the larger batteries, fast charges must increase the power delivery rates in order to keep the charging times reasonable

625.17(B) Output Cable to Electric Vehicles *(cont.)*

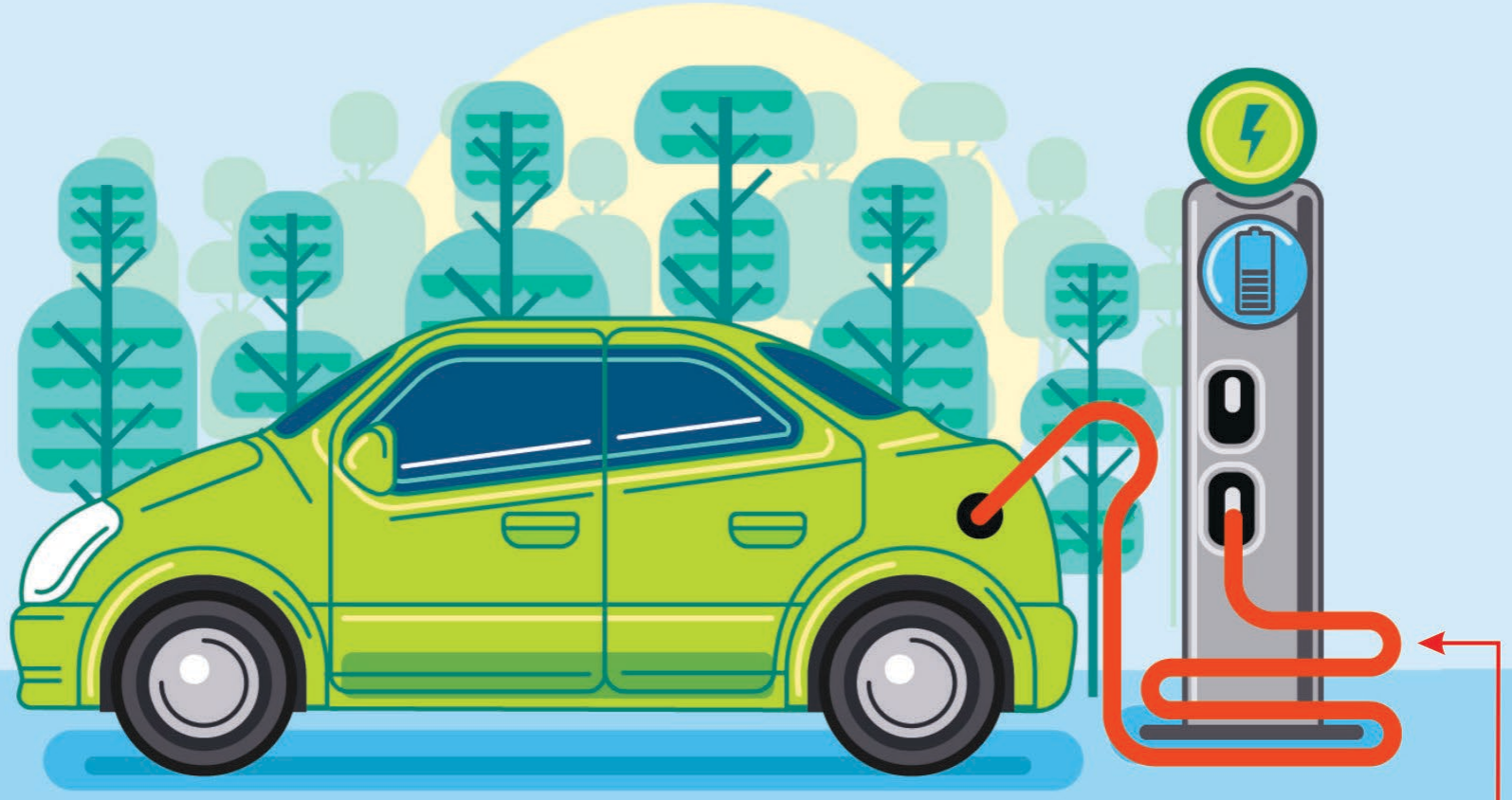
- Some in the EV industry felt like the previous *Code* language was **overly restrictive** and precluded any innovation or progress to deliver smaller, lighter, and safer cables for charging an EV
  - Such as the **engineered cabling solutions** being incorporated into the electric vehicles themselves that are **an integral *(nondetachable)* part of the listed electric vehicle supply equipment** (EVSE)
- Using the allowable cable types and construction types previously permitted at 625.17(B) for fast charging, long range EVs would result in **cables so large and heavy** that they would be practically rendered **unusable**

625.17(B) Output Cable to an Electric Vehicle

The output cable to the electric vehicle shall be one of the following:

(1) Listed Type EV, EVJ, EVE, EVJE, EVT, or EVJT flexible cable as specified in Table 400.4 or...

(2) An integral part of listed electric vehicle supply equipment



Output cable that is an integral part of listed electric vehicle supply equipment

625.44 EV Portable Equipment Connection

- The connection methods for connection of **portable EV charging equipment** to the premises wiring system has been **expanded** to include certain **250-volt rated receptacle outlets**
- Previously, **portable EV charging equipment** for connection to the premises wiring system was limited to **(1)** a nonlocking, 2-pole, 3-wire grounding-type receptacle outlet rated at 125 volt, single phase, 15 or 20 amperes or **(2)** a nonlocking, 2-pole, 3-wire grounding-type receptacle outlet rated 60 volt dc maximum, 15 or 20 amperes
- Expanded to the use of a nonlocking, 2-pole, 3-wire, **250-volt, single phase, 15 or 20 amperes** grounding-type receptacle outlet or a nonlocking, 2-pole, 3-wire or 3-pole, 4-wire grounding-type receptacle outlet rated at **250 volts, single phase, 30 or 50 amperes**

625.44 EV Portable Equipment Connection *(cont.)*

- The connection methods for connection of **portable EV charging equipment** to the premises wiring system has been **expanded** to include certain **250-volt rated receptacle outlets** *(cont.)*
- Electric vehicle (EV) manufacturers continue to **extend the range** or distance an EV can travel **between charges**
- Demand exist for having the ability to charge upon reaching that extended range destination in order to make **longer range EV travel plausible**
- Multiple EV manufacturers insist that **250-volt portable charging** is a must in order to support the sale and deployment of longer range EVs
- Title of **625.44(B)** changed from “Stationary Equipment” to “Fastened-in-Place Equipment” *(wiring method suitable for portable equipment is suitable for fastened in place equipment as well)*

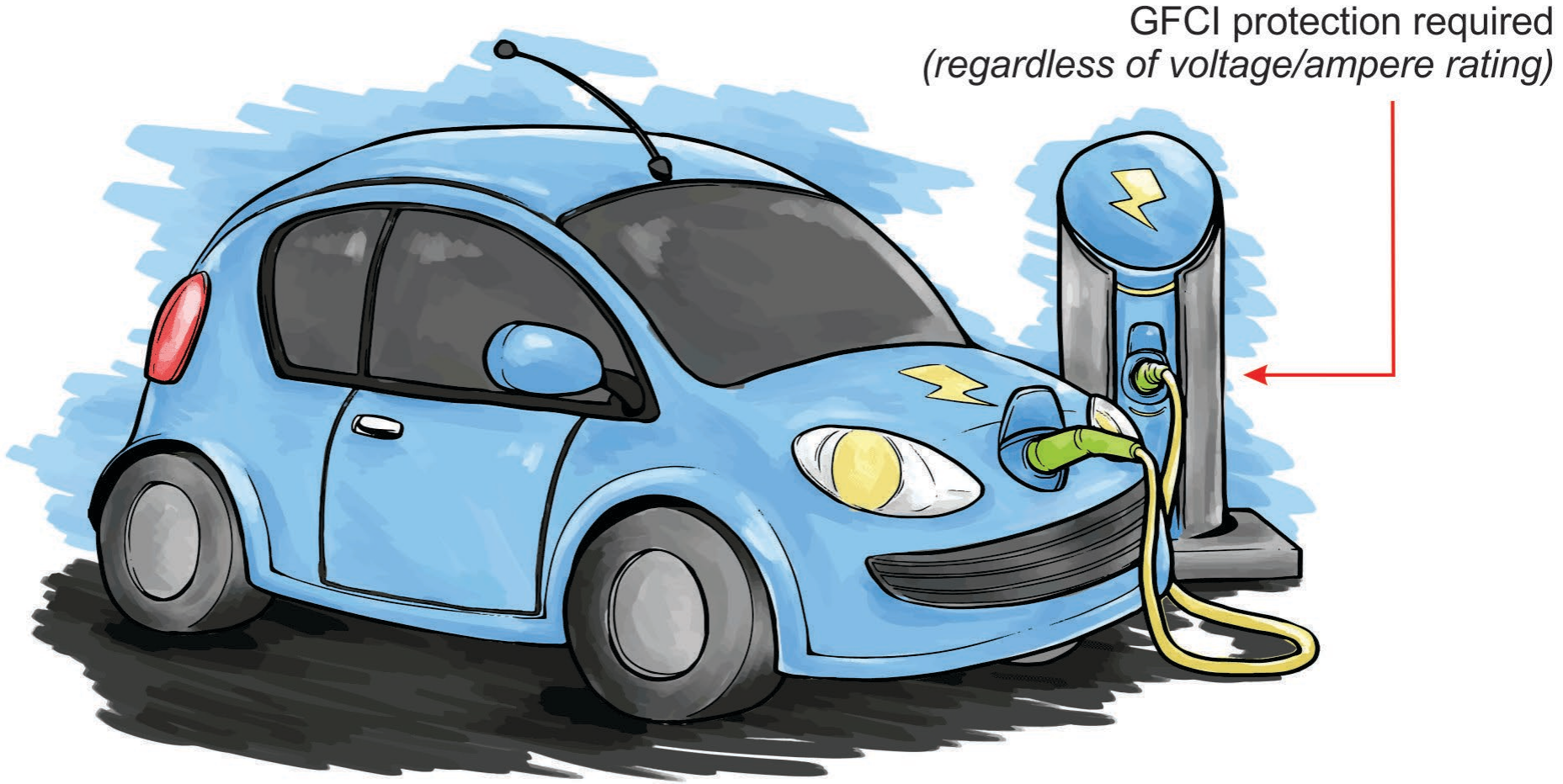

POWER
CHARGING
FAULT

625.54 GFCI Protection for EV Charging Equipment

- Revision clarifies that all receptacle outlets used for electric vehicle (EV) charging be provided with **GFCI protection** for personnel for all **cord and plug connected** electric vehicle power transfer equipment
- In the past, receptacle outlet(s) used for EV charging equipment may or may not have been required to be GFCI protected, depending on the location of the receptacle outlet and the rating of said outlet
- All receptacle outlets installed for the connection of EV charging will be required to be provide with **GFCI protection** for personnel *(regardless of the receptacle outlet's location)*
- Electrical safety concerns were expressed concerning personnel plugging and unplugging something like a 250-volt cord cap into a receptacle outlet in a wet or damp environment
- GFCI protection for receptacle outlets used for EV charging is "**in addition to the requirements in 210.8**"

625.54 GFCI Protection for EV Charging Equipment

In addition to the requirements in 210.8, ***ALL*** receptacles installed for the connection of electric vehicle charging equipment is required to provide GFCI protection for personnel

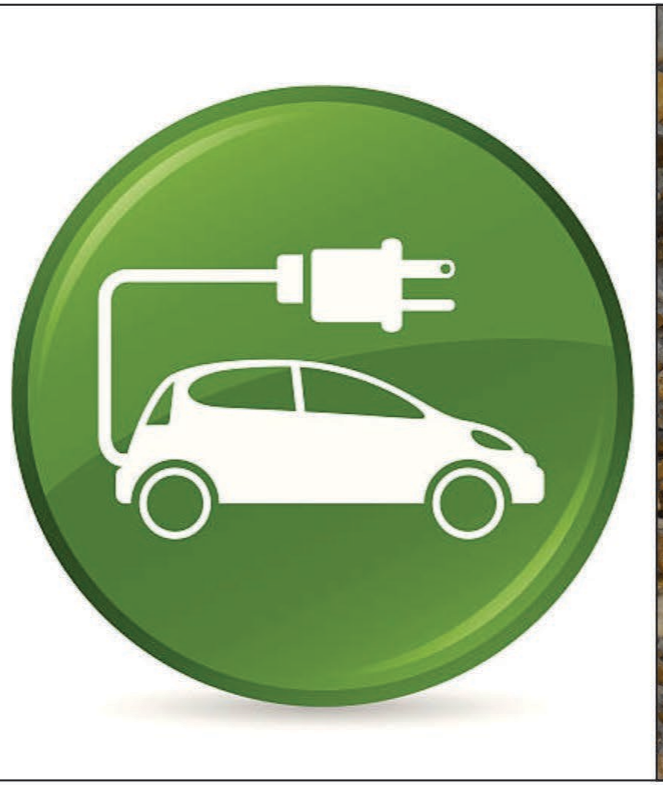


625.56 Weatherproof Enclosure for EV Charging Receptacle Outlets

- New requirement added requiring ***all*** receptacles installed in **wet locations** for **electric vehicle (EV) charging** to be installed in an enclosure that provides **weatherproof protection** with or without an attachment plug cap inserted
- Similar to weatherproof enclosure requirements of **406.9(B)**, but this Chapter 4 requirement only applies to 15 and 20 amperes rated receptacles
- No voltage or amperage rating limitation to this new Article 625 rule
- Outlet box hood installed for this purpose required to be **listed** and be identified as "**extra duty**," while allowing other listed products, enclosures, or assemblies providing weatherproof protection that do not utilize an outlet box hood to not be required to be marked "extra duty"
- New receptacle enclosure requirement at 625.56 will bring some consistency between Article 406 and Article 625

625.56 WP Enclosure for EV Charging Receptacle Outlets

All receptacles installed in a wet location for electric vehicle charging require an enclosure that is weatherproof with the attachment plug cap inserted or removed



An outlet box hood installed for this purpose required to be listed and identified as "extra duty"

Other listed products, enclosures, or assemblies providing weatherproof protection *(not utilizing an outlet box hood)* shall not be required to be marked "extra duty"

625.60 AC Receptacle Outlets Used for EVPE

- New section added to require **all on-board receptacle outlets** on or in an electric vehicle to be **GFCI protected**
- The ground-fault circuit-interrupter indication and reset to be installed in a **readily accessible location**
- Common occurrence to see **120-volt alternating current (ac) receptacle outlets** installed on-board in vehicles *(not just electric vehicles)*
- These on-board ac receptacle outlets will be required to be **listed** and rated at **250 volts maximum**, single phase **50 amperes maximum** with overcurrent protection integral to the power export system
- Should a person be less protected in their electric vehicle at the beach that they would be at home in their garage?


12V
MAX 120W
AC 120V
MAX 150W
VOL
VOL
HI
LO
HI
LO
HDMI

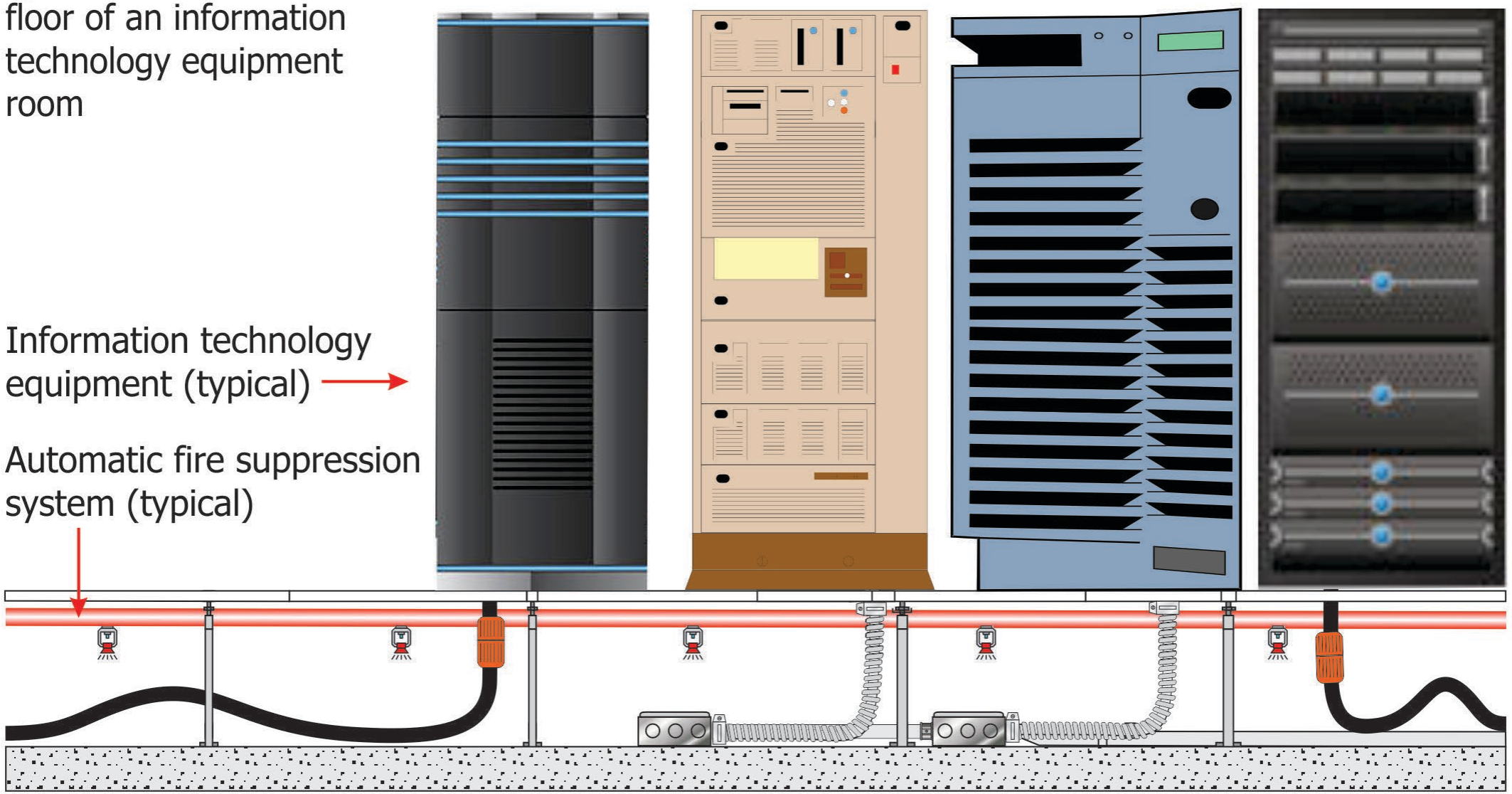

AC 115V
MAX 150W
12V

645.5(E) Wiring Under Raised Floors (IT Equipment Rooms)

- Revisions distinguish between air space under a raised floor in an information technology (IT) equipment room when protected by an **automatic fire suppression system** and those that are not
- This information is a condition that is needed to help determine the **appropriate wiring method** under a raised floor
- Protection by an automatic fire suppression system *(or lack thereof)* is a condition spelled out in detail in **NFPA 75** *(Standard for the Fire Protection of Information Technology Equipment)*
- This revision removes any conflict between *NEC* and NFPA 75, which permits non-plenum wiring under a raised floor when an automatic fire suppression system is present, otherwise plenum wiring is required

645.5(E) Wiring Under Raised Floors (ITE Rooms)

Requirements revised to incorporate protected techniques offered by an automatic fire suppression system under a raised floor for supply circuits and interconnecting cables installed under a raised floor of an information technology equipment room



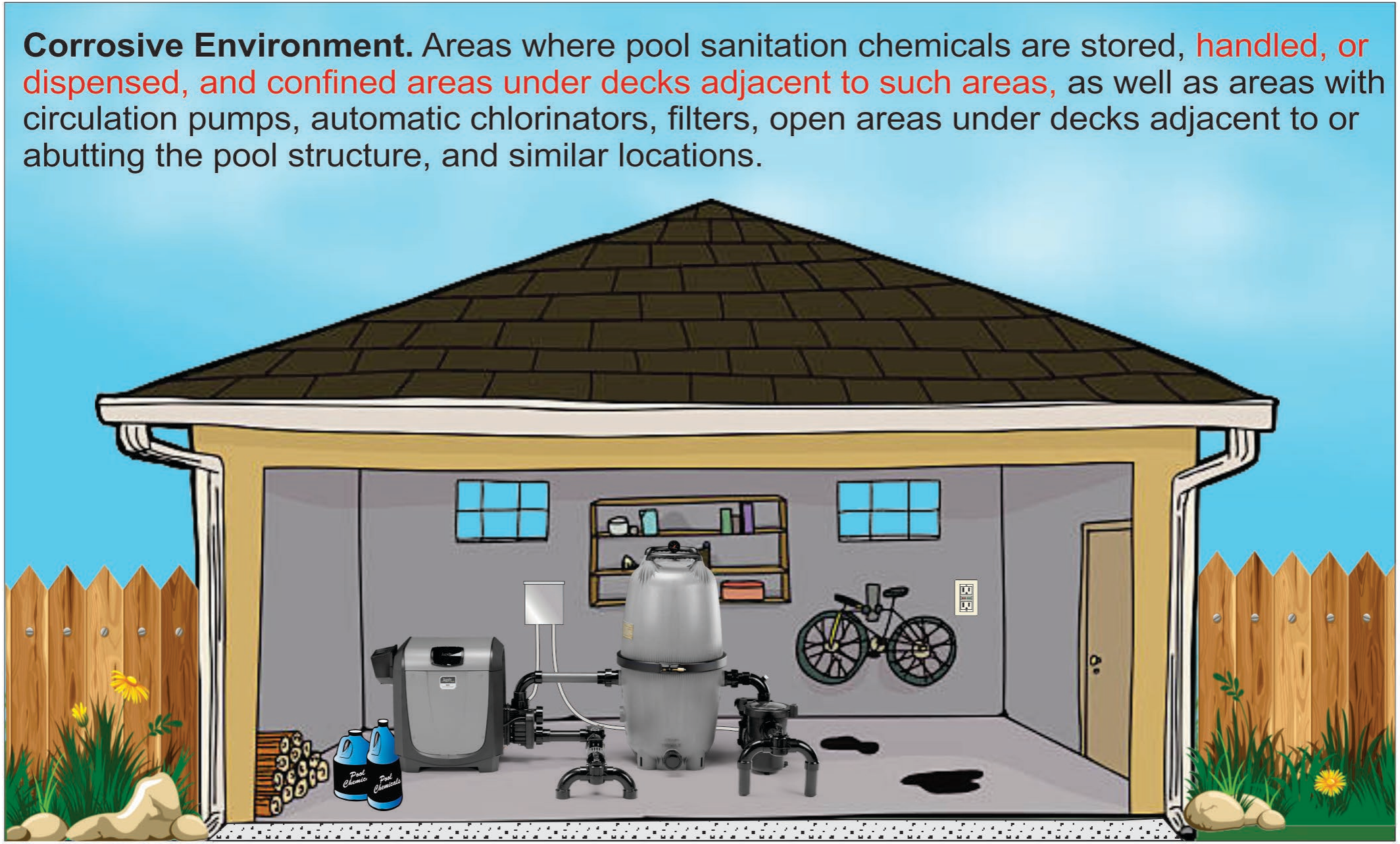
645.5(E) Supply Circuits and Interconnecting Cables Under Raised Floors

680.2 and 680.14 Corrosive Environment

- The definition of "**Corrosive Environment**" was revised and moved from 680.14 to 680.2
- Title of **680.14** was revised to "**Wiring Methods in Corrosive Environment**" and now only address the **wiring methods identified for use in a corrosive environment** in and around swimming pools, fountains, and similar installations
- 2017 *NEC* added section at 680.14 with a "**description**" of what a corrosive environment could be
- This "description" was very close to a "definition" of a corrosive environment and needed to be relocated to 680.2

680.2 and 680.14 Corrosive Environments

Corrosive Environment. Areas where pool sanitation chemicals are stored, handled, or dispensed, and confined areas under decks adjacent to such areas, as well as areas with circulation pumps, automatic chlorinators, filters, open areas under decks adjacent to or abutting the pool structure, and similar locations.



680.2, 680.35, and 680.45 Immersion Pools

- Two new sections covering **immersion pools** were added to Article 680 providing installation requirements for a newly added definition at 680.2 for "**Immersion Pools**"
- "Immersion pools" were previously covered by Article 680 with these terms included in the **three definitions** but their unique characteristics were not specifically addressed in previous *Code* language
- New requirements at 680.35 and 680.45 and definition at 680.2 will provide needed clarity to applications where listed pre-packaged units are not used
- New definition added to 680.2 indicates that an immersion pool is "a pool for ceremonial or ritual immersion of users, which is designed and intended to have its contents drained or discharged"

680.2, 680.35, and 680.45 Immersion Pools *(cont.)*

- Two new sections covering **immersion pools** were added to Article 680 providing installation requirements for a newly added definition at 680.2 for "**Immersion Pools**" *(cont.)*
- Immersion pools are typically installed in a building such as a church and are generally installed indoors but may be installed outdoors, on the ground or supporting structure, or in the ground or supporting structure
- Typically contain integral interior steps and may be equipped with a heater and/or pump and can employ an underwater luminaire
- New **680.35** will deal with requirements for "**Storable and Portable Immersion Pools**" and new **680.45** was added for "**Permanently Installed Immersion Pools**"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680.2 and 680.50 Splash Pads

- A **new definition** for **“Splash Pads”** was added and provisions added at **680.50** to allow for future revisions to more accurately target installation requirements for these units
- **Splash Pad.** A fountain with a pool depth **25 mm (1 in.) or less**, intended for recreational use by pedestrians. This definition does not include showers intended for hygienic rinsing prior to use of a pool, spa, or other water feature.
- Splash pads now required to comply with **Part II** *(permanently installed pools)* and equipotential bonding requirements
- Splash pads and similar installations present the **same potential risk of electric shock** as do the areas around swimming pools
- Similar **equipotential bonding** should therefore be required


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ELECTRICAL INSPECTORS


CYLE
FIELD A

680.4 Inspections After Installation (Swimming Pools, Fountains, and Similar Installations)

- New section ***(Inspections After Installation)*** added to provide the AHJ with the opportunity to address hazards associated with **aging pool installations**
- Grants AHJ permission to require **periodic inspection and testing** of pool related equipment
- After final inspection of a new installation, AHJ rarely sees that installation again during the lifespan of that particular installation *(unless a remodel or renovation occurs)*
- Due to corrosive conditions beyond what normal electrical equipment has to endure, pool-related electrical equipment is **subject to failure** and typically has a **shorter lifespan** than most electrical equipment
- Leaving the nature and frequency of inspection or maintenance to the AHJ allows jurisdictions to decide whether to apply this to all pools, commercial pools, etc.

680.4 Inspections After Installation

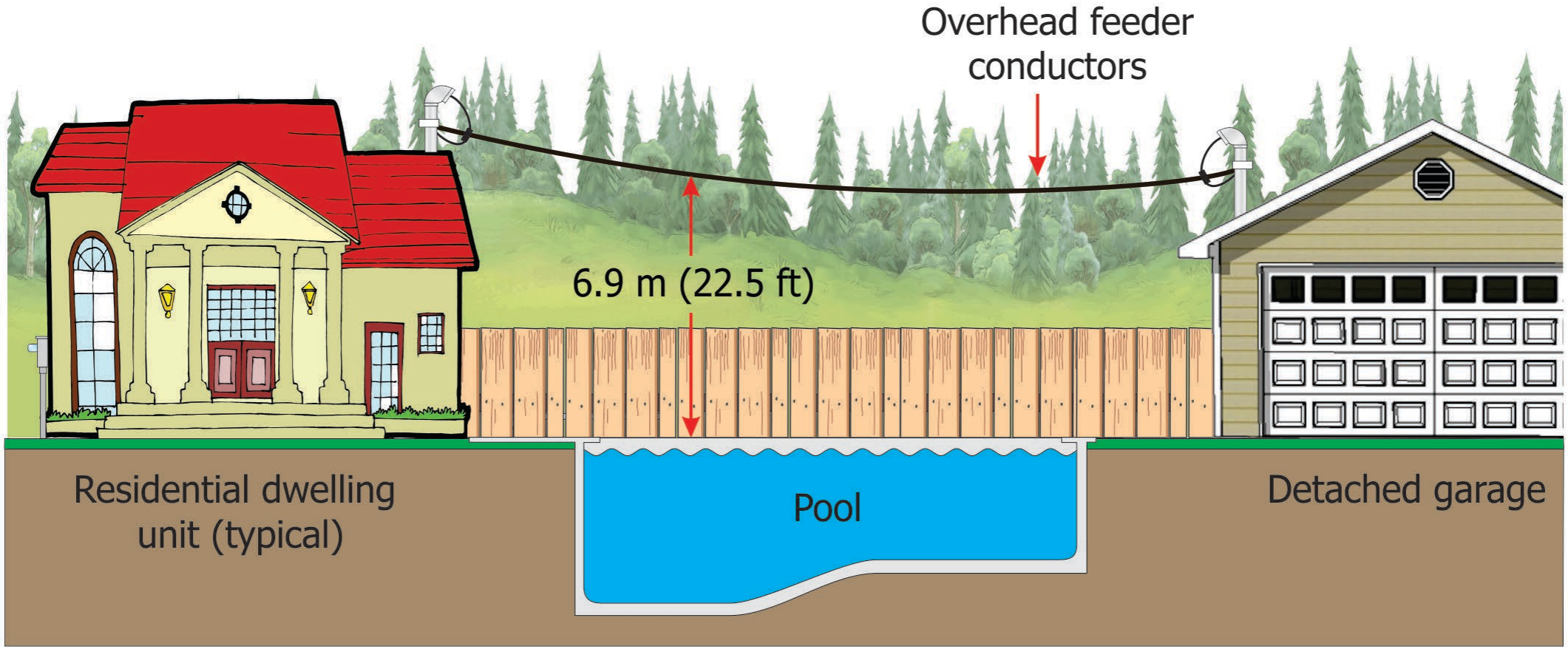
The AHJ shall be permitted to require periodic inspection and testing of Article 680 equipment

680.9(A) Overhead Power Conductor Clearances

- Revision clarifies that **all overhead conductor** *(not just service conductors)* need proper clearances when installed over swimming pools and similar installations
- Previous requirements only addressed overhead service-drop conductors, overhead service conductors, and open overhead wiring
- 680.9(A) revised to make these overhead clearances applicable to any and *ALL* overhead power conductors *(overhead **feeders**, **branch circuits**, etc.)*
- Overhead clearances for communications cables [680.9(B)] and overhead network-powered broadband communications systems (NPBCS) conductors [690.9(C)] remain the same as previous *Code* cycle

680.9(A) Overhead Power Conductor Clearances

The minimum clearances for overhead power conductors *(not just service conductors)* from pools, fountains, etc. shall comply with the provisions in Table 680.9(A) for conductors operating at 0 to 750 volts to ground [6.9 m (22.5 ft)] *(typical)*

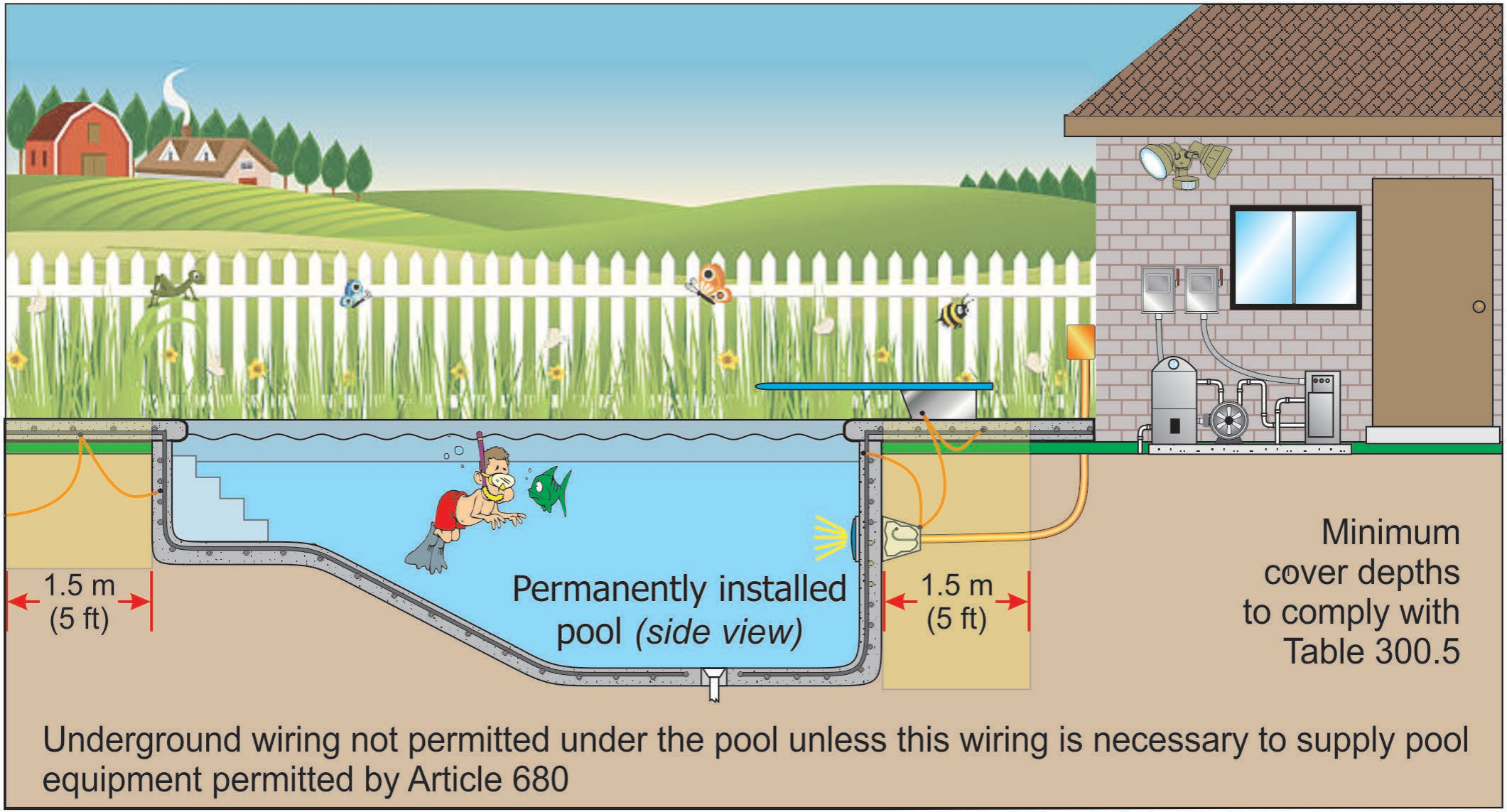


680.11 Underground Wiring Around Swimming Pools

- Underground wiring methods around a swimming pool revised into a **list format**
- Long-standing distance of **1.5 m (5 ft)** *(removed for the 2017 NEC)* around pool that **underground wiring restrictions were subject to** was revived for this *Code* cycle and apply to acceptable wiring methods that are listed for direct burial in these areas where exposure to a corrosive environment is a concern
- Two new wiring methods added to the list of **acceptable wiring methods** within this 1.5 m (5 ft) underground zone *(**liquidtight flexible nonmetallic conduit** listed for direct burial use and **liquidtight flexible metal conduit** listed for direct burial use)*

680.11 Underground Wiring Around Swimming Pools

Underground wiring within 1.5 m (5 ft) horizontally from the inside wall of the pool shall be permitted



680.21(C) GFCI Protection for Motors

- **GFCI protection** generally applicable to all **motors** used in pool applications
- **Exception** added for **listed low-voltage motors** not requiring grounding *(with ratings not exceeding the low-voltage contact limit)*
  - A GFCI device cannot detect a loss of current on the low-voltage side of a listed transformers or power supply, so it offers no protection on the low-voltage side
- **Outlets** supplying **all pool motors** *(not just pool pump motors)* on branch circuits rated 150 volts or less to ground and 60 amperes or less, single- or 3-phase, shall be provided with Class A GFCI protection
- Prior to this revision, GFCI protection was only called upon for “single-phase, 120-volt through 240-volt” rated pool pump motors
- Revision incorporates **single-phase** and **3-phase motors**, which would include **single-phase 120/240 volt**, **single-phase 208Y/120 volt**, and **3-phase 208Y/120 volt** motors

680.21(C) GFCI Protection for Motors

Outlets supplying ***all*** pool motors on branch circuits rated 150 volts or less to ground and 60 amperes or less, single- or 3-phase, shall be provided with Class A GFCI protection

Exception permits listed low-voltage motors not requiring grounding (with ratings not exceeding the low-voltage contact limit) supplied by listed transformers or power supplies to be installed without GFCI protection

680.21(D) Pool Pump Motor Replacement

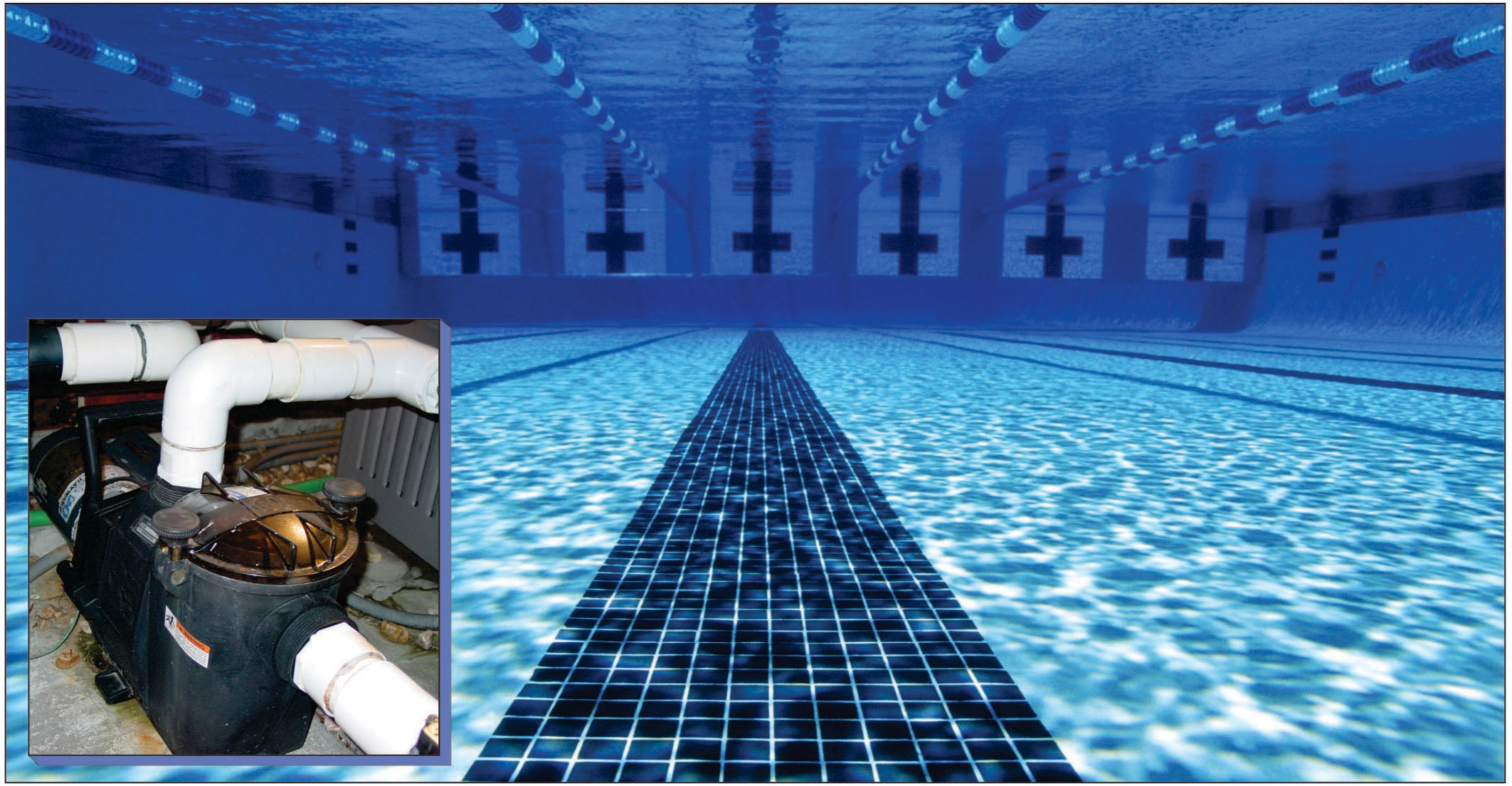
- A new requirement was added to facilitate **GFCI protection** implantation on older pools for **replacement motors**
- New rule will demand **GFCI protection** for a new pool pump motor replacing an existing pool pump motor being **replaced** for maintenance or repair
- Substantiated **injuries** and **fatalities** have occurred in the past by a non-GFCI protected pool pump motor being replaced with a non-GFCI protected motor
- This new GFCI requirement is intended to facilitate **GFCI protection** at **older existing swimming pools** that might not have been required to provide GFCI protection at pool pump motors installed under previous *Code* cycles

680.21(D) Pool Pump Motor Replacement

Where an existing pool pump motor described at 680.21(C) is replaced for maintenance or repair, the replacement pump motor shall be provided with ground-fault circuit-interrupter protection

680.21(D) Pool Pump Motor Replacement

Where an existing pool pump motor described at 680.21(C) is replaced for maintenance or repair, the replacement pump motor shall be provided with ground-fault circuit-interrupter protection



680.22(A)(5) Pool Equipment Room Receptacle

- New provisions were added to require **at least one GFCI-protected receptacle** within a **pool equipment room**
- At least one **GFCI-protected 125-volt**, **15- or 20- ampere** receptacle on a **general-purpose circuit** to be located within a pool equipment room
- All other receptacles *(supplied by branch circuits rated 150 volts or less to ground)* in a pool equipment room now require **GFCI protection** as well
- Requiring at least one GFCI protected receptacle within a pool equipment room will lessen the **potential hazard of employing an extension cord** run from a receptacle outlet elsewhere that is not GFCI protected
- Water is typically present on the floor during normal operation or maintenance of pool equipment rooms

680.22(A)(5) Pool Equipment Room Receptacle

At least one GFCI-protected 125-volt, 15- or 20- ampere receptacle on a general-purpose circuit required to be located within a pool equipment room

All other receptacles supplied by branch circuits rated 150 volts or less to ground within a pool equipment room required to be GFCI protected

680.22(E) Other Equipment in Close Proximity to a Pool

- **Other equipment** *(other than traditional pool pump motors and controllers)* are now required to generally be located **at least 1.5 m (5 ft) horizontally** from the inside walls of a pool
- **Other equipment** *(with ratings exceeding the low-voltage contact limit)* required to be located at least **1.5 m (5 ft)** horizontally from the inside walls of a pool **unless separated** from the pool by a **solid fence, wall, or other permanent barrier**
- Of particular concern is **electric power production equipment** such as generators, solar photovoltaic (PV) systems, fuel cell systems, wind systems, and energy storage systems being **installed in close proximity to a pool**
  - With this type of equipment, concern about **metal parts being at different voltage potentials**, and a real concern is a **shock hazard** associated with this type of equipment located too close to a pool

680.22(E) Other Equipment in Close Proximity to a Pool

Electrical equipment with ratings exceeding the low-voltage contact limit must be located at least 1.5 m (5 ft) horizontally from the inside walls of a pool unless separated from the pool by a solid fence, wall, or other permanent barrier

680.23(B)(6) Servicing Wet-Niche Luminaires

- "**Servicing**" requirement for a wet-niche luminaire was revised for clarity
- Provisions added for **spas** that can be drained so luminaire can be placed on the **spa bench** for servicing
- For servicing wet-niche luminaires in **spa locations** with luminaire installed low in the foot well of the spa, the luminaire is only required to reach the **bench location**, where the spa can be drained to make the bench location dry
- Wet-niche luminaires installed in permanently installed swimming pools are typically required to be installed in such a manner where they were **removable from the water** for inspection, relamping, or other maintenance
- Bench of a spa that can be drained below the bench area **serves the same function as the deck of a pool** with no need to take the spa luminaire all the way to the deck in order to change a light bulb when a dry bench can serve the same purpose

680.26(B)(2)(c) Copper Grid for Perimeter Surfaces Equipotential Bonding

- A **new option** was added to allow a **copper grid system** as **alternative method** for **equipotential bonding** at the **perimeter surface** when structural steel is not available
- Copper grid system would consist of **8 AWG solid bare copper** arranged in a **300-mm (12-in.) by 300-mm (12-in.) network** of conductors in a **uniformly spaced perpendicular grid pattern** with a tolerance of **100 mm (4 in.)**
- Copper grid must follow the **contour of the perimeter surface** extending **1 m (3 ft) horizontally** beyond the inside walls of the pool
- Splices are permitted, but only with **listed splicing devices** or the **exothermic welding process**
- Copper grid is required to be secured within or under the deck or unpaved surfaces between **100 mm to 150 mm (4 in. to 6 in.)** below the subgrade

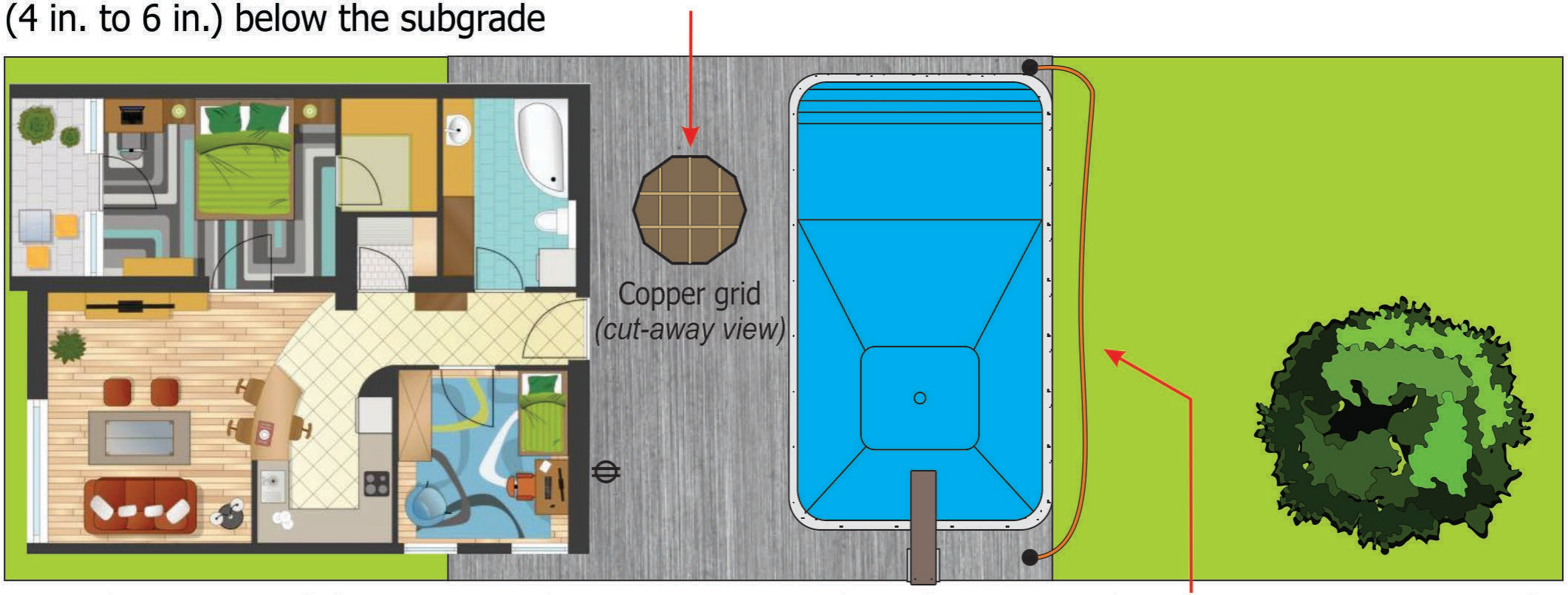
680.26(B)(2)(c) Copper Grid for Perimeter Surfaces Equipotential Bonding *(cont.)*

- Copper grid system is an **extremely effective means of bonding** when the structural reinforcing steel is encapsulated in a nonconductive compound or where unencapsulated structural reinforcing steel is not available or utilized
- Previous **copper ring system** of at least one minimum **8 AWG bare solid copper conductor** described at **680.26(B)(2)(b)** is still a **viable option** for bonding around a pool when the structural reinforcing steel is encapsulated in a nonconductive compound or where unencapsulated structural reinforcing steel is not available or utilized
- Bonding requirements are an **important and unique protective method** employed to increase the safety of the users of bodies of water such as pools, spas and hot tubs
- Bonding is required to **eliminate voltage gradients** (rises) in the pool area

680.26(B)(2)(c) Copper Grid for Perimeter Surfaces

Where structural reinforcing steel is not available or encapsulated, an 8 AWG copper grid system is permitted to be utilized arranged in a 300-mm (12-in.) by 300-mm (12-in.) network of conductors in a uniformly spaced perpendicular grid pattern with a tolerance of 100 mm (4 in.)

Required to be secured within or under the deck or unpaved surfaces between 100 mm to 150 mm (4 in. to 6 in.) below the subgrade



A single 8 AWG solid copper conductor or structural reinforcing steel *(rebar or wire mesh)* in the concrete is also permitted as the bonding grid for the perimeter surface

680.26(B)(5) Metallic Pool Cover Anchors

- Bonding of **metal anchors** used for pool safety covers were added to items that are **not required to be bonded** to the equipotential bonding grid
- This would include metallic pool cover anchors that are intended for insertion in a concrete or masonry deck surface **25 mm (1 in.) or less** in any dimension and **51 mm (2 in.) or less** in length
- If they are intended for insertion in a **wood or composite deck surface**, they would have to be **51 mm (2 in.) or less** in any flange dimension and **51 mm (2 in.) or less** in length
- Impractical to bond **small metal parts** commonly used in pools as these small conductive parts are **not likely to become energized** and are not considered to create a hazard for users of the pool
- Small isolated parts ***[not over 100 mm (4 in.) in any dimension]*** that do not penetrate into the pool structure more than **25 mm (1 in.)** are not required to be bonded *[see 680.26(B)(5)]*

680.26(B)(5) Metallic Pool Cover Anchors

Generally, all metal fittings within or attached to a pool structure are required to be bonded to the equipotential bonding grid of a pool *(small Isolated parts shall not require bonding)*

Metallic pool cover anchors intended for insertion in a concrete or masonry deck surface or wood or composite deck surface shall not require bonding

680.59 GFCI Protection for Permanently Installed Nonsubmersible Pumps

- New section added to specifically address **GFCI protection** for **nonsubmersible fountain pumps**
- Previous requirements called for GFCI protection for submersible fountain pumps only *(but not nonsubmersible fountain pumps) [see 680.51(A)]*
- This new section states that **outlets** supplying all permanently installed nonsubmersible pump motors rated **250 volts or less** and **60 amperes or less**, **single- or 3-phase**, shall be provided with GFCI protection
- Even though they are not submerged in the water, nonsubmersible pumps still move every drop of water contained in a fountain and **deserve GFCI protection** as much as their submergible counterparts
- Nonsubmersible pumps, sometimes referred to as "**centrifugal pumps**"

680.59 GFCI Protection for Nonsubmersible Fountain Pumps

Outlets supplying all permanently installed nonsubmersible pump motors rated 250 volts or less and 60 amperes or less, single- or 3-phase, required to be provided with GFCI protection

680.80 Electrically Powered Pool Lifts

- Revision removes text indicating that **electrically powered pool lifts** do not have to comply with **other parts of Article 680**
- Previously, electrically powered pool lifts were to comply with **Part VIII of Article 680** but did not have to comply with other parts of Article 680
- Electrically powered pool lifts now must comply with **Part VIII** of Article 680, with Part VIII is not subject to the requirements of other parts of Article 680 "**except where the requirements are specifically referenced**"
- References to other parts of Article 680 were added throughout Part VIII

680.84 Receptacles for Electrically Powered Pool Lifts

- Provisions for **receptacles** for electrically powered pool lifts were added to 680.84 stating that these receptacle operating above the low-voltage contact limit must comply with **680.22(A)(3) and (A)(4)**
- The above *Code* references call for receptacles to be located not less than **1.83 m (6 ft)** from the inside walls of a pool and requires GFCI protection for all 15- and 20-ampere, single-phase,125-volt receptacles located **within 6.0 m (20 ft)** of the inside walls of a pool
- 680.84 also calls for switches and switching devices that are operated above the low-voltage contact limit to comply with 680.22(C)
- 680.22(C) generally requires switches to be located at least **1.5 m (5 ft) horizontally** from the inside walls of a pool


LATITUDES
3 FT

682.15 GFP for Natural and Artificially Made Bodies of Water

- Revision incorporates **ground-fault protection (GFP)** of equipment and **ground-fault circuit-interrupter (GFCI)** protection for personnel to **one location** in Article 682
- Previously, there were no ground-fault protection (GFP) of equipment requirements in Article 682
- New provisions added for GFP *(**not exceeding 30 mA**)* for feeder and branch circuit conductors installed on piers
- Similar to the revised provisions at **555.35(A)(3)** for marinas, boatyards, floating buildings, and commercial and noncommercial docking facilities
- The revised provisions of **555.35(A)(3)** calls for GFP of equipment set to open at currents **not exceeding 100 mA** for feeder and branch-circuit conductors that are installed on docking facilities

682.15 GFP for Natural and Artificially Made Bodies of Water *(cont.)*

- Revision incorporates **ground-fault protection (GFP)** of equipment and **ground-fault circuit-interrupter (GFCI)** protection for personnel to **one location** in Article 682 *(cont.)*
- Previous **GFCI protection requirements** at 682.15 pertained to 15- and 20-ampere single-phase, 125-volt through 250-volt **receptacle outlets only**
- Revised GFCI provisions at **682.15(A)** pertain to direct connected or "**hard-wired**" equipment **as well as receptacle outlets** for cord-and-plug connected equipment

682.15 GFP for Natural and Artificially Made Bodies of Water

Outlets supplied by branch circuits not exceeding 150 volts to ground and 60 amperes, single-phase, shall be provided with ground-fault circuit-interrupter (GFCI) protection for personnel

Feeder and branch-circuit conductors installed on piers shall be provided with ground-fault protection (GFP) not exceeding 30 mA *(Coordination with downstream GFP permitted)*

682.33(C) Bonding of Equipotential Planes

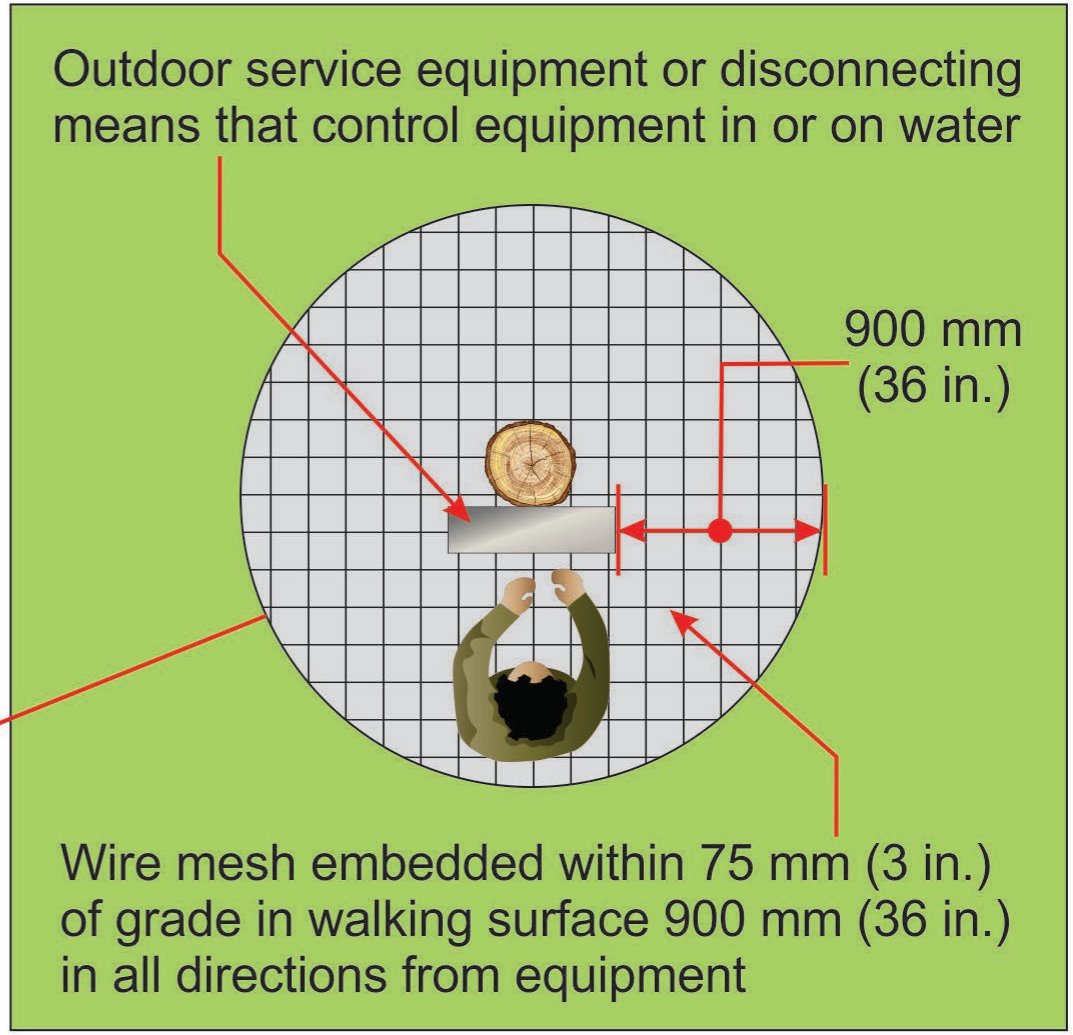
- Revision were made to more clearly define what needs to be **bonded together** and **how to bond each part** in order to properly construct an **equipotential plane** at natural and artificially made bodies of water
- The parts specified in **682.33(C)(1)** *(Bonded Parts)*, **682.33(C)(2)** *(Outdoor Service Equipment and Disconnects)*, and **682.33(C)(3)** *(Walking Surfaces)* are now required to be bonded together and to the electrical grounding system *(grounding electrode system)*
- Bonding conductors *(there can be more than one)* are required to be solid copper, insulated, covered or bare, and not smaller than 8 AWG
- Connections from the equipotential plane to the grounding electrode system are required to be made by exothermic welding or by listed pressure connectors or clamps that are labeled as being suitable for the purpose and are of stainless steel, brass, copper, or copper alloy
- **Equipotential Plane**. Accessible conductive parts bonded together to reduce voltage gradients in a designated area. *(see Article 100)*

682.33(C) Bonding of Equipotential Planes *(cont.)*

- **682.33(C)** detailing bonding provisions was **extensively revised** this *Code* cycle and was broken into **three list items**
- **682.33(C)(2)** is new text and calls for **metallic enclosures** of **outdoor service equipment or disconnecting means** that control equipment in or on water to be bonded to the equipotential plane
- **680.33(C)(3)** will now require surfaces directly below the service equipment to be bonded to the equipotential plane as well
- This surface requiring bonding is considered to be the surface area **not less than 900 mm (36 in.) in all directions** from the equipment from which a person would be able to stand and come in contact with the equipment
- Surface in question can be bonding by employing **wire mesh** or **other conductive elements** on, embedded in, or placed under the walk surface **within 75 mm (3 in.) from grade**

682.33(C) Bonding of Equipotential Planes

Revision made to 682.33(C) more clearly explains in more details as to what needs to be bonded together and how to bond each part in order to properly construct an equipotential plane



690.2 Definitions: ~~Functional~~ Grounded, Functionally ~~PV System~~

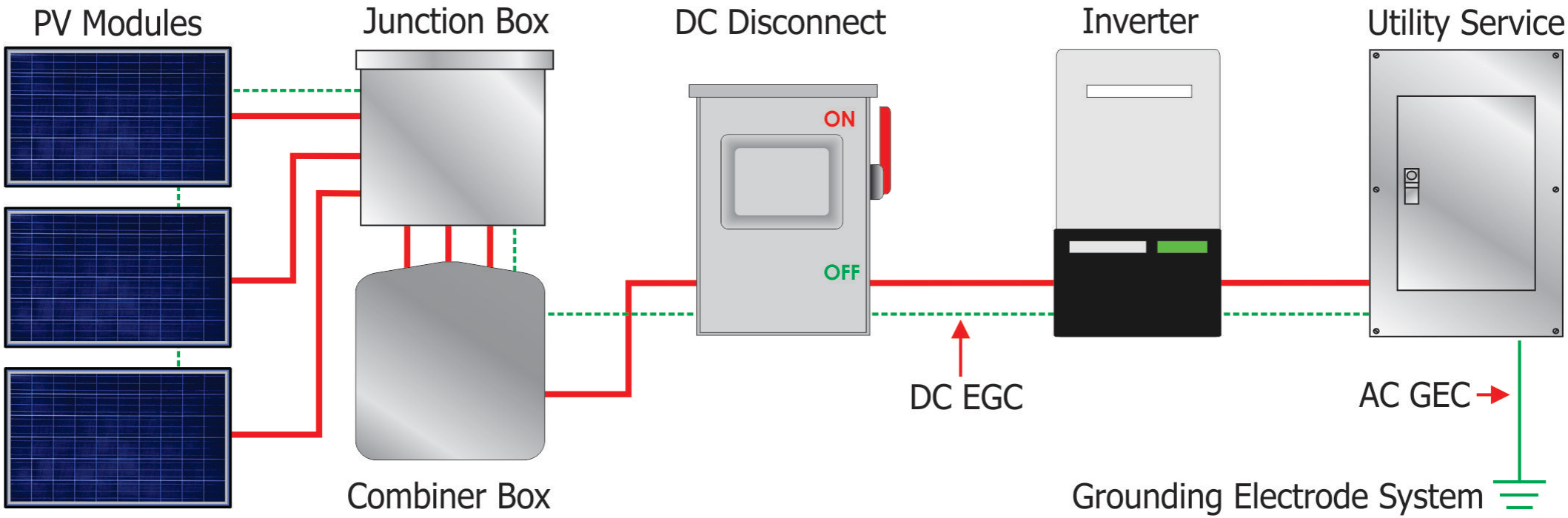
- The previous definition for "**Functional Grounded PV System**" was revised to "**Grounded, Functionally**"
- **Informational Note** also revised to clarify the operational purposes for a functionally grounded system and to indicate that ground faults are only one reason to employ a functionally grounded system
- Changed to "**Grounded, Functionally**" to follow the format in Article 100 as this definition is used in multiple articles such as Article 705, 706, and 712
- Text in the previous definition was **vague and misleading** since functionally grounded PV systems *(without a point of direct connection to a grounding electrode system)* is only permitted through the use of a **listed ground-fault protection system** that will open all of the ungrounded conductors of a system when a fault is detected in accordance with **690.41(A) or (B)**
- To accomplish this detection, an **equipment grounding connection** is necessary as a reference to a grounding system since the functionally grounded system is effectively isolated from a ground reference until a ground fault is sensed

690.2 Definitions: ~~Functional~~ Grounded, Functionally ~~PV System~~ *(cont.)*

- The previous definition for "**Functional Grounded PV System**" was revised to "**Grounded, Functionally**" *(cont.)*
- Most PV systems installed in the past decade or so are actually functionally grounded systems rather than solidly grounded systems as defined in Article 100
- For functionally grounded PV systems with an interactive inverter output, the ac equipment grounding conductor is connected to associated grounded ac distribution equipment
- This connection is often the connection to ground for ground-fault protection and equipment grounding of the PV array

690.2 Definition: Grounded, Functionally

~~**Functional**~~ **Grounded, Functionally** ~~**PV System**~~**.** A system that has an electrical ground reference for operational purposes that is not solidly grounded.



Informational Note: A functionally grounded system is often connected to ground through an electronic means internal to an inverter or charge controller that provides ground-fault protection. Examples of operational purposes for functionally grounded systems include ground-fault detection and performance-related issues for some power sources.

690.4(B) PV Equipment Listing and Evaluation

- Revision clarifies that if the **listed PV equipment** is not **listed for the application** then it must be **field evaluated** by a NRTL or Field Evaluation Body (FEB) and have a field label applied if it passes the evaluation
- Inverters, motor generators, PV modules, ac modules and ac module systems, dc combiners, dc-to-dc converters, rapid shutdown equipment, dc circuit controllers, and charge controllers **intended for use in PV systems** are now required to be listed or be **evaluated for the application** and have a **field label applied** *(function of the "field evaluation" process)*
- New *Code* language added to not just require this equipment to be "**field labeled**" but be "**evaluated**" for the intended application
- Equipment that is listed for the application means that it is intended for use in that application

690.4(B) PV Equipment Listing and Evaluation

Equipment intended for use in PV systems required to be listed or be evaluated for the application and have a field label applied

- Equipment required to be listed or evaluated:
- Inverters
- Motor generators
- PV modules
- ac modules and ac module systems
- dc combiners
- dc-to-dc converters
- Rapid shutdown equipment
- dc circuit controllers
- Charge controllers

690.8(A) PV Circuit Sizing and Calculation of Maximum Circuit Current

- 690.8(A) was reorganized to provide improvement to the understanding of the requirements for PV circuit sizing and current
- Maximum current for specific PV circuits are now calculated in accordance with **690.8(A)(1) through (A)(2)**, with previous 690.8(A)(2), (A)(3), (A)(5), and (A)(6) incorporated into **revised 690.8(A)(1)**
- Language was added to clarify that calculations for these circuits have **options**, however, the **secondary options** in 690.8(A)(1)(b) and 690.8(A)(1)(a)(2) contain **restrictions**
- New **690.8(A)(2)** titled, "**Circuits Connected to the Input of Electronic Power Converters**" added to provide provision pertaining to the case in stand-alone inverter input circuit currents *[previous 680.8(A)(4)]*
  - This section includes clarifying language to require an overcurrent device in accordance with **240.4(B)** to address the allowance to **round up to the next standard size**


RHW-2 2000V
Ø8-HCB-19B-Ø1-Ø1(+)
Ø8-HCB-19B-Ø1-Ø1(+)
PV WIRE 8 AI
Ø8-HCB-19B-Ø1-Ø2(+)
Ø8-HCB-19B-Ø1-Ø2(+)
CU 2000V 90°C WET OR DR
RHW-2 2000V
Ø8-HCB-19B-Ø1-Ø3(+)
Ø8-HCB-19B-Ø1-Ø3(+)

690.9(A) Overcurrent Protection for PV Circuits and Equipment

- Revision reorganizes **690.9(A)** for **overcurrent protection** to eliminate previous exception with three List Items created for unique and different protection scenarios

- The previous exception was written in positive *Code* language and transformed into **new 690.9(A)(1)** *(Circuits Where Overcurrent Protection Not Required)* with two conditions that must be meet in order to not have to provide overcurrent protection

- New **690.9(A)(2)** addresses circuits connected to current limited sources

- New **690.9(A)(3)** titled "**Other Circuits**" captures all remaining options covered under this section with four protection options

690.9(A) Overcurrent Protection for PV Systems

690.12 Rapid Shutdown of PV Systems on Buildings

- The requirements for a **Rapid Shutdown** of PV systems received extensive revision again this *Code* cycle
- The **2014 *NEC*** genesis of the rapid shutdown requirements of 690.12 were launched with the United States Department of Homeland Security (DHS) Assistance to Firefighter grant program
- For the **2017 *NEC***, the rapid shutdown requirements of 690.12 was revised to emphases the primary existence of the rapid shutdown requirements is to **reduced shock hazard for emergency responders** and to answer questions regarding the functionality of the PV rapid shutdown device itself
- This pattern of revision continued for the **2020 *NEC***

690.12 Rapid Shutdown of PV Systems on Buildings *(cont.)*

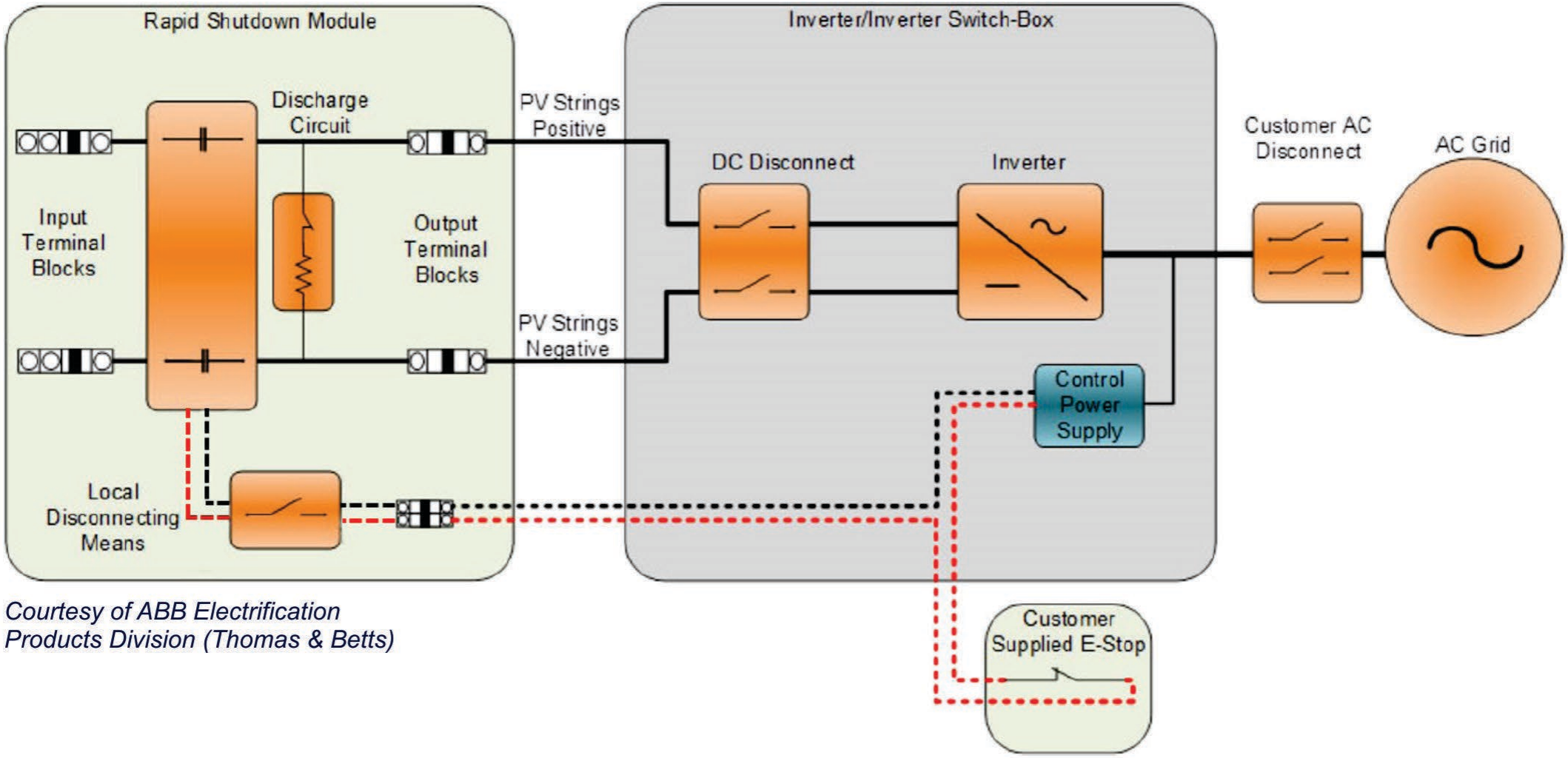
- The requirements for a **Rapid Shutdown** of PV systems received extensive revision again this *Code* cycle *(cont.)*
- A **new product standard** has been developed by UL so that hazardous energy levels within a PV array can be reduced when firefighters or other emergency response personnel are required to enter the array area to mitigate emergency conditions
- See **UL 3741** *(Standard for Safety Photovoltaic Hazard Control)*
- Parent text of 690.12 "**emergency responders**" replaced with "**fire fighter**" to narrow down exactly who the rapid shutdown function is intended for which harmonizes this *Code* text with **UL 3741**

690.12 Rapid Shutdown of PV Systems on Buildings *(cont.)*

- The requirements for a **Rapid Shutdown** of PV systems received extensive revision again this *Code* cycle *(cont.)*
- Revision to **690.12(A)** *(Controlled Conductors)* define what conductors are to be controlled; **(1)** PV system dc circuits and **(2)** Inverter output circuits
- **690.12(B)** *(Controlled Limits)* revised to indicate that controlled conductors **outside** the array boundary comply with **690.12(B)(1)** and **inside** the array boundary comply with **690.12(B)(2)**
- New *Code* text added at **690.12(C)** to address cases where more than one initiation device is used on a single PV system
- Previous **informational note** following **690.12(D)**, *(inverter input circuit conductors often remain energized for up to 5 minutes with inverters not listed for rapid shutdown)* **deleted** as informational note no longer needed

690.12 Rapid Shutdown of PV Systems on Buildings

Rapid shutdown requirements revised extensive revision to emphases the primary existence of rapid shutdown requirements is to reduced shock hazard for fire fighters



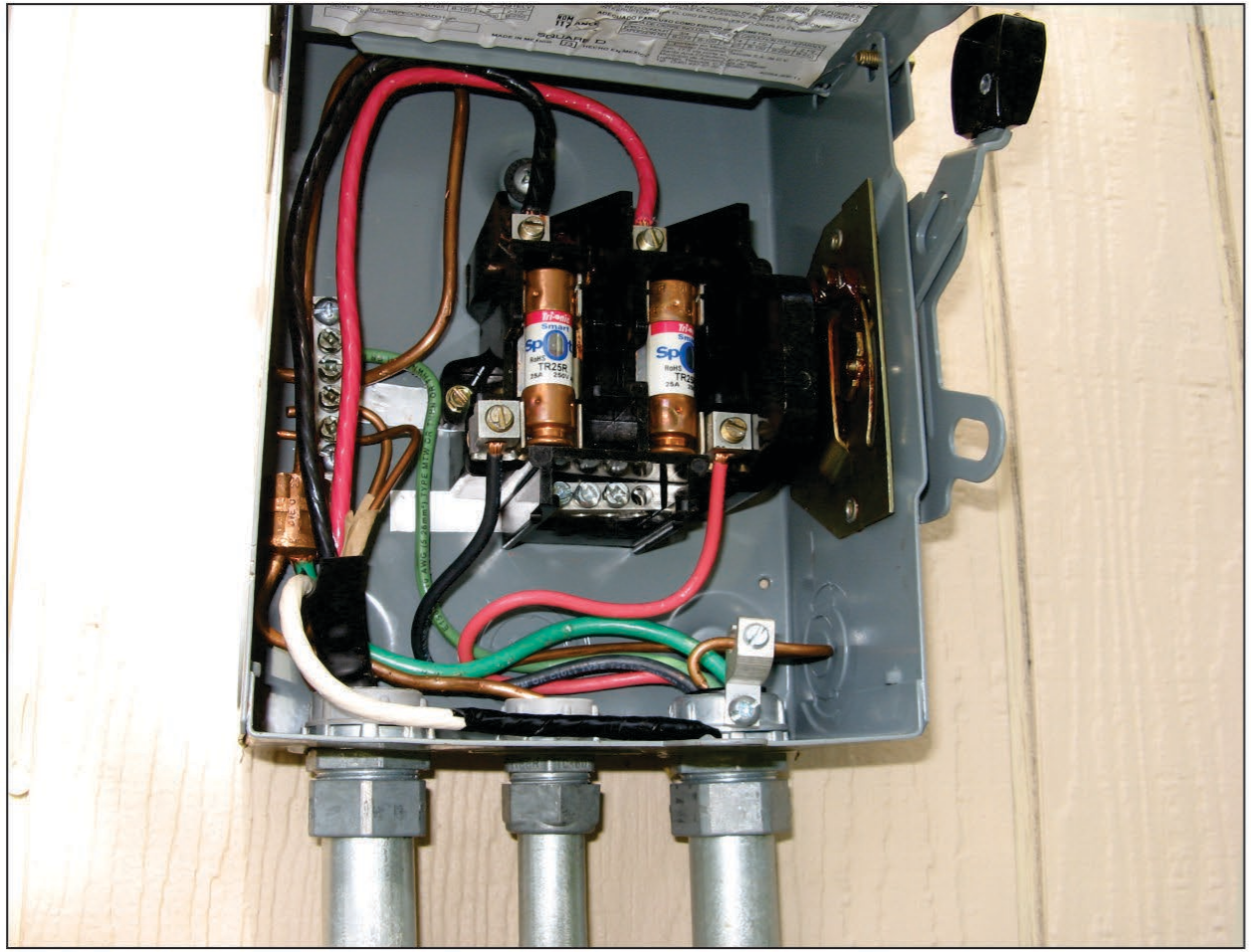
Courtesy of ABB Electrification Products Division (Thomas & Betts)

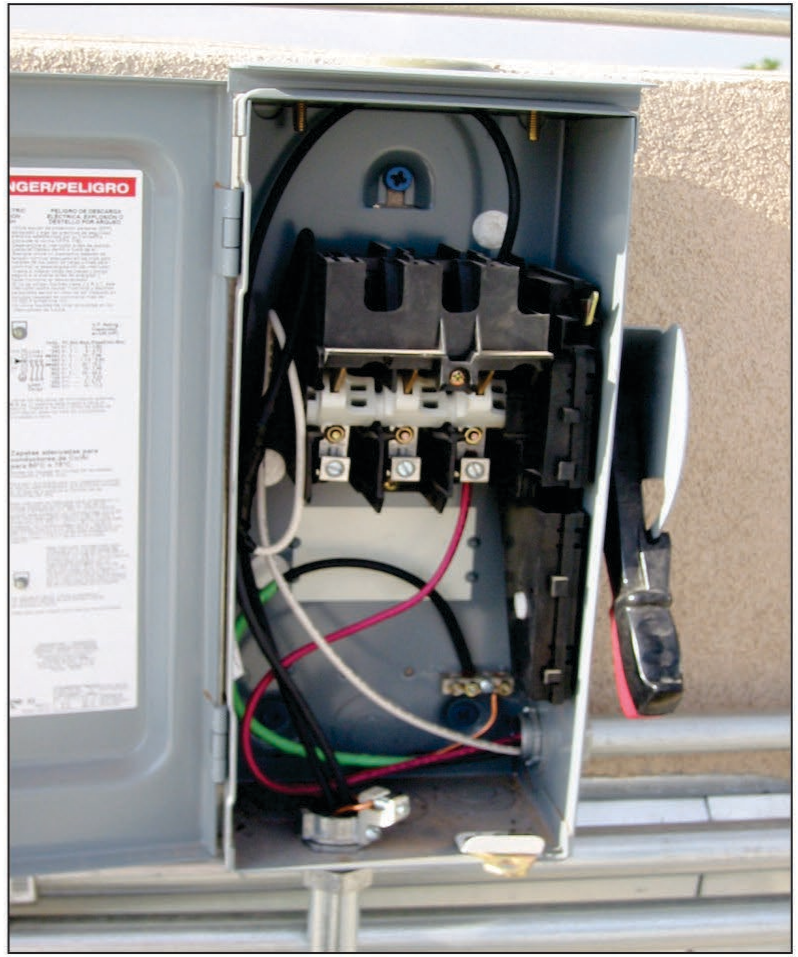
690.13(A) PV System Disconnecting Means

- New requirement calling for the PV disconnecting means to be **lockable or require a tool to open** under certain conditions
- New requirement calls for any PV disconnect enclosure with a door or hinged cover that exposes live parts when open to be **locked or require a tool to open** where a disconnecting means of systems **above 30 volts are readily accessible to unqualified persons**
- Similar format to **110.31(D)** *(Enclosed Equipment Accessible to Unqualified Persons)* which addresses equipment accessible to unqualified persons
- Installation of PV systems has created numerous opportunities for PV disconnect switches to be located in positions that are **accessible by other than qualified personnel** *(children in some instances)*
- Same basic change occurred at **690.15(A)** for the isolating devices or disconnecting means for PV equipment and **705.20(5)** for the disconnecting means for interconnected electric power production sources

690.13(A) Photovoltaic System Disconnecting Means

PV system disconnecting means are required to be installed at a readily accessible location





Where PV disconnecting means (above 30 volts) are readily accessible to unqualified persons, any enclosure door or hinged cover that exposes live parts when open is now required to be locked or require a tool to open

690.13(E) Type of PV System Disconnecting Means

- Previous (3) List Items under "**Type of Disconnect**" removed and the revision summarizes the type of disconnects that may be used as a PV system disconnect with **lockability requirements** of **110.25** included
- Previous provisions at 690.13(F)(1), (F)(2) and (F)(3) pertaining to "**backfeed**" operations has been **removed** and referenced in a **new Informational Note** following 690.13(E)
- Revision clarifies that all **non-solidly grounded conductors** must be disconnected, but the **ac grounded (neutral) conductors** *(which are solidly grounded)*, are not required to be disconnected
- Type PV system disconnecting means allowed was put into a **list format** *[similar to the list that was found at previous 690.15(D)]*


PV SYSTEM
PHOTOVOLTAIC DISCONNECTING MEANS
ON
SIEMENS
General Duty Safety Switch
200A 240VAC, 250VDC
Horsepower Rated
DANGER
Hazardous Voltage. Will cause death or serious injury.
OFF
NORMAL AC OUTPUT CURRENT: 120A
NORMAL OPERATING AC VOLTAGE: 208V
PHOTOVOLTAIC SYSTEM AC DISCONNECT
- WARNING - ELECTRIC SHOCK HAZARD
DO NOT TOUCH TERMINALS.
TERMINALS ON BOTH THE AND LOAD SIDES MAY BE ENERGIZED IN THE OPEN POSITION.
PARALLEL ON-SITE SOLAR GENERATION. PHOTOVOLTAIC SYSTEM EQUIPPED WITH RAPID SHUTDOWN.
DANGER
PELIGRO
PARALLEL ON-SITE SOLAR GENERATION. PHOTOVOLTAIC SYSTEM EQUIPPED WITH RAPID SHUTDOWN.
MILBANK

690.15 Disconnecting Means for Photovoltaic Equipment

- Requirements for **disconnecting means** for **isolating PV equipment** of PV systems received **extensive revision** to emphasis isolation of equipment from energized conductors
- The original 1984 *NEC* title was changed from "**Disconnection of Photovoltaic Equipment**" to "**Disconnecting Means for Photovoltaic Equipment**"
  - Previous title was misleading and could be interpreted to refer to disconnecting means that is discussed at **680.13**
  - Section is intended to address isolation of equipment from energized conductors (isolated)
  - Does not necessarily have to be accomplished by an equipment disconnecting means

690.15 Disconnecting Means for Photovoltaic Equipment *(cont.)*

- Requirements for **disconnecting means** for **isolating PV equipment** of PV systems received **extensive revision** to emphasis isolation of equipment from energized conductors *(cont.)*
- Revision occurred at the parent text of **690.15** to point directly to 690.15(D) to clarify the types of disconnecting means allowed for isolation of PV equipment
- A provision was added at the end of **690.15(A)** requiring the disconnecting means of equipment operating above 30 volts and readily accessible to unqualified persons to be lockable and locked or require a tool to open
- **Previous 690.15(B)** titled, “Interrupting Rating” was **deleted** as this information is covered and better suited for the disconnecting means requirements of **690.13(D)** *[previously 690.13(E)]*

690.15 Disconnecting Means for Photovoltaic Equipment *(cont.)*

- Requirements for **disconnecting means** for **isolating PV equipment** of PV systems received **extensive revision** to emphasis isolation of equipment from energized conductors *(cont.)*
- **New 690.15(B)** *[previously 690.15(C)]* titled, "**Isolating Device**" had new language added to point out the fact that an isolating device is **not required** to have an **interrupting rating** *(can have an interrupting rating, but not required)*
- A new first sentence was added to **690.15(C)** to address the language removed from previous 690.15(B) on **interrupting ratings** and added fault current
- The lockability requirement of **690.15(C)** changed so that this would only be applicable to cases where the disconnecting means is **more than 3 m (10 ft)** from the equipment or not within site of the equipment

690.15 Disconnecting Means for Photovoltaic Equipment *(cont.)*

- Requirements for **disconnecting means** for **isolating PV equipment** of PV systems received **extensive revision** to emphasis isolation of equipment from energized conductors *(cont.)*
- A new **690.15(D)** added titled, "**Type of Disconnecting Means**," which is intended to clarify the requirements related to disconnection of equipment
- Two different requirements for these devices:
  - Circuits with a **maximum circuit current over 30 amperes** must have devices that comply with **new 690.15(D)** as these conversion devices can present a load to the fault current limited circuit
  - Circuits **under 30 amperes** where isolation is required for servicing equipment, *Code* language was added to make it clear that isolating devices are permitted

690.15 Disconnecting Means for Photovoltaic Equipment

Requirements for disconnecting means for isolating PV equipment of PV systems received extensive revision to emphasis isolation of equipment from energized conductors

690.31 Wiring Methods for Solar Photovoltaic (PV) Systems

- Revisions to **690.31** organized **PV wiring methods** into one section
- Wiring methods for PV installations were previously located in various areas
- New sentence added to **690.31(A)** to introducing a revised table [**Table 690.31(A)(a)**] and a **new Table 690.31(A)(b)**
  - Revision cleans up **Table 690.31(A)(a)** [formerly Table 690.31(A)] by only including correction factors for 105°C (221°F) and 125°C (257°F) as all other correction factors are in Article 310
  - The temperature ranges above 30°C are given in 5°C increments
  - New ampacity table for 105°C (221°F) and 125°C (257°F) has been added as **new Table 690.31(A)(b)**

690.31 Wiring Methods for Solar Photovoltaic (PV) Systems *(cont.)*

- Revisions to **690.31** organized **PV wiring methods** into one section *(cont.)*
- Additional clarity was needed at **690.31(B)** to address the most common application of this requirement for enforcers; installation of inverter dc input conductors and ac output conductors in the **same wireway** below an inverter
- **690.31(B)(2)** permitted the installation of those same conductors *(even if from different PV systems)* within the same raceway or junction box with a removable cover without a barrier or partition
- **Exception** to **690.31(B)(2)** even deleted the grouping requirement where the conductors enter the enclosure through separate means
- **690.31(B)** revised to provide needed **lines of demarcation** for conductors of dc and ac PV systems

690.31 Wiring Methods for Solar Photovoltaic (PV) Systems *(cont.)*

- Revisions to **690.31** organized **PV wiring methods** into one section *(cont.)*
- Several of the items in 690.31 are directly related to cables and those **cable requirements** were consolidated in the new and revised **690.31(C)**
- *Code* language added to the parent text of **690.31(C)** pertaining to the listing requirement for **Photovoltaic (Type PV) wire or cable** and **Distributed Generation (Type DG) cable** with a new informational note added to direct users of the *Code* to **UL 4703** *(Standard for Photovoltaic Wire)* and **UL 3003** *(Distributed Generation Cables)*
- Requirements of **690.31(C)(1)** for "**Single-Conductor Cable**" simplified to now call for single-conductor cable in exposed outdoor locations in PV system dc circuits within the PV array to be either PV wire or cable or single-conductor cable marked sunlight resistant and Type USE-2 and Type RHW-2

690.31 Wiring Methods for Solar Photovoltaic (PV) Systems *(cont.)*

- Revisions to **690.31** organized **PV wiring methods** into one section *(cont.)*
- **690.31(C)(2)** deals with single-conductor PV wire or cable installed in a cable tray with revision to this list item adding single-conductor **distributed generation (Type DG) cable** of all sizes to be permitted to be installed in a cable tray installed in outdoor locations *(with conditions)*
- **690.31(C)(3)** for multiconductor jacketed cables added new provisions for distributed generation (Type DG) cables
- Type DG cable is closely related to Type TC-ER, but it is better suited for the renewable energy and other distributed generation applications allowing for different variations in conductor combinations within a single jacket

690.31 Wiring Methods for Solar Photovoltaic (PV) Systems *(cont.)*

- Revisions to **690.31** organized **PV wiring methods** into one section *(cont.)*
- **690.31(C)(4), (5), and (6)** were existing requirements moved from previous 690.31(E),(H), and (F) respectfully with no technical change to group all single-conductor cables requirements together at **690.31(C)**
- **690.31(D)** title was shortened to be more descriptive of what it covers *(Direct-Current Circuits on or in a Buildings) [was 690.31(G)]* and extensively revised
- **690.31(D)** generally requires PV system dc circuits run inside a building to be contained in a metallic wiring system
- Purpose of revision was to acknowledge that the **physical protection requirements** of **690.31(D)** are related to the ability to detect ground faults and to protect from contact with higher voltage cables

690.31 Wiring Methods for Solar Photovoltaic (PV) Systems *(cont.)*

- Revisions to **690.31** organized **PV wiring methods** into one section *(cont.)*
- New **exception** was added for **690.31(D)** which addresses PV hazard control systems
- **Previous requirement at 690.31(G)(1)** that called for PV circuits that were embedded in built-up, laminate, or membrane roofing materials in roof areas *(not covered by PV modules and associated equipment)* to be clearly marked for its location has been **deleted** as these marking requirement referred to a wiring method that is no longer used *(embedded in building surfaces)*
- Revision also occurred at **690.31(D)(2)** ***(Marking and Labeling Required)*** by adding language to clarify that wiring methods need not be marked where their purpose is evident

690.31 Wiring Methods for Solar Photovoltaic (PV) Systems *(cont.)*

- Revisions to **690.31** organized **PV wiring methods** into one section *(cont.)*
- **690.31(E)** titled, "**Bipolar Photovoltaic Systems**," *[was 690.31(I)]* received slight revision by replacing the term "monopole subarray" with the term "monopole circuit" as the reference is to the circuits to these monopole subarrays so the term "circuit" was added in all five locations where monopole subarray was previously used
- New **690.31(F)** added pertaining to roof-mounted PV array mounting systems and their wiring methods
  - Permits the roof-mounted PV array to be held in place with an **approved means** other than those required by 110.13 *(Mounting and Cooling of Equipment)*

690.31 Wiring Methods for Solar Photovoltaic (PV) Systems

690.31 was revised and re-organized for clarity and to bring PV wiring methods for PV source and output circuits to one location

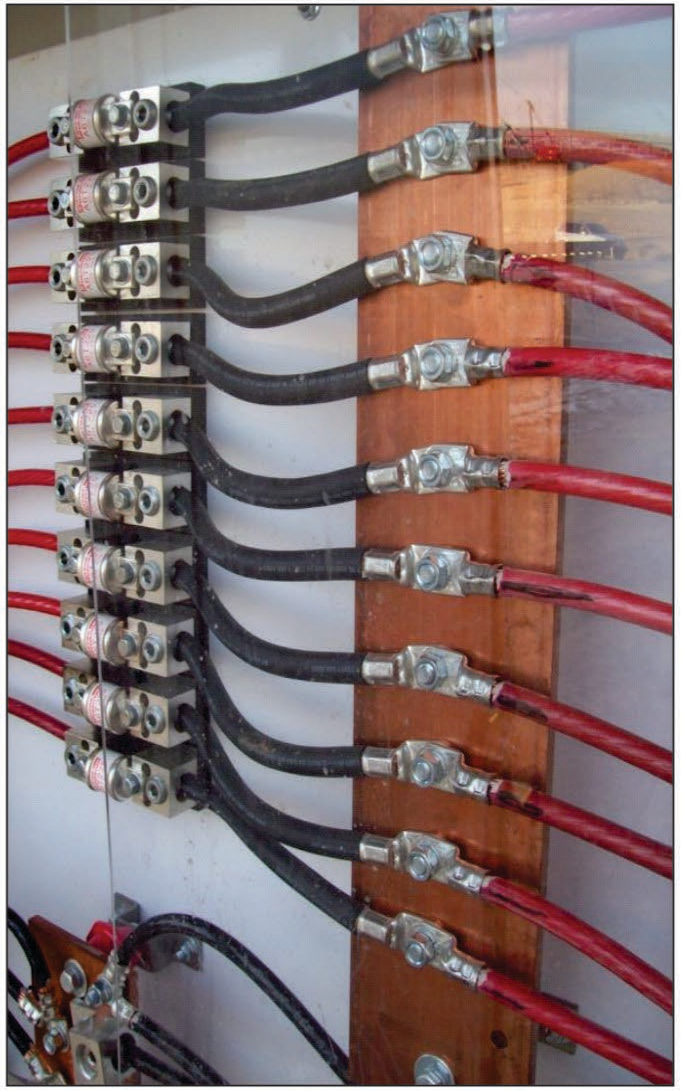
(A) Wiring Systems

(B) Identification and Grouping
- (1) Identification
- (2) Grouping

(C) Cables
- (1) Single-Conductor Cables
- (2) Cable Tray
- (3) Multiconductor Jacketed Cables
- (4) Flexible Cords and Cables Connected to Tracking PV Arrays
- (5) Flexible, Fine Stranded Cables
- (6) Small-Conductor Cables

(D) Direct-Cirrent on or in Buildings
- (1) Flexible Wiring Methods
- (2) Marking and labeling Required

(E) Bipolar Photovoltaic Systems



690.33 Mating Connectors Types for PV Systems

- New allowances added for mixing and matching brands of **PV mating connectors**
- Mating connectors **not of the identical type and brand** required to be "**listed and identified for intermatability**," as described in the manufacturer's instructions
- "**Intermatabilty**" is a term used in **UL 6703** (*Standard for Connectors for Use in Photovoltaic Systems)*
- Mating connectors required to be of the **latching or locking type** *(not new)*
- Mating connectors that are readily accessible and used in circuits operating at **over 30 volts dc or 15 volts ac** require a tool for opening *(not new)*
- Type of connector being described at 690.33 is clearly a mating connector, so the title of 690.33 was changed from "Connectors" to "**Mating Connectors**"
- Failures of connections made between mating connectors from different brands are well documented and represent a source of **electrical and fire hazard**

690.33(C) Mating Connector Types for PV Systems

Mating connectors shall be of the latching or locking type and where readily accessible and used in circuits operating at over 30 volts dc or 15 volts ac shall require a tool for opening

Mating connectors not of the identical type and brand are required to be “listed and identified for intermatability,” as described in the manufacturer's instructions

690.41(B) Ground-Fault Protection for PV Systems

- PV system dc circuits *(not just the arrays)* that exceed **30 volts** or **8 amperes** are now required to be provided with dc ground-fault protection (GFP)
- This section now consists of three subsections
  - (1) Ground-Fault Detection
  - (2) Faulted Circuits
  - (3) Indication of Faults (New)
- PV dc AFCI and GFP requirements in both **UL 1699-B** *[Standard for Photovoltaic (PV) DC Arc-Fault Circuit Protection]* and **IEC 62109-2** *(Safety of Power Converters for use in Photovoltaic Power Systems - Part 2)* acknowledge that only energy values above these levels pose an arcing or other fire risk

690.41(B) Ground-Fault Protection for PV Systems *(cont.)*

- PV system dc circuits *(not just the arrays)* that exceed **30 volts** or **8 amperes** are now required to be provided with dc ground-fault protection (GFP) *(cont.)*
- PV system circuits operating at lower voltage and power levels do not pose an arcing or other fire risk, therefore permitted to be installed **without GFP**
- Previous **exception** to **690.41(B)** permitted PV arrays with not more than two PV source circuits to be installed without GFP (where solidly grounded) as long as all PV system dc circuits were not on or in buildings has been reworded into positive language suitable for inclusion into the charging paragraph without changing the existing requirements
- New **informational note** has been added after the parent text of **690.41(B)** indicating that not all inverters, charge controllers, or dc-to-dc converters include GFP

690.41(B) Ground-Fault Protection for PV Systems *(cont.)*

- PV system dc circuits *(not just the arrays)* that exceed **30 volts** or **8 amperes** are now required to be provided with dc ground-fault protection (GFP) *(cont.)*
- Provisions for ground-fault detection at **690.41(B)(1)** have been revised to better align with the definitions in 690.2 and in particular, with the revised definition of "**Functionally Grounded**"
  - New language clarifies that either **GFP must be included in the converter**, or the converter and the equipment providing GFP must be **identified as being compatible** such that GFP of the circuit is maintained on either side of the converter
- Revised text at **690.41(B)(2)** concerning faulted circuits improves the application of these requirements to **any device providing GFP** *(not just inverters or charge controllers)* and clarifies the circuits to be controlled

690.41(B) Ground-Fault Protection for PV Systems *(cont.)*

- PV system dc circuits *(not just the arrays)* that exceed **30 volts** or **8 amperes** are now required to be provided with dc ground-fault protection (GFP) *(cont.)*
- Changes at **690.41(B)(2)** also better align *NEC* requirements with those found in PV GFP equipment safety standards such as **UL 1741** *(Inverters, Converters, Controllers and Interconnection System Equipment for Use with Distributed Energy Resources)*
- New **690.41(B)(3)** added titled, "**Indication of Faults**" states that any GFP equipment must provide an "**indication of ground faults at a readily accessible location**"
- **UL 1741** requires inverters to "identify, interrupt, and provide an indication of ground faults"
- New **690.41(B)(3)** giving examples of **indication devices** such as remote indicator light, display, monitor, signal to a monitored alarm system, or receipt of notification by web-based services

GFP dc PV protection typically integral to the inverter

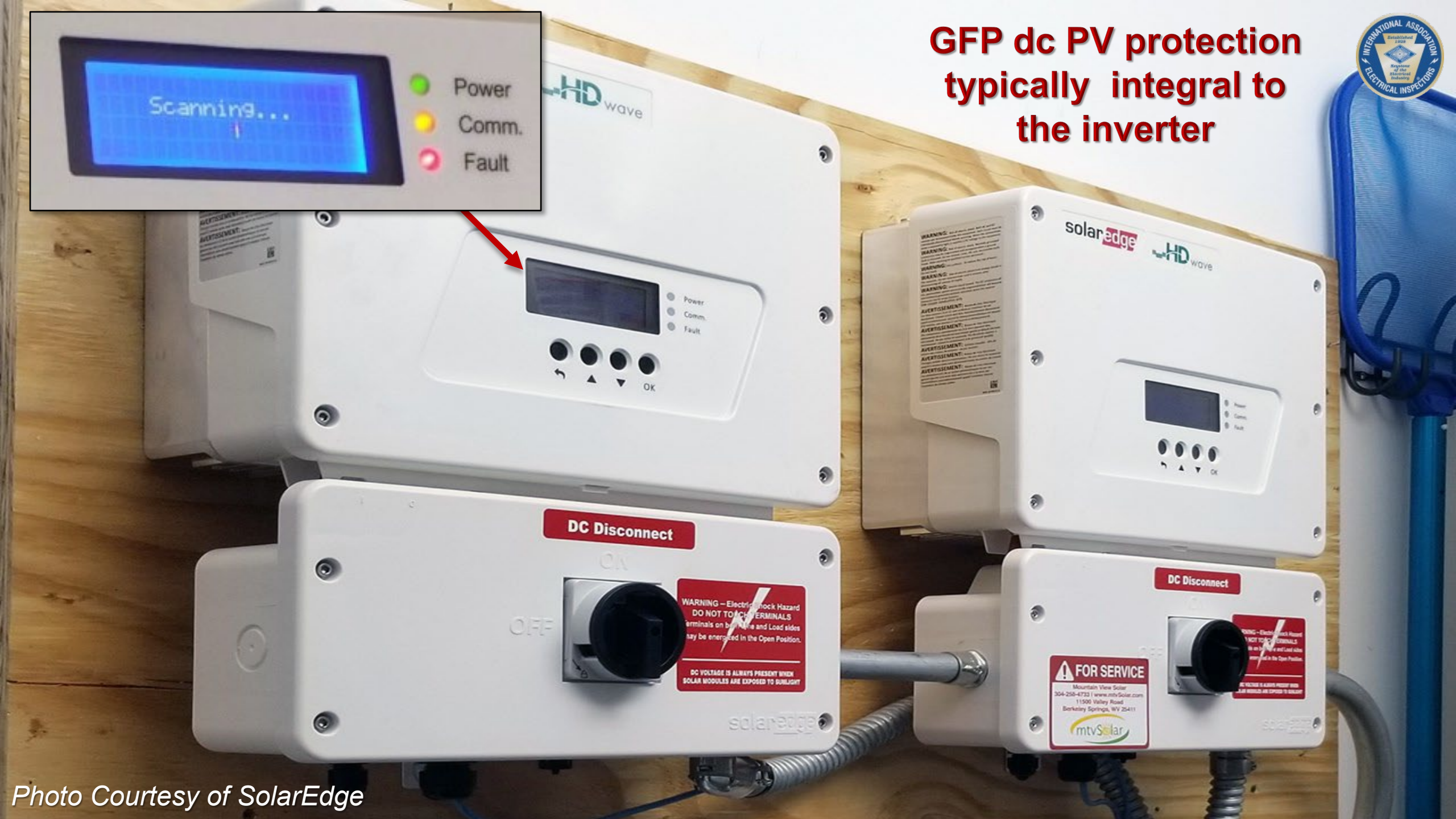
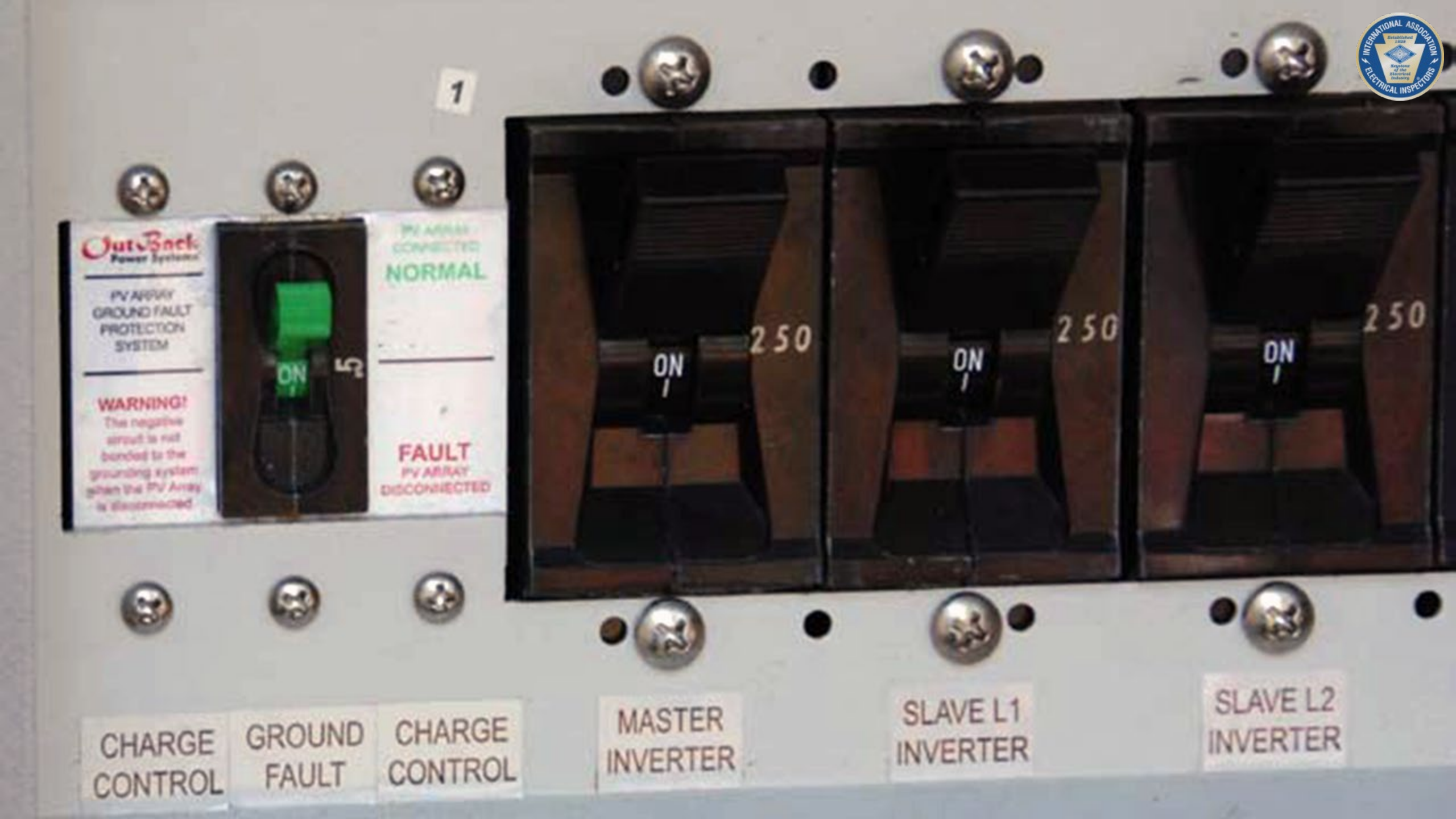


Photo Courtesy of SolarEdge

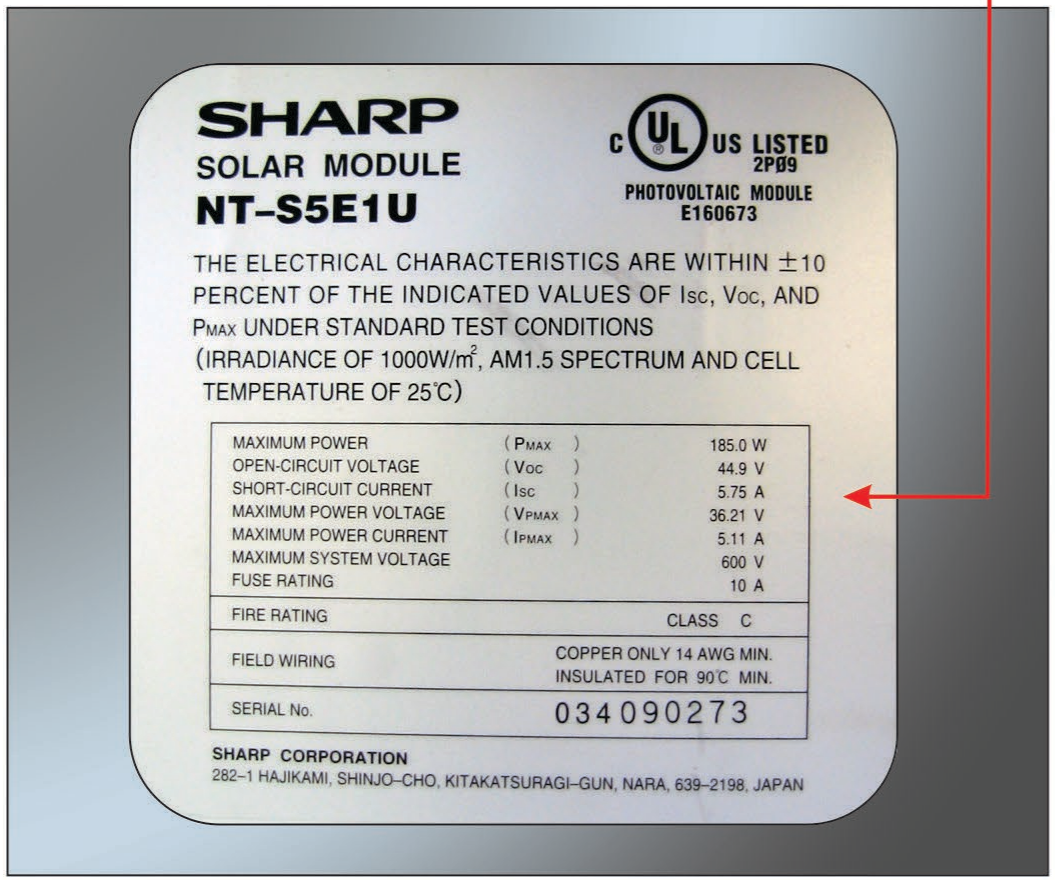

1
OutBack Power Systems
PV ARRAY GROUND FAULT PROTECTION SYSTEM
WARNING!
This negative circuit is not bonded to the grounding system when the PV Array is disconnected
ON
PV ARRAY CONNECTED
NORMAL
FAULT
PV ARRAY DISCONNECTED
ON
250
ON
250
ON
250
CHARGE CONTROL
GROUND FAULT
CHARGE CONTROL
MASTER INVERTER
SLAVE L1 INVERTER
SLAVE L2 INVERTER

690.51, ~~690.52~~, and 690.53 Marking Requirements of PV Modules and dc PV Circuits

- Information outlined at previous **690.51**, **690.52**, and **690.53** that is required as part of the listing requirement of this equipment has been deleted as it is being provided on the device by the manufacturer
- **690.51** revised to simply require modules and ac modules to be marked in accordance with their listing
- **Previous 690.52** was deleted entirely
- **690.53** was revised to require a permanent readily visible label indicating the highest maximum dc voltage in a PV system
- Desirable to remove these values from the required label in order to not inadvertently create conflict or confusion with any other required safety labeling such as may be required in Article 110

Marking Requirements for PV Modules and DC PV Circuits

Information outlined at previous 690.51, 690.52, and 690.53 that is required as part of the listing of this equipment has been deleted as it is being provided on the device by the manufacturer



A permanent readily visible label indicating the highest maximum dc voltage in a PV system is required by 690.53

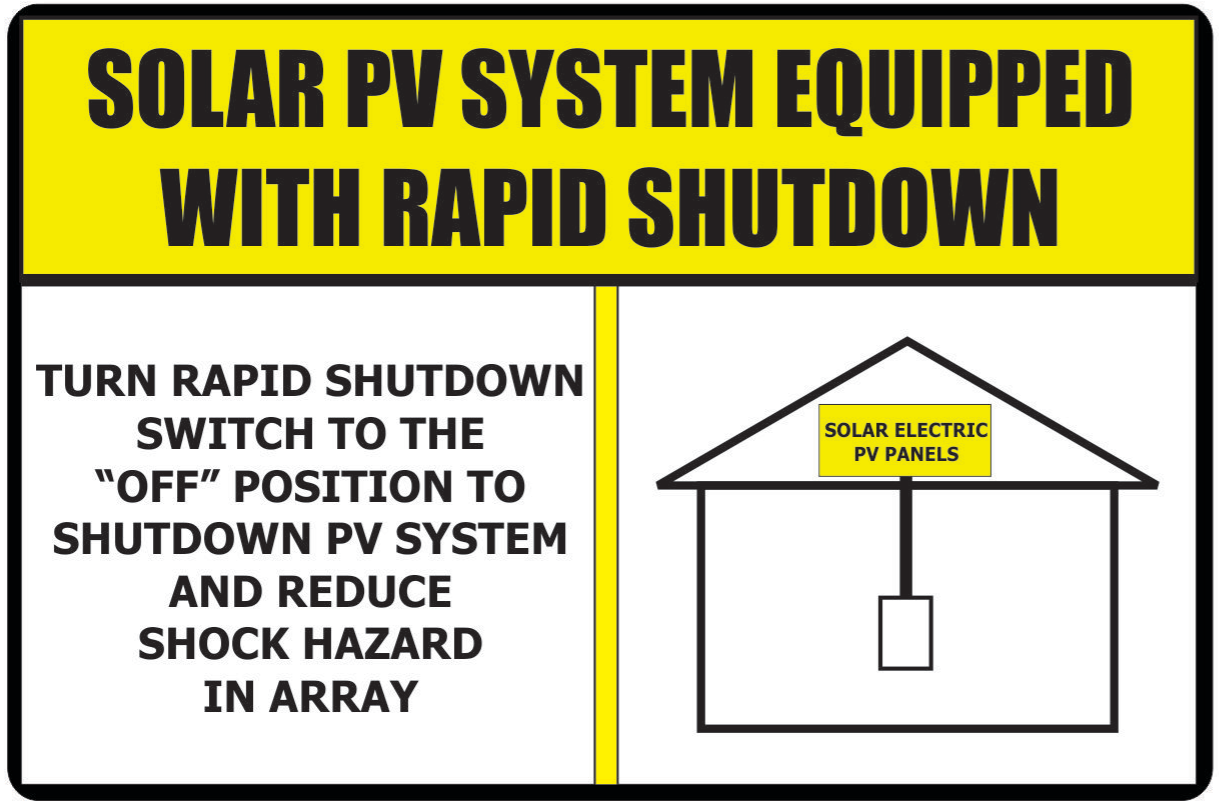
690.56(C) Identification of Power Sources for Buildings with Rapid Shutdown

- Several changes were made to **690.56(C)** to address the updated requirements in **690.12** *(Rapid Shutdown of PV Systems on Buildings)*
- Previous 690.56(C) contained **two figures** at 690.56(C)(1) illustrating labels required for the then two different types of rapid shutdown systems for a PV installation
- Remaining text of previous **690.56(C)(1)** has been changed to **remove** the option for the label and **previous Figure 690.56(C)(1)(b)**, previously listed under **690.56(C)(1)(b)**, since this label now describes a shutdown method that is no longer *Code* compliant
- The title of the remaining figure has been changed to identify this figure as an **informational note figure** to clarify that the label as shown is merely **an example** of a rapid shutdown system label

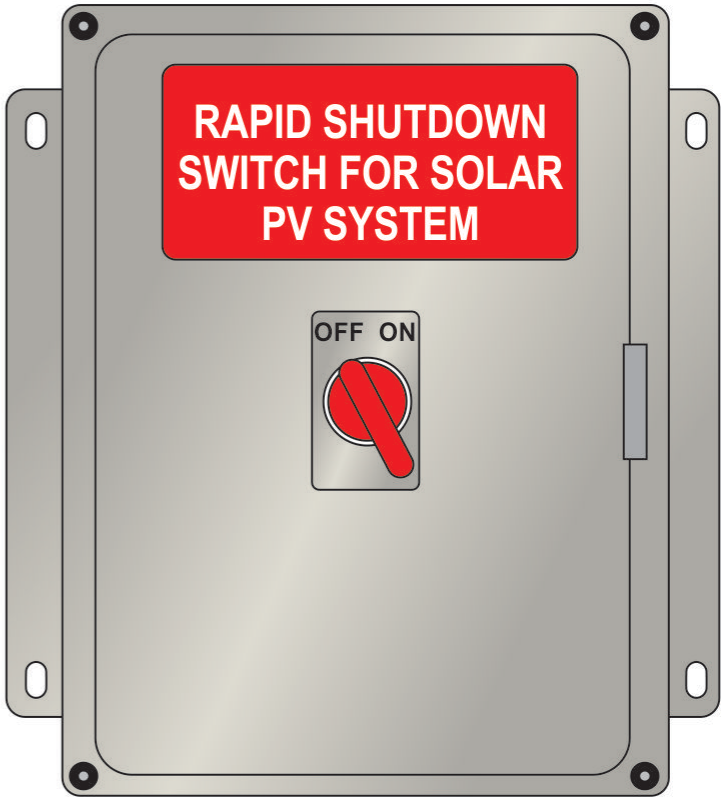
690.56(C) ID of Power Sources for Buildings with Rapid Shutdown

Buildings with PV systems shall have a permanent label located at each service equipment location to which the PV systems are connected or at an approved readily visible location and shall indicate the location of rapid shutdown initiation devices

Information Note Figure 690.56(C): Label for Roof-Mounted PV Systems with Rapid Shutdown



Label required by 690.56(C)(2)



Title of remaining figure has been changed to identify this figure as an informational note figure to clarify that the label as shown is merely an example of a rapid shutdown system label

691.1 Scope and I-Note Figure 691.1

- New **Informational Note No. 3** and **Informational Note Figure 691.1** were added to Article 691 as an aid in interpretation
- Title of **Article 691** was changed to "**Large-Scale Photovoltaic (PV) Electric Power Supply Stations**" with the **scope changed** to indicate that the article is intended to cover "the installation of large-scale PV electric supply stations with an inverter generating capacity of no less than 5000 kW, and not under exclusive utility control"
- Term "**supply station**" which was used 12 times throughout Article 691 in the 2017 *NEC* and 17 times in the 2020 *NEC*
- Utilizing the term "**supply station**" better aligns the *NEC* and **National Electrical Safety Code (NESC)** on this term, which is describing the same equipment set in both Codes

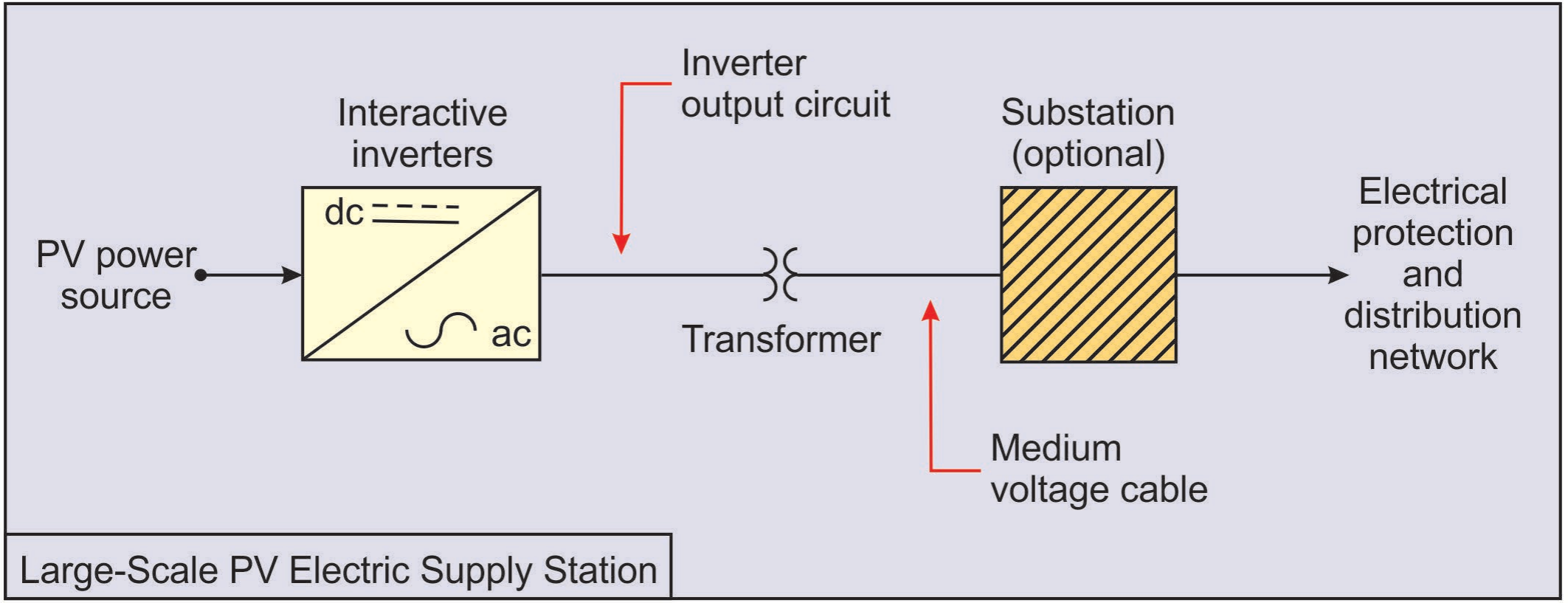
691.1 Scope and I-Note Figure 691.1 *(cont.)*

- New **Informational Note No. 3** and **Informational Note Figure 691.1** were added to Article 691 as an aid in interpretation *(cont.)*
- Scope of Article 691 was **updated** to align with the definition of "**Generating Capacity, Inverter**" located in Article 100
- This definitions states that Inverter Generating Capacity is defined as "the sum of parallel-connected inverter maximum continuous output power at 40°C in watts or kilowatts"
- **New informational note** was **added** after the scope of Article 691 directing users of the *Code* to a **new informational figure** intended to help in identification of unique system components related to large scale PV electrical supply stations

691.1 Scope and Informational Note Figure 691.1

This article covers the installation of large-scale PV electric ~~power production facilities with a~~ supply stations with an inverter generating capacity of no less than 5000 kW, and not under exclusive utility control.

Informational Note Figure 691.1: Large-Scale PV Electric Supply Station Components.



Notes:
(1) Custom designs occur in each configuration, and some components are optional.
(2) The drawing is for informational purposes only and is not representative of all potential configurations.

691.9 Disconnection Means for Isolating PV Equipment

- **Title revised** to be consistent with usage in Article 690, particularly 690.15
- First sentence allowing isolating devices to be located remotely from equipment was revised to align more closely with the defined term "**In Sight From (Within Sight From, Within Sight)**" in Article 100
- Provisions requiring **written safety procedures** and conditions of maintenance and supervision ensuring that only **qualified persons** service the equipment was **deleted**
- New text added requiring **documentation** of the disconnection procedures and means of isolating equipment required by the engineered design of 691.6

691.9 Disconnection Means for Isolating Photovoltaic Equipment

Isolating devices not required within sight of equipment and permitted to be located remotely from equipment

Engineered design required by 691.6 shall document disconnection procedures and means of isolating equipment

692.4(B) Identification of Power Sources (Fuel Cell System)

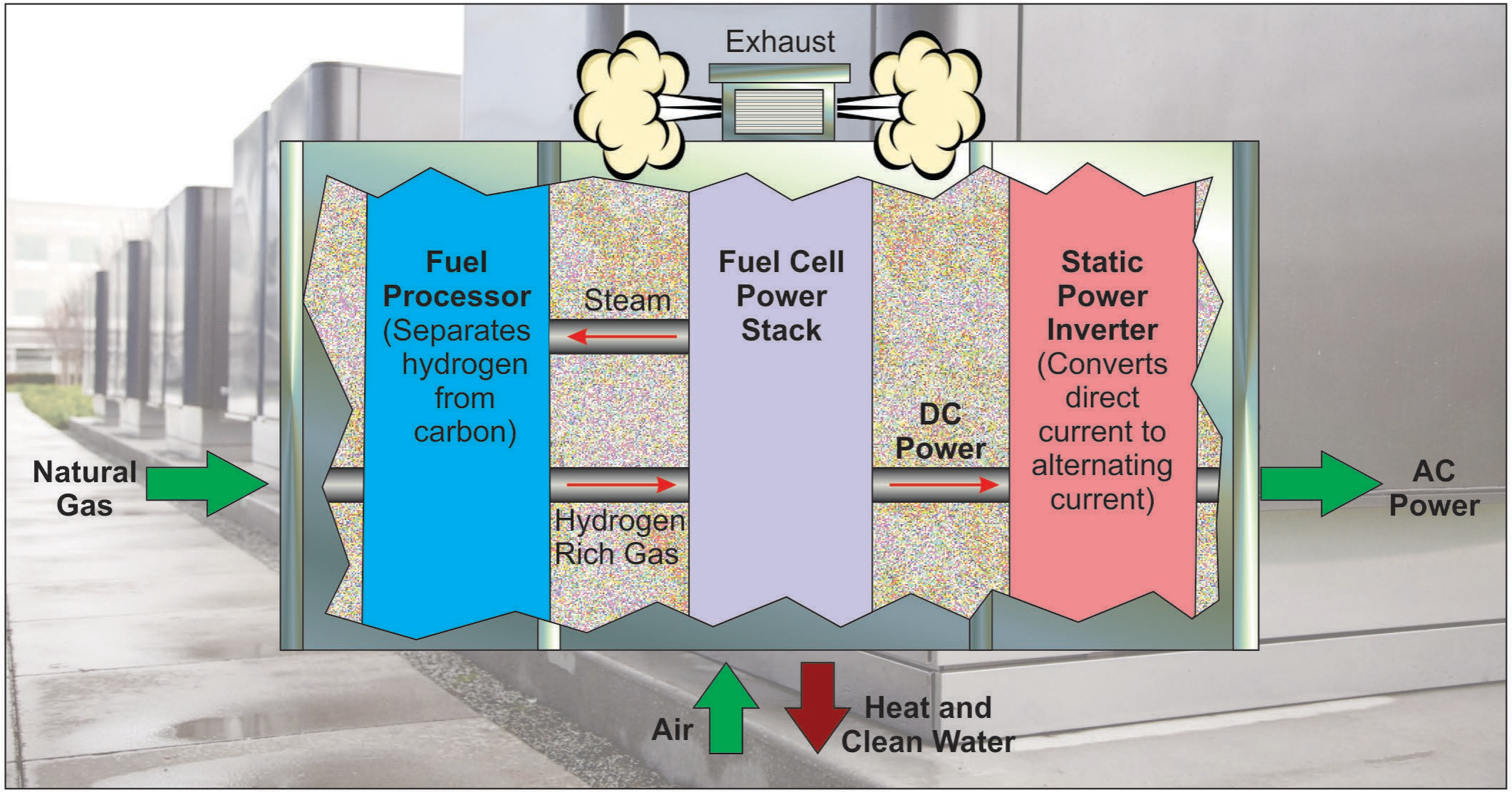
- Three separate **List Items** where **created** to clearly identify the requirements for different fuel cell system types to add clarity to the **placarding** of these systems
- Where these alternative energy systems are present, fuel cell systems are required to be **identified** depending upon the type of system involved;
  - (1) **Interconnected ac System** plaques or directories are required to be installed in accordance with **705.10**
  - (2) **dc Microgrid System** plaques or directories are required to be installed in accordance with **712.10**
  - (3) **Stand-Alone System** plaques or directories are required to be installed in accordance with **710.10**

692.4(B) Identification of Power Sources (Fuel Cell System) *(cont.)*

- Three separate **List Items** where **created** to clearly identify the requirements for different fuel cell system types to add clarity to the **placarding** of these systems *(cont.)*
- Ongoing concerns have been expressed by the **fire service** and other **first responders** on the need to secure on-site power sources during emergencies and ready awareness of where those alternative sources are located
- There has been a **lack of uniform procedures** from an *NEC* standpoint on how to effectively secure on-site power sources that may be at a premises due to the variety of different source types
- Changes implemented at 692.4(B) will correlate various sections of the *NEC* and consistently require this important marking be located at each service equipment location, or at an approved readily visible location
- Same basic change occurred at **694.54** for **Wind Electric Systems**

692.4(B) Identification of Power Sources (Fuel Cell Systems)

Three separate List Items where created to clearly identify the requirements for different fuel cell system types to add clarity to the placarding of these systems



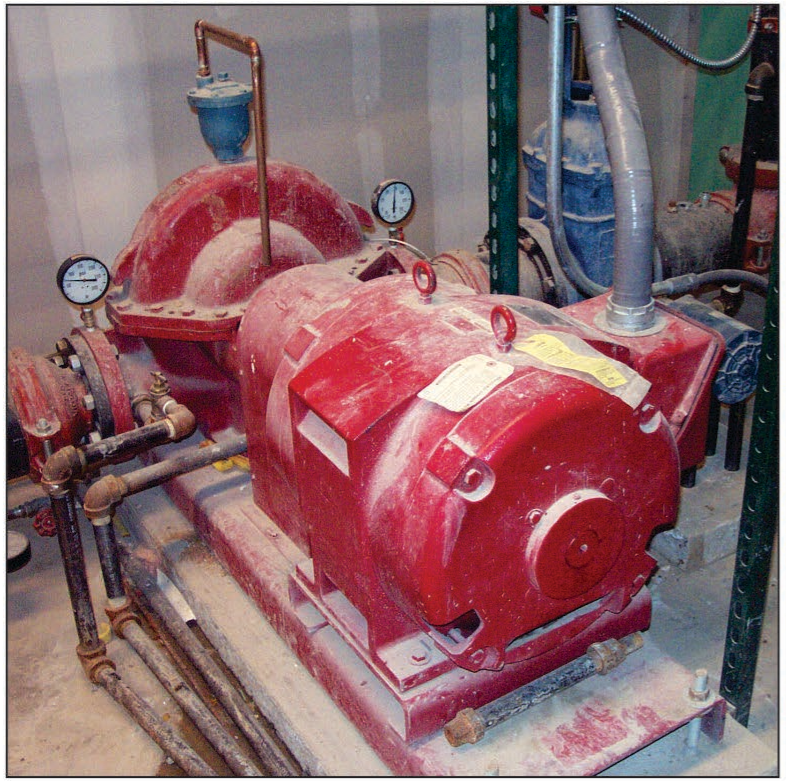
692.4(B) Identification of Power Sources for Fuel Cell Systems

695.3(C)(3) Selective Coordination (Fire Pumps)

- New provisions were added providing guidance for **selective coordination** of OCPD for fire pumps
- For fire pumps in multibuilding campus-style complexes, all overcurrent protective device(s) must be selectively coordinated with all supply-side overcurrent protective device(s)
- This selective coordination is required to be selected by **a licensed professional engineer** or **other qualified persons** engaged primarily in the design, installation, or maintenance of electrical systems with the selection documented and made available to those authorized to design, install, maintain, and operate the system
- Selective coordination is not required between two overcurrent devices located in series if no loads are connected in parallel with the downstream device

695.3(C)(3) Selective Coordination (Fire Pumps)

Fire pumps in multibuilding campus-style complexes require all overcurrent protective device(s) to be selectively coordinated with all supply-side overcurrent protective device(s)



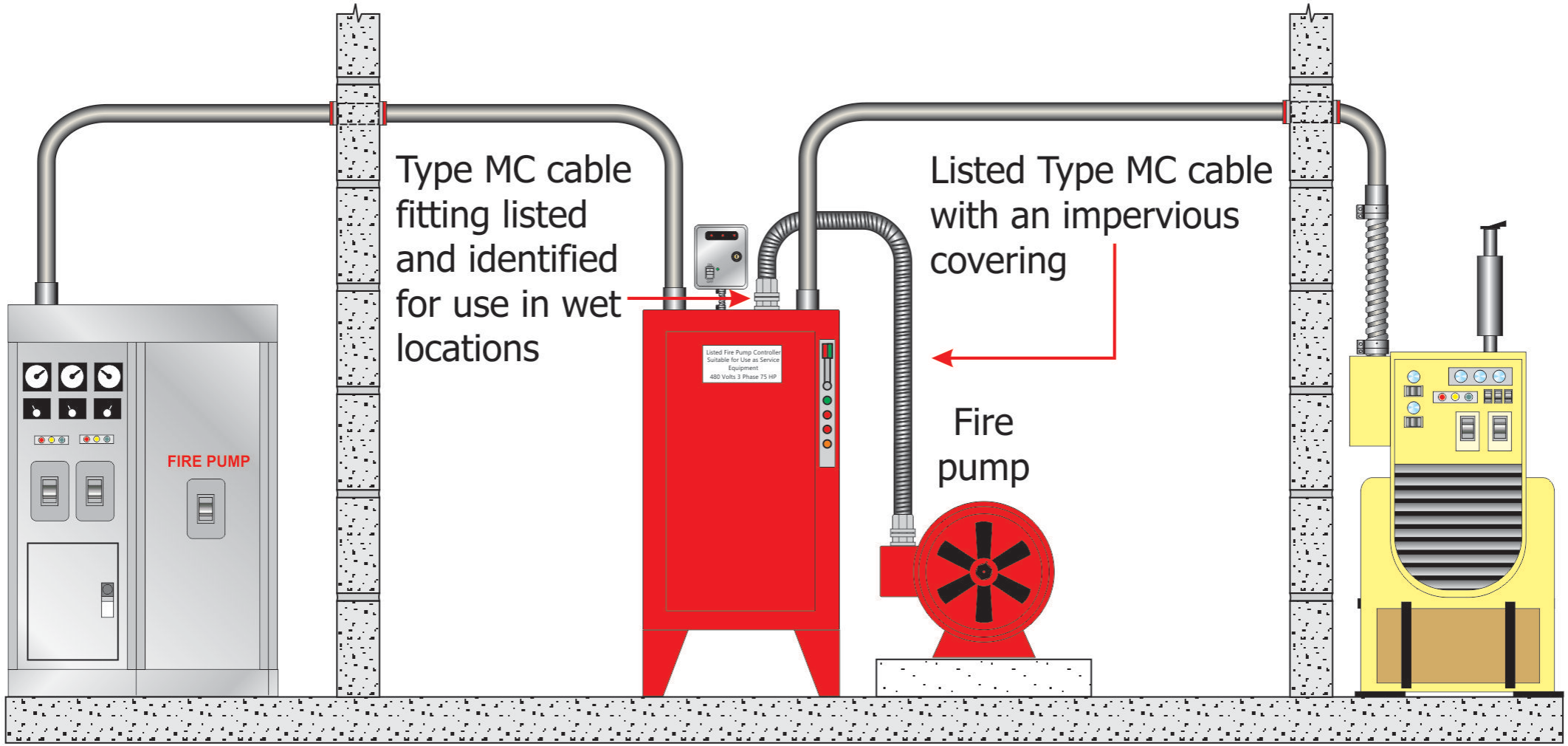
Selective coordination required to be selected by a licensed professional engineer or other qualified persons engaged primarily in the design, installation, or maintenance of electrical systems

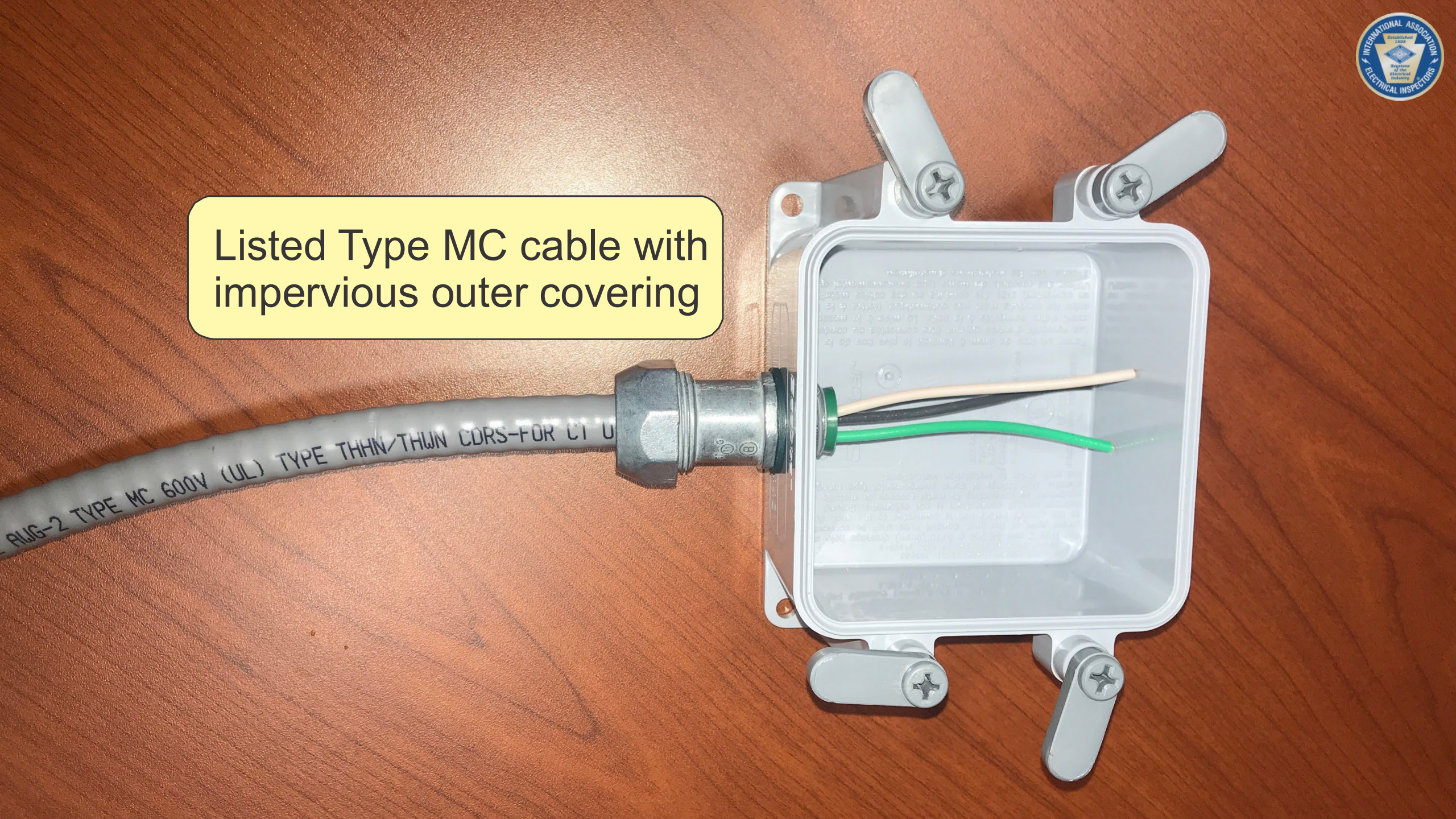
695.6(J) ~~Raceway~~ Terminations (Fire Pumps)

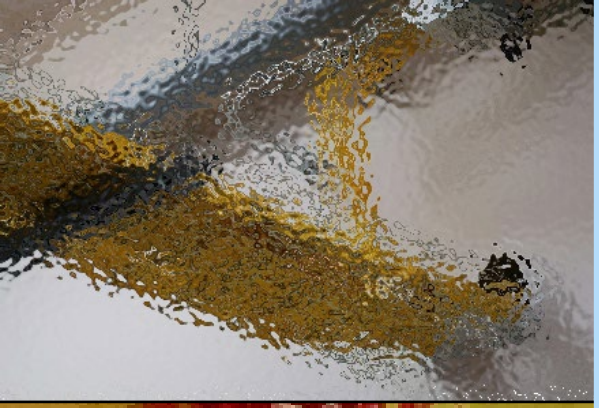
- Revision were made to align the **allowable wiring methods** in 695.6(D) with the required **terminations fittings** at a fire pump controller
- Cable fittings that are listed for the wiring method used and with a type rating at least equal to that of the fire pump controller are appropriate for these installations
- The installation instructions of the manufacturer of the fire pump controller must be followed
- Alterations to the fire pump controller *(other than raceway or cable terminations)* are required to be approved by the authority having jurisdiction

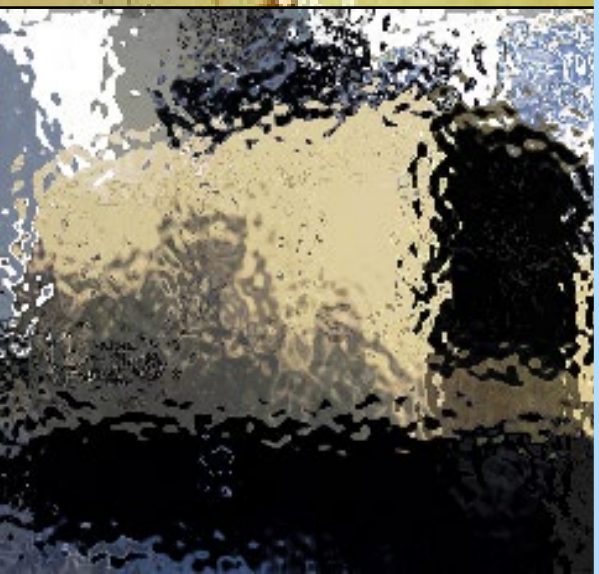
695.6(J) ~~Raceway~~ Terminations

Where raceways or cable are terminated at a fire pump controller, terminations must be a raceway or cable fittings listed and identified for use in wet locations with the type rating of the raceway or cable fittings being at least equal to that of the fire pump controller.




Listed Type MC cable with impervious outer covering
AWG-2 TYPE MC 600V (UL) TYPE THHN/THWN CDRS-FOR CT U





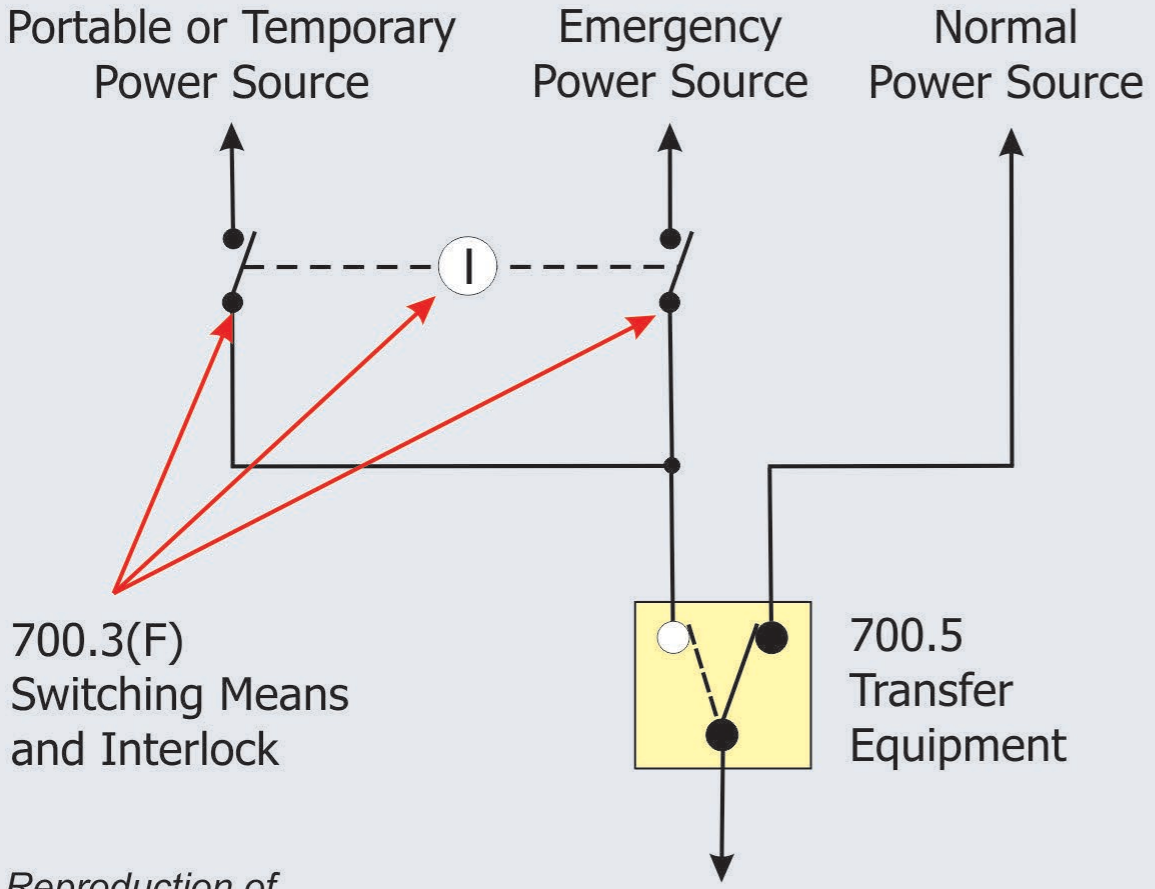
Chapter Seven Special Conditions

700.5(A) Transfer Equipment (Emergency Systems)

- A new last sentence is added to clarify that **meter mounted transfer switches** are not permitted for use in emergency systems
- Where emergency system is required, means must be provided to switch critical loads from normal utility source to standby emergency power source
- Several types of device are available for this operation
- A meter-mounted transfer switch is installed in the meterbase between the glass plug-in meter and the base unit
- Meter mounted transfer switch allows a typical homeowner to connect a portable generator to their home with relative ease via the electric meter located on the outside of the building
- **Same basic change** pertaining to listing and marking requirement and prohibiting meter-mounted transfer equipment occurred at **701.5(A)** *(Legally Required Systems)*

700.5(A) Emergency Systems Transfer Equipment

Transfer equipment ~~(including automatic transfer switches)~~ shall be automatic, ~~identified~~ listed, and marked for emergency use



Reproduction of NEC Figure 700.3(F)

Courtesy of GenerLink

Meter-mounted transfer switches not permitted for emergency system use

700.12(B) Emergency Systems Equipment Design and Location

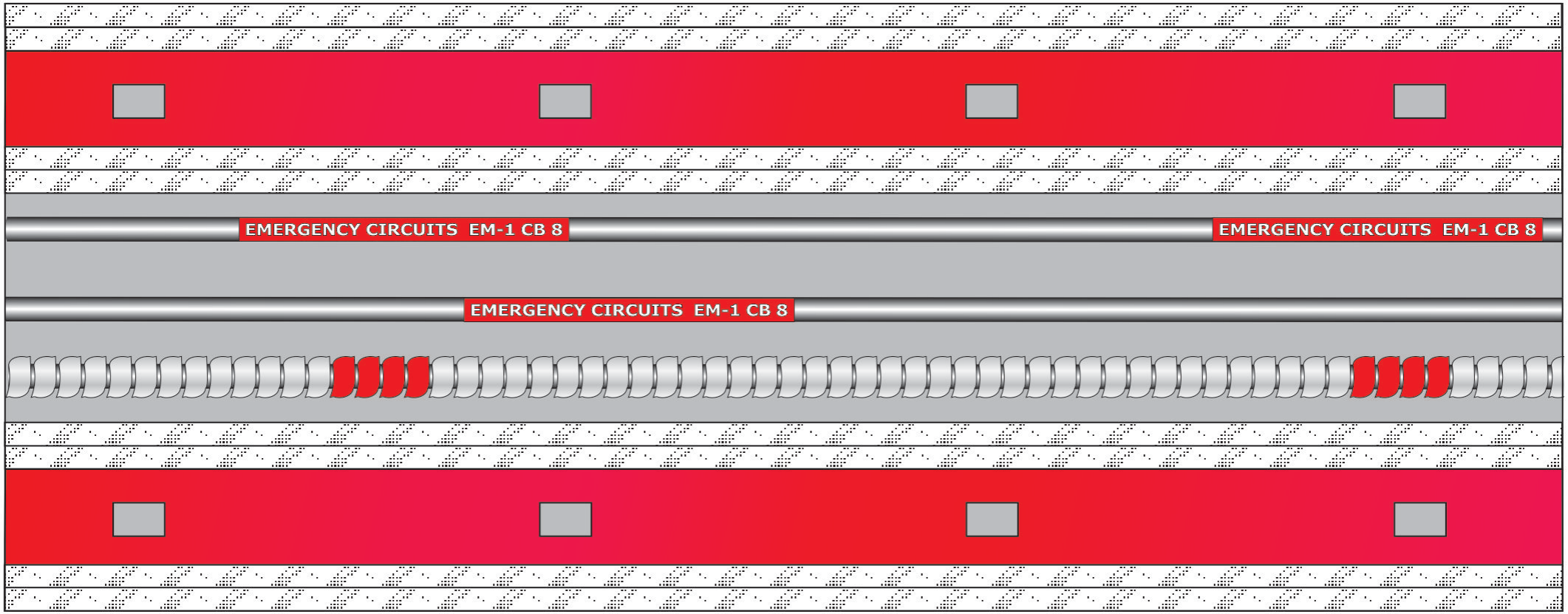
- Reference to “spaces with a **1-hour fire rating**” revised to **2-hour**, to correlate with the requirements of **700.10(D)** and **NFPA 110**
- **NFPA 110** *(Standard for Emergency and Standby Power Systems)* indicates this same 2-hour fire rating
- Emergency system equipment for sources of power now required to be installed either in spaces **fully protected by approved automatic fire protection systems** or in spaces with a **2-hour fire rating** where located within:
  - (1) Assembly occupancies for more than 1000 persons
  - (2) Buildings above 23 m (75 ft) in height with any of the following occupancy classes; assembly, educational, residential, detention and correctional, business, and mercantile
  - (3) Educational occupancies with more than 300 occupants

700.12(B) Emergency Systems Equipment Design and Location *(cont.)*

- Previous editions of the *Code* called for this 1-hour fire rating (now 2-hour) to be applied to four specific locations
- One of these locations was previous List item (3) addressing "**health care occupancies where persons are not capable of self-preservation**"
- This list item was **deleted** to resolve conflicts between 700.12(B) and **NFPA 99** *(Health Care Facilities Code)*
- Conflict between NFPA documents [700.12(B)(3) and NFPA 99] could have resulted in AHJ being unable to determine which of the standards takes precedence

700.12(B) Emergency System Equipment Design and Location

Equipment for sources of power required to be installed either in spaces fully protected by approved automatic fire protection systems or in spaces with a 2-hour fire rating where located within:

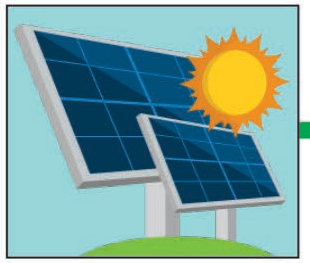


(1) Assembly occupancies for more than 1000 persons, (2) Buildings above 23 m (75 ft) in height with any of the following occupancy classes; assembly, educational, residential, detention and correctional, business, and mercantile, ~~(3) Health care occupancies where persons are not capable of self-preservation,~~ and (3) Educational occupancies with more than 300 occupants

700.12(H) DC Microgrid Systems as Emergency System

- New List Item (H) added to clarify that a **dc microgrid system** that is separate from the normal source of supply is permitted as an emergency system source
- Several systems are identified at **700.12** that can serve as an emergency system source such as storage batteries, generator sets, uninterruptible power supplies (UPS), additional separate services, fuel cell systems, and unit equipment
- In order for a **dc microgrid system** to qualify as an emergency system, it must be capable of being **isolated from all non-emergency sources** and must also have a suitable rating and capacity to supply and maintain the total emergency load for not less than **2 hours of full-demand operation**
- Where a dc microgrid system source serves as the **normal supply** for the building or group of buildings concerned, it **cannot serve as the sole source of power** for the emergency standby system

700.12(H) DC Microgrid Systems as Emergency System



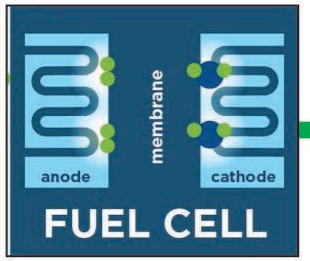
PV

DC-DC Converter

Wind

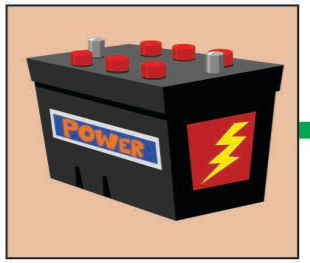
DC-DC Converter

DC Microgrid



Fuel Cell

DC-DC Converter



Storage Battery

DC-DC Converter

DC-AC Bidirectional Converter

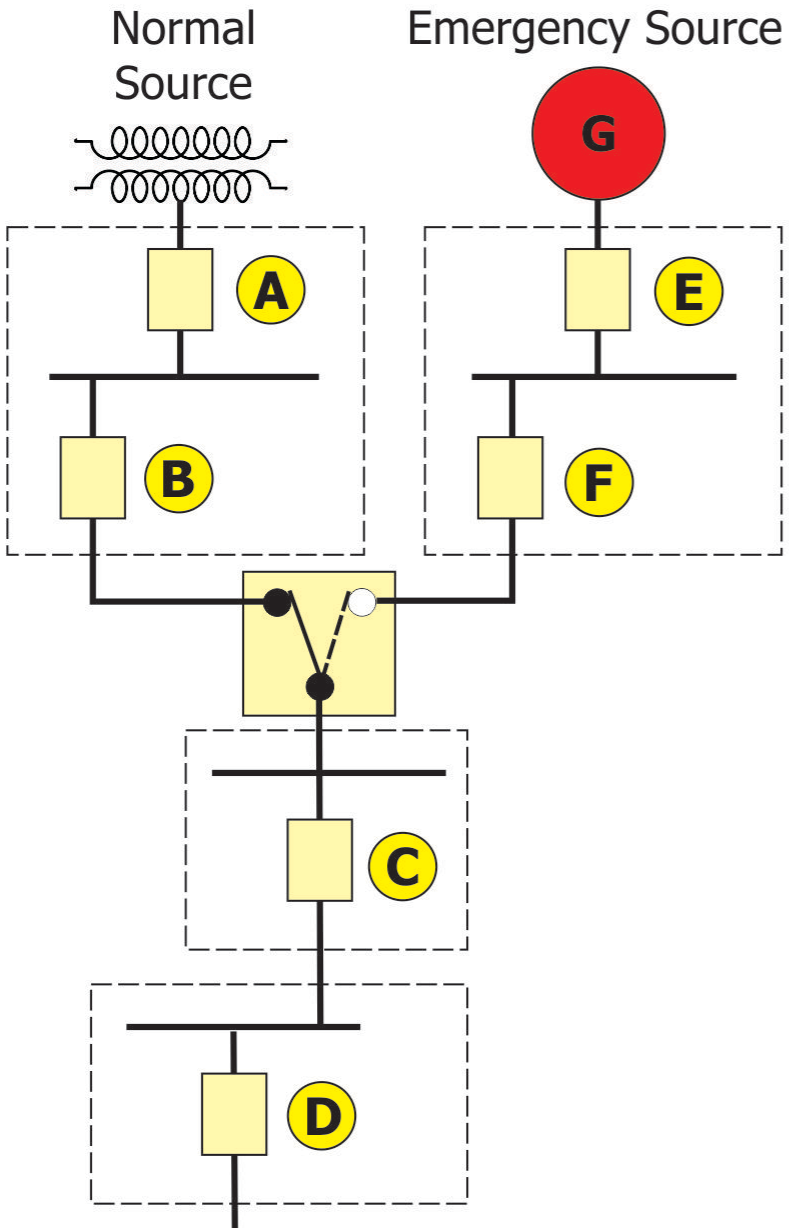
Emergency System

A dc microgrid system that is separate from the normal source of supply is now permitted as an emergency system source

Informational Note Figure 700.32 Emergency System Selective Coordination

- A **new informational note** was added at 700.32 giving reference to a **new Informational Note Figure 700.32**, which gives an **example** of how emergency system overcurrent protective devices (OCPDs) selectively coordinate with all supply-side OCPDs
- Emergency system(s) overcurrent devices are required to be selectively coordinated with all supply-side overcurrent protective devices
- Selective coordination is the ability of a system to isolate a fault or overload to a branch circuit or feeder panelboard without effecting the service equipment
- Addition of new figure provides **significant clarity** the determination of how emergency system OCPDs selectively coordinate comes together to protect upstream loads
- Very same change occurred at **708.54** for Critical Operations Power Systems (COPS)

I-Note Figure 700.32 Emergency System Selective Coordination



Example of how emergency system overcurrent protective devices (OCPDs) selectively coordinate with all supply-side OCPDs

OCPD D selectively coordinates with OCPDs C, F, E, B, and A

OCPD C selectively coordinates with OCPDs F, E, B, and A

OCPD F selectively coordinates with OCPD E

OCPD B is not required to selectively coordinate with OCPD A because OCPD B is not an emergency system OCPD

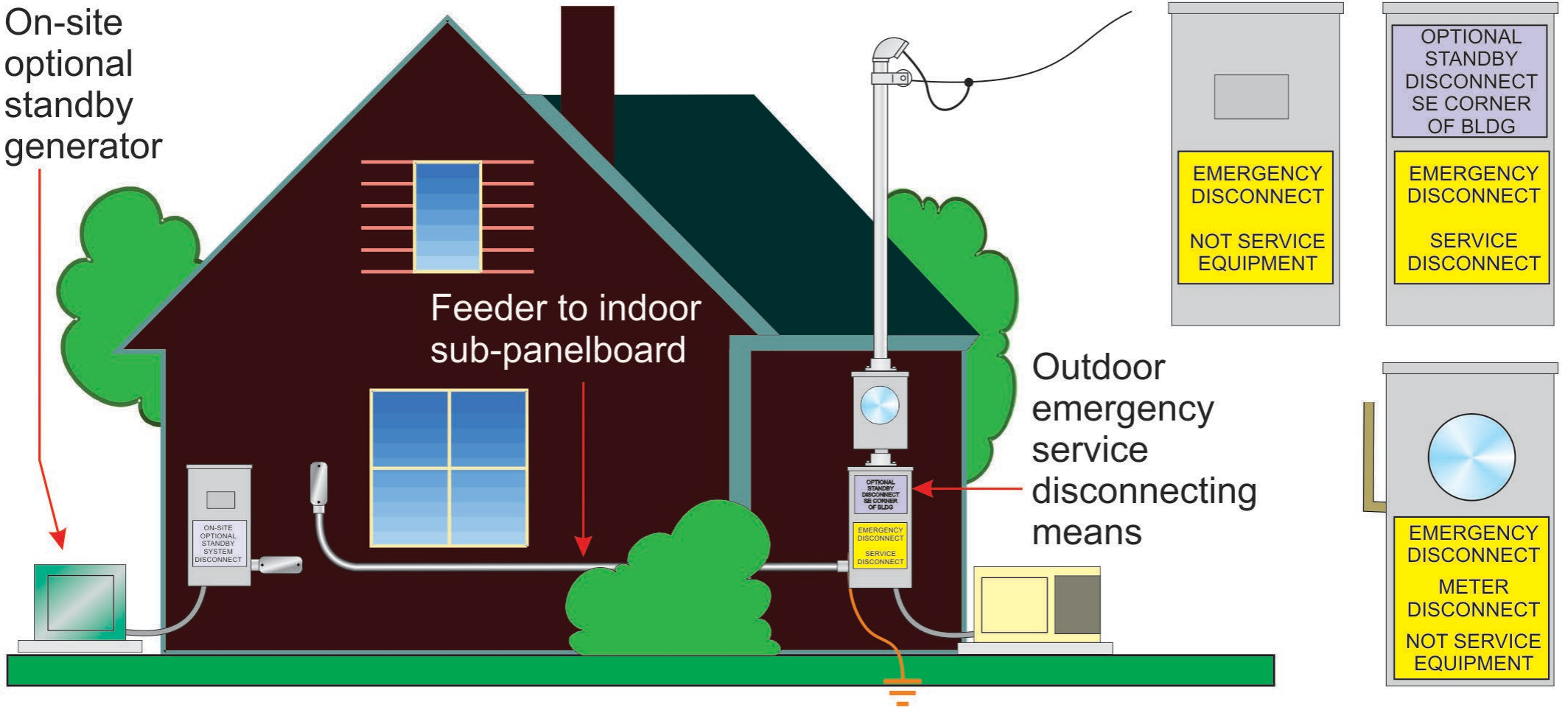
702.7(A) Signs for Optional Standby Systems

- A sign is required to be placed at the **residential emergency disconnecting means** required by **230.85** that indicates the location of each permanently installed **on-site optional standby power source disconnect**
- An emergency disconnecting means *(which could include the service disconnecting means)* for a one- or two-family dwelling is now required to be installed and located on the outside of the structure *(see 230.85)*
- If the outdoor first responder 230.85 emergency disconnect is **not the service disconnect**, then the **on-site optional standby system signage** would be located at this equipment rather than the service equipment
- Same requirement would apply to an **on-site optional generator** to identify the shutdown means of the prime mover as required in **445.18(D)**

702.7(A) Sign for On-Site Optional Standby Systems

A sign is required to be placed at the residential emergency disconnecting means required by 230.85 that indicates the location of each permanently installed on-site optional standby power source disconnect.

Same requirement to identify shutdown means of generator prime mover as required in 445.18(D)



Article 705 Interconnected Electric Power Production Sources

- Article 705 was **extensively reorganized and revised**
- Article 705 covers installation of one or more electric power production sources operating in parallel with a primary source(s) of electricity
- Article has been revised and now contains (2) Parts
  - Part I-General
  - Part II-Microgrid Systems
- Previous Part II and Part III have been deleted as part of the restructuring of Article 705 for the 2020 *NEC* (*deleted or incorporated into other sections of Article 705)*

Article 705 Interconnected Electric Power Production Sources *(cont.)*

- Article 705 was **extensively reorganized and revised** *(cont.)*
- Title of **705.10** was changed from “Directory” to “**Identification of Power Sources**” to align with related changes to identification of power sources in other articles in a continued effort to harmonize all directory requirements for onsite sources under a variety of applications
- New **705.11** was added to address connections made by electric power production sources on the **supply side of the service disconnecting means** as permitted by **230.82(6)**
- New requirements of **705.11(B)** sets a minimum conductor size of **6 AWG copper** and **4 AWG aluminum** for connections on the supply side of the service disconnecting means

Article 705 Interconnected Electric Power Production Sources *(cont.)*

- Article 705 was **extensively reorganized and revised** *(cont.)*
- New requirements of **705.11(C)** sets forth the requirements for overcurrent protection of the power source output conductors
  - Overcurrent protection be located in a readily accessible location either outside of a building or at the first point of entry
  - If the service is inside a building, two options are available for the location of overcurrent protection:
    - within **3 m (10 ft)** of conductor length in dwelling units
    - within **5 m (16.5 ft)** at other than dwelling units *[within **20 m (71 ft)** with current limiters at other than a dwelling unit]*

Article 705 Interconnected Electric Power Production Sources *(cont.)*

- Article 705 was **extensively reorganized and revised** *(cont.)*
- New **705.11(D)** deals with the grounding and bonding of metal equipment associated with conductors connected on the supply side of the service disconnect ***(This subdivision was removed from the 2020 NEC by CAM 70-45)***
- Type of connections that are permitted for conductors are addressed by new **705.11(E)** ***(This subdivision is now 705.11(D) in the 2020 NEC)***
- **705.11(F)** clarifies that a power source disconnecting means shall not be considered as one of the service disconnecting means as required by 230.70 ***(This subdivision was removed from the 2020 NEC by CAM 70-46)***
- New requirements of **705.11(G)** *(Ground-Fault Protection)*, gives a reference to 230.95 ***(This subdivision is now 705.11(E) in the 2020 NEC)***

Article 705 Interconnected Electric Power Production Sources *(cont.)*

- Article 705 was **extensively reorganized and revised** *(cont.)*
- New **705.13** titled, "**Power Control Systems**" was added calling for **power control system (PCS)** to be listed and evaluated to control the output of one or more power production sources, energy storage systems (ESS), and other equipment
- New **705.13(E)** titled, "**Access to Settings**" calls for access to settings of the PCS to be restricted to qualified personnel in accordance with the requirements of 240.6(C) (Restricted Access Adjustable-Trip Circuit Breakers), which achieves this restricted access by location behind bolted equipment enclosure doors, location behind locked doors accessible only to qualified personnel, etc.

Article 705 Interconnected Electric Power Production Sources *(cont.)*

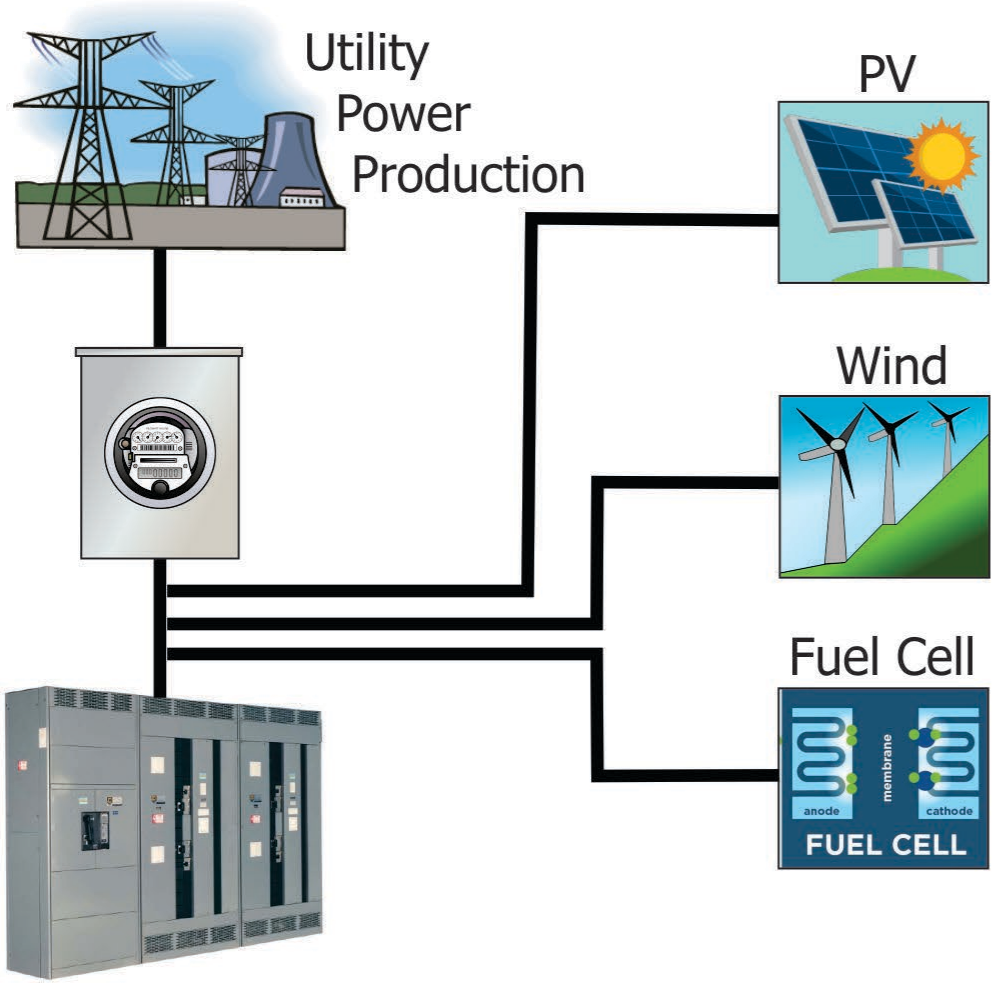
- Article 705 was **extensively reorganized and revised** *(cont.)*
- Existing *Code* language at **705.20** was revised and expanded upon for clarity and usability to use proper terminology as this section discusses a singular means of disconnection *(Disconnecting Means, Source)*
- A new section titled, "**Wiring Methods**" was added at **705.25** indicating that all raceway and cable wiring methods included in Chapter 3 of the *NEC* and other wiring systems and fittings specifically listed, intended, and identified for use with power production systems and equipment are permitted to be used
- New **705.28** titled, "**Circuit Sizing and Current**" has been added, which is previous 705.60 revised, consolidated, and relocated into 705.28 to be consistent with Article 690

Article 705 Interconnected Electric Power Production Sources *(cont.)*

- Article 705 was **extensively reorganized and revised** *(cont.)*
- New **705.30** titled, "**Overcurrent Protection**" is previous language from 705.65 and combined into this new section
- Previous Part II and Part III have been deleted as part of the restructuring of Article 705 *(sections of these previous parts have been deleted or incorporated into other sections of Article 705)*
- *N*ew provisions of **705.45** *(**Unbalanced Interconnections**)*, which was previous 705.100 have been restored and relocated at the end of Part I of Article 705

Article 705 Interconnected Electric Power Production Sources

Article 705 covers installation of one or more electric power production sources operating in parallel with a primary source(s) of electricity



Article 705 was extensively reorganized and revised for the 2020 *NEC Code* cycle

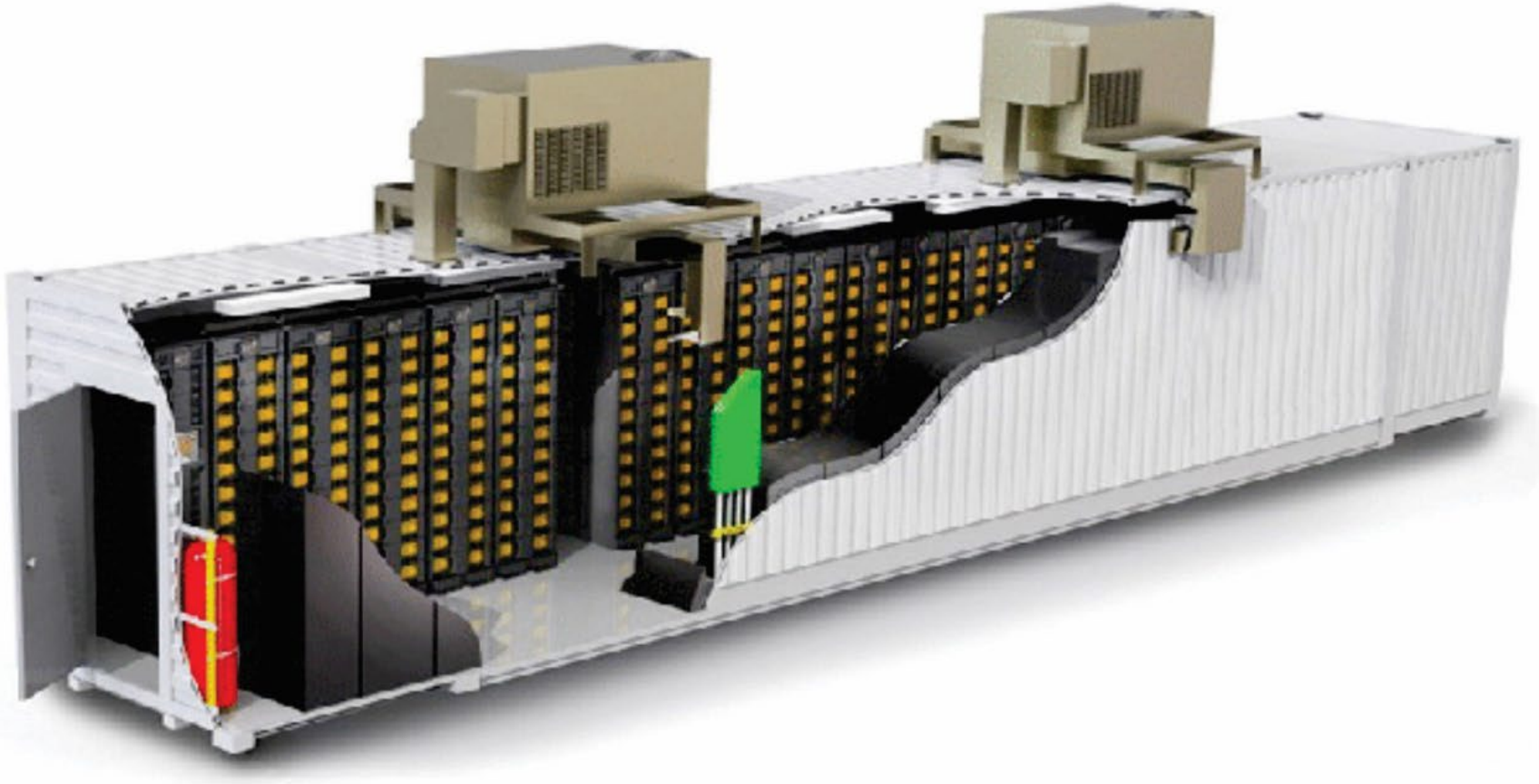
706.1 Scope (Energy Storage Systems)

- **Scope of Article 706** has been **revised** to provide clarity and to better express what is covered by the article
- Previously, an energy storage system may have been confused with an **uninterruptible power supply (UPS) system** or a **large battery system** that is used only when power is lost to the building
- Revised scope and definition of an "**Energy Storage System**" provides additional clarity that an ESS can store and provide energy during normal operating conditions
- Previous scope identified an ESS as one "operating at over 50 volts ac or 60 volts dc," which has been revised to "**having a capacity greater than 3.6 MJ (1 kWh)**" *[MJ = megajoule, kWh = kilowatt hour]*
- Scope was also revised to make it clear that Article 706 will not only apply to a **permanently installed ESS**, but those used in **temporary applications** also

706.1 Scope of Article 706 (Energy Storage Systems)

This article applies to all energy storage systems (ESS) having a capacity greater than 3.6 MJ (1 kWh) that may be stand-alone or interactive with other electric power production sources.

These systems are primarily intended to store and provide energy during normal operating conditions.



The scope of Article 706 has been revised to provide clarity and to better express what is covered by the article

706.2 Definitions: Energy Storage System (ESS)

- Revision occurred to the previous definition of an **Energy Storage System (ESS)** to better define what an ESS is and is not
- **Energy Storage System (ESS).** One or more components assembled together capable of storing energy and providing electrical energy into the premises wiring system or an electric power production and distribution network.
- The **different classifications** of ESS that were in the 2017 *NEC* were **deleted** as these terms are no longer used in the ESS industry
- **UL 9540** *(Standard for Energy Storage Systems and Equipment)* does not specify or define any specific system classification terminology
- Improvements to the definition of an energy storage system will help users of the *Code* better apply Article 706 to electrical installations

706.2 Definition: Energy Storage System (ESS)

One or more components assembled together capable of storing energy and providing electrical energy into the premises wiring system or an electric power production and distribution network.

ESS(s) can include but is not limited to batteries, capacitors, and kinetic energy devices (e.g., flywheels and compressed air) and can include inverters or converters to change voltage levels or to make a change between an ac or a dc system

706.4 System Requirements (Energy Storage Systems)

- New **marking requirements** ***(nameplate information)*** added for energy storage systems (ESS)
- Marking requirement in this revision correlates with the marking requirements found in **UL 9540** *(Standard for Energy Storage Systems and Equipment)*
- ESS to be provided with a **nameplate plainly visible after installation** and marked with **(8) specific pieces of information** provided on the nameplate
- The classifications of an ESS have been **deleted** *(no longer used in the ESS industry)*
- During the development of **NFPA 855** *(Standard for the Installation of Energy Storage Systems)* the ESS classifications that were indicted at 706.4 were initially used but are no longer used in NFPA 855

706.4 System Requirements (Energy Storage System)

Each ESS shall be provided with a nameplate plainly visible after installation and marked with (8) specific pieces of information provided on the nameplate

IAEI ENERGY STORAGE SYSTEM

KVA	68 kVA	**% IMP.**	4.2	**NO. OF PHASES**	3
RATED FREQUENCY	50 Hz ; 60 Hz			**Hz**	60
MAXIMUM OUTPUT/INPUT CURRENT					1040 A
MAXIMUM OUTPUT/INPUT VOLTAGE					850 V
AVAILABLE FAULT CURRENT					23.2 kA
UTILITY INTERACTIVE CAPABILITY					N/A
NORMAL PHASE-TO-PHASE VAC					380 V
MAX. DC OPERATING CURRENT					
EFFICIENCY (@ 50 Hz)	98.7%				
OUTPUT POWER (S)	630 kVA				

Listed ESS

(1) Manufacturer's name, trademark, or other descriptive marking (2) Rated frequency (3) Number of phases, if ac (4) Rating (kW or kVA) (5) Available fault current derived by the ESS at the output terminals (6) Maximum output and input current of the ESS at the output terminals (7) Maximum output and input voltage of the ESS at the output terminals (8) Utility-interactive capability, if applicable

706.7 Maintenance of Energy Storage Systems (ESS)

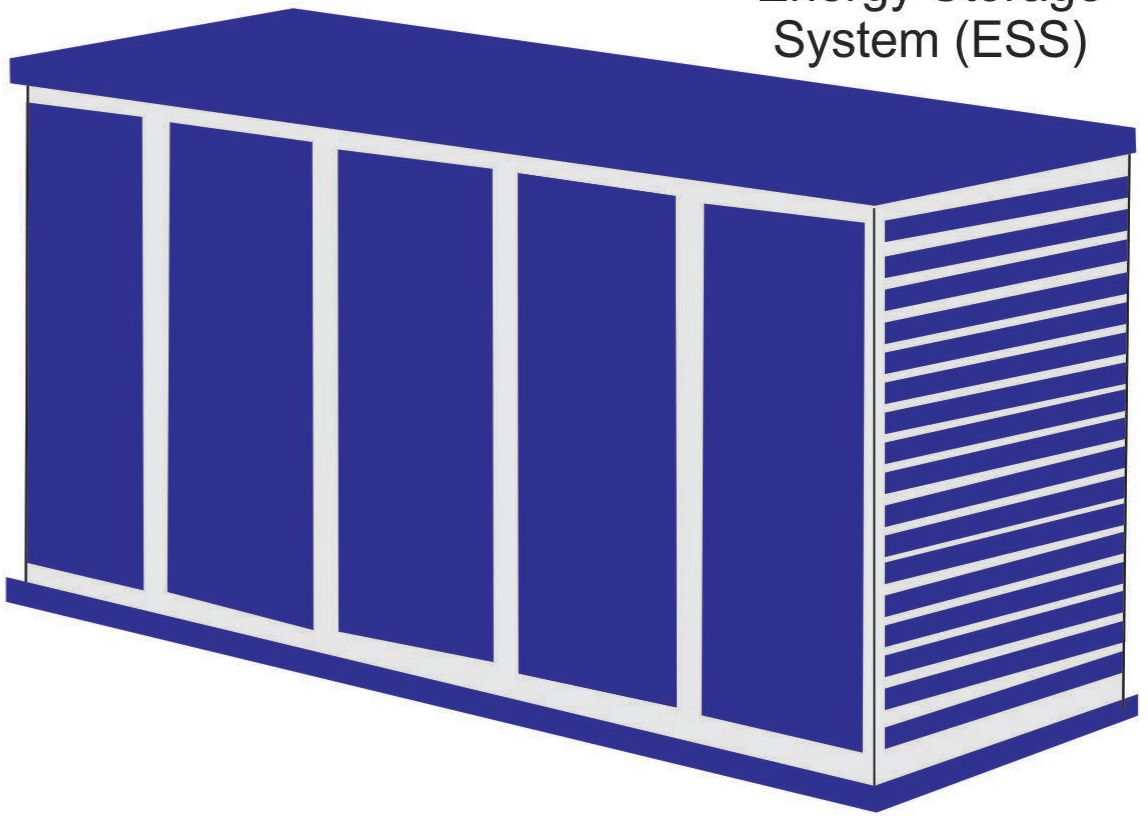
- New provisions added calling for **maintenance** of energy storage systems (ESS)
- Energy storage systems (ESS) are required to be maintained in proper and safe operating condition
- This required maintenance is to be performed in accordance with the **manufacturer's requirements** and industry standards
- A **written record** of the system maintenance is required to be kept and shall include records of repairs and replacements necessary to maintain the system in proper and safe operating condition
- New informational note gives reference to **NFPA 70B-2016** *(Recommended Practice for Electrical Equipment Maintenance)* and **ANSI/NETA ATS-2017** *(Standard for Acceptance Testing Specifications for Electrical Power Equipment and Systems)*

706.7 Maintenance of Energy Storage Systems (ESS)

ESS required to be maintained in proper and safe operating condition with required maintenance performed in accordance with the manufacturer's requirements and industry standards

Maintenance Personnel

Energy Storage System (ESS)



A written record of the system maintenance is required to be kept including records of repairs and replacements necessary to maintain the system in proper and safe operating condition

706.9 Maximum Voltage (Energy Storage Systems)

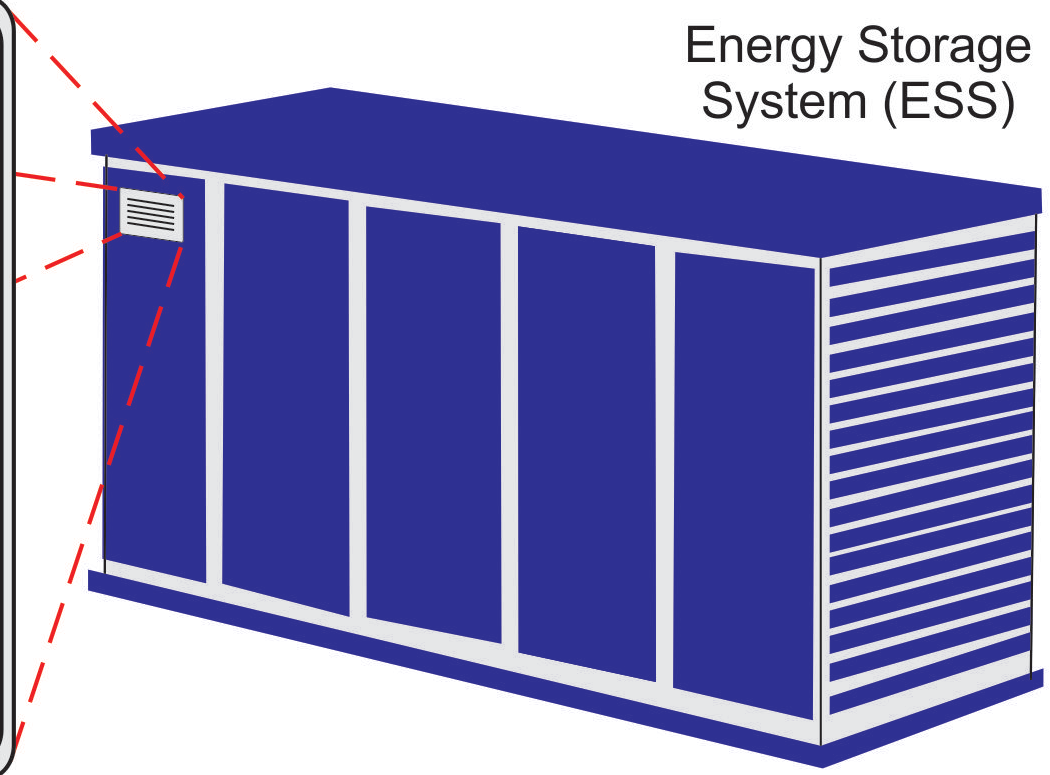
- New section added to provide prescriptive requirements for the determination of **maximum voltage** of an energy storage system (ESS)
- Maximum voltage of an ESS is determined by the rated ESS input and output voltage(s) indicated on the **ESS nameplate(s)** or system listing
- This requirement is in alignment with the new requirements of **706.4**, which calls for an ESS to be provided with a nameplate plainly visible after installation and marked with (8) specific pieces of information provided on the nameplate
- One of the pieces of information now required on the **ESS nameplate** is the "maximum output and input voltage of the ESS at the output terminals"
- New requirements of 706.9 provides clear guidance on how to determine maximum voltage of an ESS

706.9 Maximum Voltage (Energy Storage Systems)

The maximum voltage of an ESS shall be the rated ESS input and output voltage(s) indicated on the ESS nameplate(s) or system listing

IAEI ENERGY STORAGE SYSTEM			
KVA	68 kVA	% IMP. 4.2	NO. OF PHASES 3
RATED FREQUENCY	50 Hz ; 60 Hz	Hz	60
MAXIMUM OUTPUT/INPUT CURRENT			1040 A
MAXIMUM OUTPUT/INPUT VOLTAGE			850 V
AVAILABLE FAULT CURRENT			23.2 kA
UTILITY INTERACTIVE CAPABILITY			N/A
NORMAL PHASE-TO-PHASE VAC			380 V
MAX. DC OPERATING CURRENT			
EFFICIENCY (@ 50 Hz)	98.7%		
OUTPUT POWER (S)	630 kVA		

Listed ESS



New section added to provide prescriptive requirements for the determination of maximum voltage of an ESS

706.30(A)(1) Nameplate-Rated Circuit Current for ESS

- Revision occurred to clarify that an energy storage system (ESS) may have **two nameplates**, each respectively indicating input or output circuit rating, or one nameplate showing input and output circuit ratings
- Previous *Code* text at 706.20(A)(1) [now **706.30(A)(1)**] stated that the nameplate(s) rated circuit current was to be the rated current indicated on the ESS nameplate(s) or system listing for pre-engineered or self-contained systems of "**matched components**" intended for field assembly as a system
- Neither the *NEC* or **UL 9540** *(Standard for Energy Storage Systems and Equipment)* contain a definition for "**matched components**"
- The term "**matched components**" was removed from 706.30(A)(1) to align with revised definitions used in conjunction with Article 706

706.30(A)(1) Nameplate-Rated Circuit Current for ESS *(cont.)*

- Not uncommon to see an ESS with **two separate nameplates**, each respectively indicating input or output circuit rating, or one nameplate showing input and output circuit ratings
- **706.30(A)(1)** was revised for clarity and to recognize the fact that an ESS can indeed have **two separate nameplates**
- Where an ESS has separate input (charge) and output (discharge) circuits or ratings, these ratings are to be considered individually
- Where the same terminals on the ESS are used for charging and discharging, the rated current would be considered the greater of the two

706.30(A)(1) Nameplate-Rated Circuit Current (ESS)

Circuit current is the rated current indicated on an energy storage systems (ESS) nameplate(s) or system listing ~~for pre-engineered or self-contained systems of matched components intended for field assembly as a system~~

Courtesy of ABB Electrification Products Division (Thomas & Betts)

Where an ESS has separate input (charge) and output (discharge) circuits or ratings, these ratings are to be *considered individually* *(possibly two nameplates)*

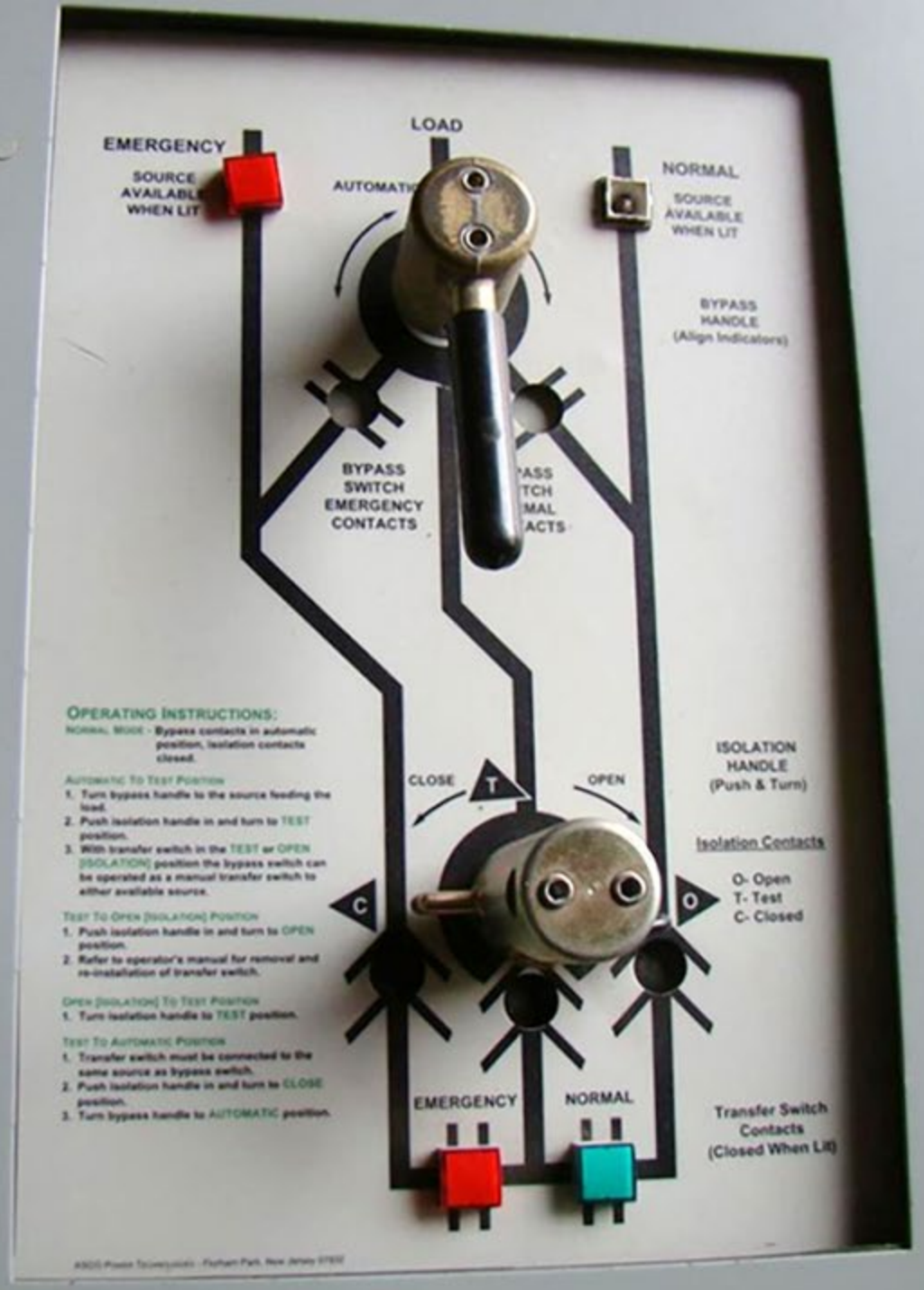
Where the same terminals on the ESS are used for charging and discharging, the rated current would be considered the *greater of the two*

708.24(D) Bypass Isolation Automatic Transfer Switches (COPS)

- New List Item (D) added to address **bypass isolation automatic transfer switches** where necessary for a designated **Critical Operations Power Systems (COPS)** buildings
- Transfer equipment *[including automatic transfer switches (ATS)]* used in conjunction with a COPS system is required to be automatic and identified for emergency use
- COPS transfer equipment is required to be designed and installed to prevent the inadvertent interconnection of normal and critical operations sources of supply in any operation of the transfer equipment
- In some cases, design criteria call for a means to put an **automatic transfer switch** in an **electrically safe work condition** so that **maintenance** can be performed safely on the automatic transfer switch without losing power to the critical loads associated with a COPS designated building

708.24(D) Bypass Isolation Automatic Transfer Switches (COPS) *(cont.)*

- New List Item (D) added to address **bypass isolation automatic transfer switches** where necessary for a designated **Critical Operations Power Systems (COPS)** buildings *(cont.)*
- If a COPS design has loads that can only be supplied via one automatic transfer switch, the **maintenance may not get done** or if it is done, it is performed in an **unsafe non-compliant NFPA 70E** *(Electrical Safety in the Workplace)* **manner**
- **Bypass isolation switches** provide redundancy and **continuous powering of the loads** while the automatic transfer switch is de-energized so that proper maintenance can be performed under safe compliant NFPA 70E work conditions
- However, while in the bypass mode, if the connected power source fails, it would be necessary to quickly transfer between power sources (this can be achieved by an **automatic bypass isolation switch**)

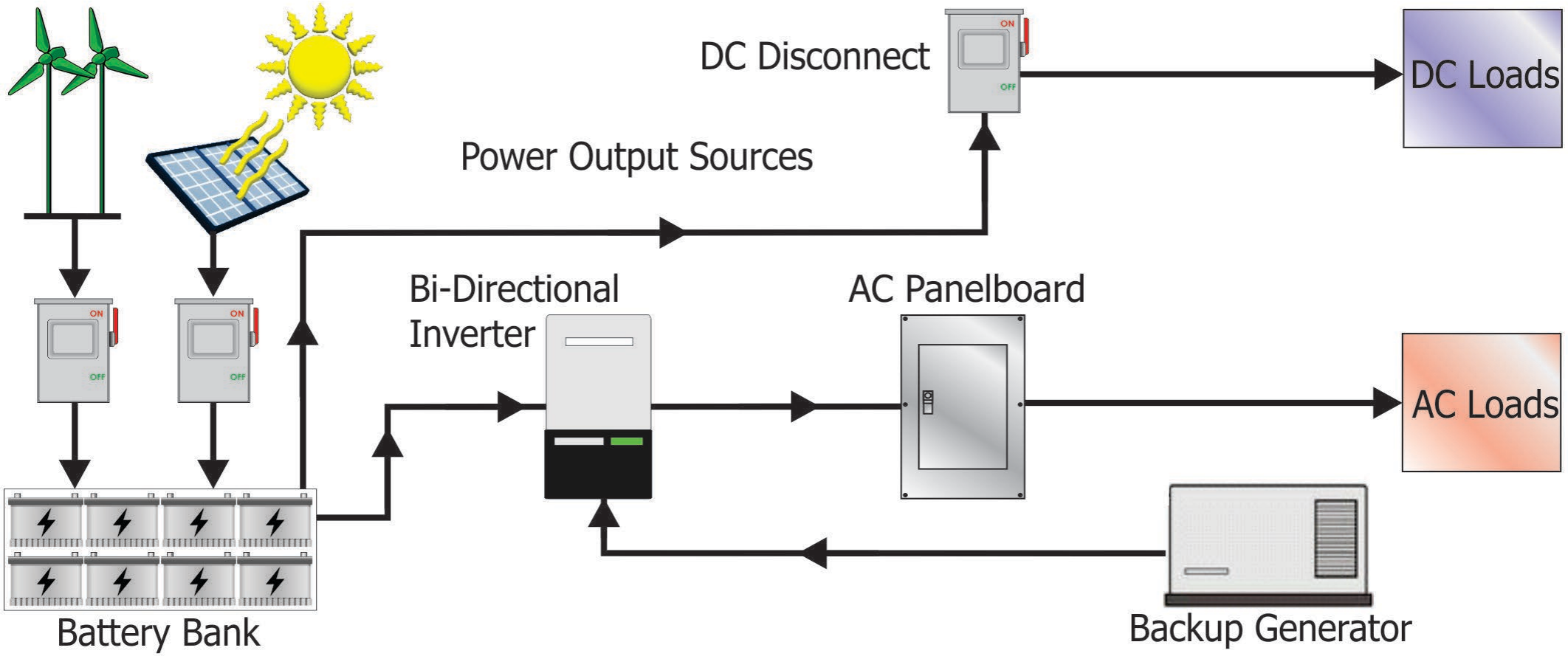

EMERGENCY
SOURCE AVAILABLE WHEN LIT
LOAD
AUTOMATIC
NORMAL
SOURCE AVAILABLE WHEN LIT
BYPASS HANDLE (Align Indicators)
BYPASS SWITCH EMERGENCY CONTACTS
OPERATING INSTRUCTIONS:
NORMAL MODE - Bypass contacts in automatic position, isolation contacts closed.
AUTOMATIC TO TEST POSITION
1. Turn bypass handle to the source feeding the load.
2. Push isolation handle in and turn to TEST position.
3. With transfer switch in the TEST or OPEN [ISOLATION] position the bypass switch can be operated as a manual transfer switch to either available source.
TEST TO OPEN [ISOLATION] POSITION
1. Push isolation handle in and turn to OPEN position.
2. Refer to operator's manual for removal and re-installation of transfer switch.
OPEN [ISOLATION] TO TEST POSITION
1. Turn isolation handle to TEST position.
TEST TO AUTOMATIC POSITION
1. Transfer switch must be connected to the same source as bypass switch.
2. Push isolation handle in and turn to CLOSE position.
3. Turn bypass handle to AUTOMATIC position.
CLOSE
T
OPEN
ISOLATION HANDLE (Push & Turn)
Isolation Contacts
C
O
O- Open
T- Test
C- Closed
EMERGENCY
NORMAL
Transfer Switch Contacts (Closed When Lit)

710.15 General Requirements for Stand-Alone Systems

- New Code language has been added at 710.15 to recognize that stand-alone systems can deliver power to **three-phase applications** as well as single-phase systems
- 2017 *NEC* seemed to have indicated that a stand-alone system was reserved for a single-phase system only
- Several manufacturers design and sell products such as inverters, dc disconnects, battery banks, and generators that are capable of delivering and receiving a **three-phase application** as well and a single-phase system
- Existing systems can meet the definition of a stand-alone or islanded system that deliver power to **three-phase applications** such as mid-size server rooms, networks, telecommunication systems, and industrial processes

710.15 General Requirements for Stand-Alone Systems

New provisions added to 710.15 to recognize that stand-alone systems can deliver power to three-phase applications as well as single-phase systems



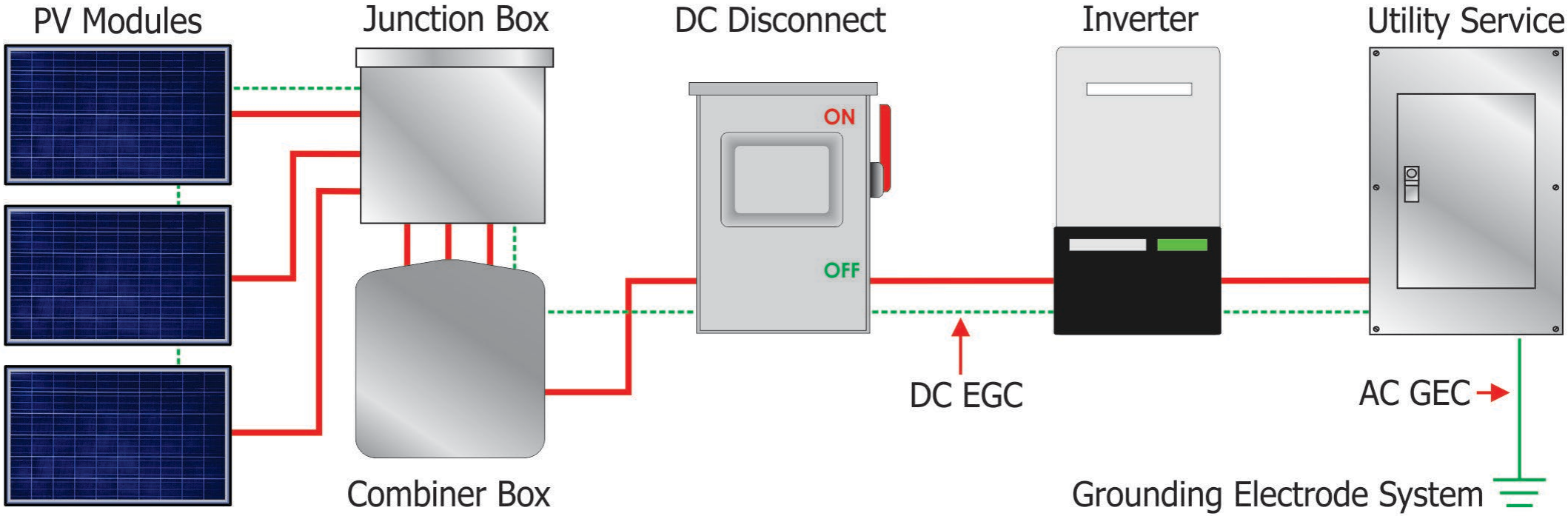
710.15(D): Three-phase Supply. Stand-alone and microgrid systems are permitted to supply three-phase, 3-wire or 4-wire systems

712.2 Definitions: ~~Resistively~~ Grounded, Functionally

- The term “Resistively Grounded” in Article 712 was revised to “**Grounded, Functionally**” to correlate with the same definition in Article 690
- The term “**Grounded, Functionally**” is defined at both 712.2 and 690.2 as “a system that has an electrical ground reference for operational purposes that is not solidly grounded”
- Some users of the *Code* would argue that only one definition is need and that definition needs to be located in Article 100, especially since these definitions mirror each other
- That is a battle for another day and perhaps that is the direction this issue will be heading toward in the 2023 *NEC* revision cycle

712.2 Definition: Grounded, Functionally

The term "Resistively Grounded" in Article 712 was revised to "Grounded, Functionally" to correlate with the same definition in Article 690



Grounded, Functionally. A system that has an electrical ground reference for operational purposes that is not solidly grounded.

Informational Note: Examples of operational reasons for functionally grounded systems include ground-fault detection and performance-related issues for some power sources.

712.10(B) Building Directory (Direct Current Microgrids)

- New **outdoor plaque or directory** requirement added to denote **all sources of dc power** to a building installed at each outside service equipment location or at an **approved readily visible location**
- This outdoor plaque or directory must denote the location of each power source disconnecting means on or in the building or be grouped with other plaques or directories for other on-site sources
- This provision brought on by ongoing concern expressed by the **fire service** and other **first responders** concerning the need to secure all on-site power sources during emergencies and awareness of where those sources are installed and utilized
- Provide warnings to first responders about the **presence and location of on-site power sources** prior to entering a building
- This new outdoor plaque or directory requirement for dc microgrids aligns with similar *Code* language at **705.10** *(Interconnected Electric Power Production Sources)* and **710.10** *(Stand-Alone Systems)*, with the goal to harmonize these similar requirements

712.10(B) Building Directory (DC Microgrids)

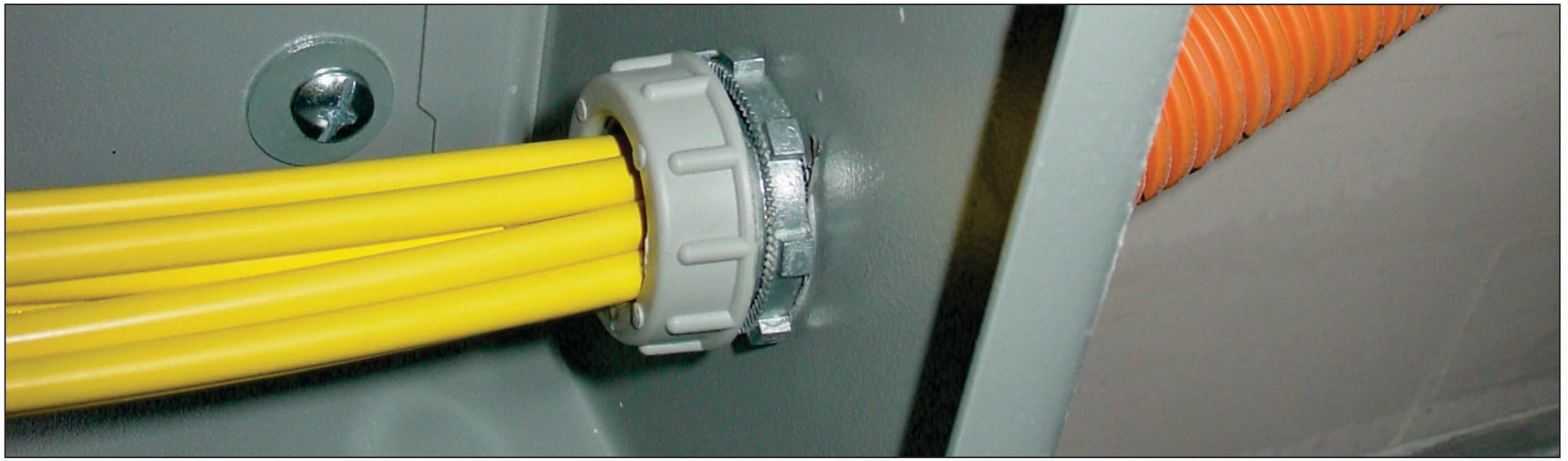
A building supplied by a dc microgrid system shall have a permanent plaque or directory installed outside the building at each service equipment location or at an approved readily visible location

725.3(O) Temperature Limitation of Class 2 and Class 3 Cables

- New text clarifies that the **temperature limitations for conductors** of 310.14(A)(3) apply to Class 2 and Class 3 cables as well *(not just conductors)*
- New **725.3(O)** ***(Temperature Limitation of Class 2 and Class 3 Cables)*** states that requirements of **310.14(A)(3)** *[previous 310.15(A)(3)] (temperature limitation of conductors)* shall apply to Class 2 and Class 3 cables
- Because Class 2 and Class 3 circuits are typically installed in a cable rather than individual conductors, some argued that the temperature limitations of conductors of **310.14(A)(3)** did not apply to Class 2 and Class 3 cables
- To put this argument to rest, a new subsection was added to Article 725 at 725.3(O)
- Same change occurred at **760.3(N)** for **fire alarm system Class 2 and Class 3 cables**

725.3(O) Temperature Limitation of Class 2 and Class 3 Cables

The requirements of 310.14(A)(3) on the temperature limitation of conductors shall apply to Class 2 and Class 3 cables *(not just conductors)*

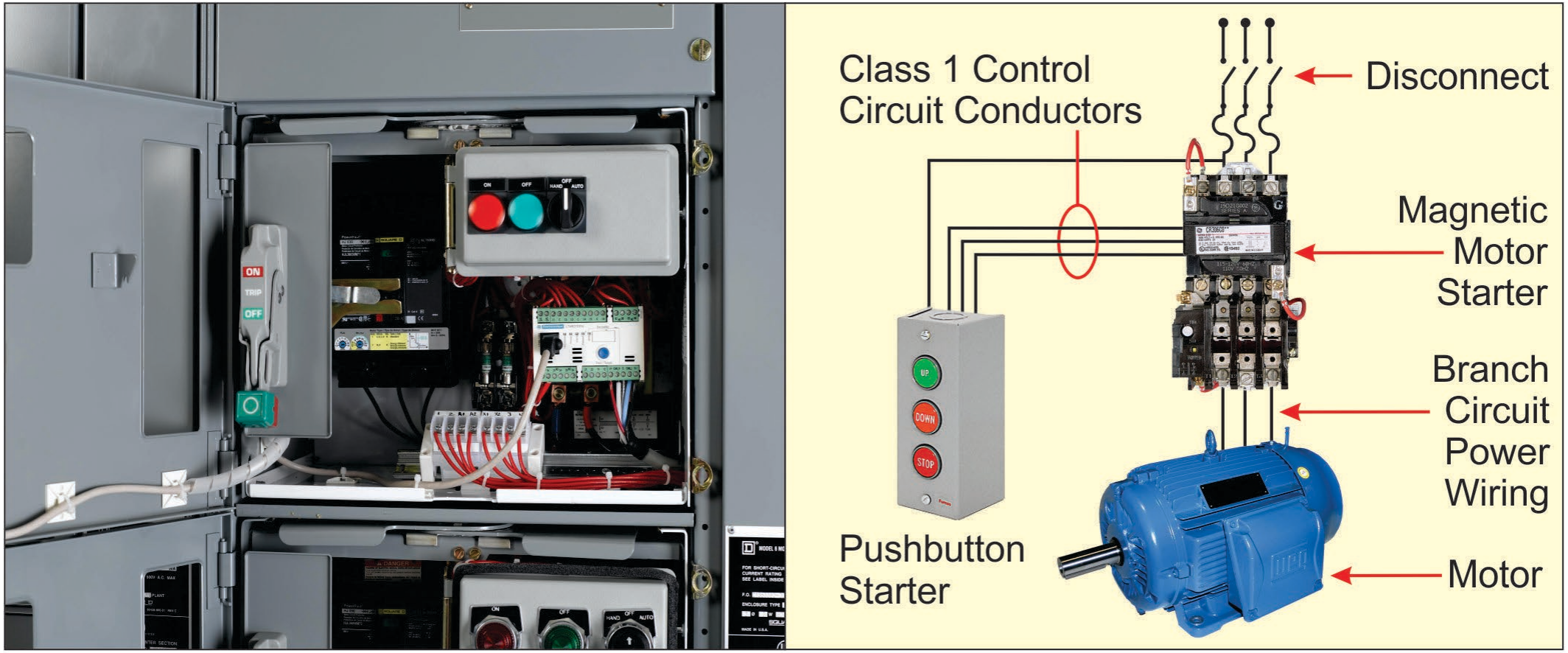


725.48(B)(1) Class 1 Circuits with Power-Supply Circuits

- Revision permits **Class 1 circuits** to share enclosure space with conductors of electric light, power, non–power-limited fire alarm and medium power network-powered broadband communications circuits as long as separated by a **barrier**
- Previously, Class 1 circuits and power-supply circuits were only permitted to occupy the same cable, enclosure, or raceway ***without a barrier*** only where the equipment powered was ***functionally associated*** *(still applies)*
- The “barrier” requirement for Class 1, Class 2, and Class 3 circuits is not specific as to the type of material required

725.48(B)(1) Class 1 Circuits with Power-Supply Circuits

Class 1 circuits and power-supply circuits permitted to occupy the same cable, enclosure, or raceway without a barrier only where the equipment powered is functionally associated



Class 1 circuits permitted to be installed with conductors of electric light, power, non-power-limited fire alarm, etc. *where separated by a barrier*

725.144 and Table 725.144 Transmission of Power and Data

- Extensive revision occurred for 725.144, Table 725.144, 725.144(A), and 725.144(B) dealing with **transmission of power and data** on Class 2, Class 3, Class 2-LP, or Class 3-LP cables
- Requirements of parent text of 725.144 did not change, just revised for clarity
- New ***Informational Note No. 3 and No. 4*** were added to identify the unique nature of the type of conductors and cables specified at Table 725.144 and to provide the appropriate reference standards that address the cables covered in the Table
- New ***Informational Note No. 5*** was added since Power over Ethernet (PoE) lighting is a very important application covered by 725.144

725.144 and Table 725.144 Transmission of Power and Data *(cont.)*

- Extensive revision occurred for 725.144, Table 725.144, 725.144(A), and 725.144(B) dealing with **transmission of power and data** on Class 2, Class 3, Class 2-LP, or Class 3-LP cables *(cont.)*
- New ***Informational Note No. 6*** was added to clarify that the rated current for power sources covered in 725.144 is the output current per conductor the power source is designed to deliver to an operational load at normal operating conditions, as declared by the manufacturer
- At Table 725.144, the undefined term “Data Cables” has been replaced with “**Balanced Twisted-Pair Cables**,” which is language that is consistent with relevant industry standards *(such as **ANSI/TIA-568-C.2-2009** Balanced Twisted-Pair Telecommunications Cabling and Components Standards)* and is also consistent with language in other parts of Article 725

725.144 and Table 725.144 Transmission of Power and Data *(cont.)*

- Extensive revision occurred for 725.144, Table 725.144, 725.144(A), and 725.144(B) dealing with **transmission of power and data** on Class 2, Class 3, Class 2-LP, or Class 3-LP cables *(cont.)*
- All the ampacity adjustment factors in **previous Table 725.144** were expressed to **one tenth values** *(i.e. 1.4, 1.7. 0.6, etc.)* except for the ampacity adjustment factors of whole numbers, such as “1, 2 and 3” amperes
- Based on **Note 2 to the table**, an ampacity of 1 ampere could be interpreted to be 1.4 amperes as this note states that where only half of the conductors in each cable are carrying current, the values in the table are permitted to be increased by a factor of 1.4
- The table ampacity adjustment factors of “1, 2 and 3” needed to be revised to “1.00, 2.00 and 3.00” respectively to avoid incorrectly interpreting these numbers

725.144 and Table 725.144 Transmission of Power and Data *(cont.)*

- Extensive revision occurred for 725.144, Table 725.144, 725.144(A), and 725.144(B) dealing with **transmission of power and data** on Class 2, Class 3, Class 2-LP, or Class 3-LP cables *(cont.)*
- **Table 725.144** ampacity adjustment factors are now expressed in double digit values
- Some of the ampacity values have been updated in **Table 725.144** to reflect new ampacity values for 23 AWG cables after recreating and reaffirming the data from the substantiation that generated this table in the 2017 *NEC*
- **725.144(A)**, covering the use of Class 2 or Class 3 cables to transmit power and data was **revised** to enhance the usability of this subsection by identifying applications where Table 725.144 need not be consulted

725.144 and Table 725.144 Transmission of Power and Data *(cont.)*

- Extensive revision occurred for 725.144, Table 725.144, 725.144(A), and 725.144(B) dealing with **transmission of power and data** on Class 2, Class 3, Class 2-LP, or Class 3-LP cables *(cont.)*
- The requirements of **725.144(B)**, titled "**Use of Class 2-LP or Class 3-LP Cables to Transmit Power and Data**" was revised with a new sentence added pertaining to **bundled LP cables**
- **725.144(B)** now states that where bundled LP cables number **192 or less** and the selected ampacity of the cables in accordance with Table 725.144 exceeds the marked current limit of the cable, the ampacity determined from the table is permitted to be used

Table 725.144

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

	Number of 4-Pair Cables in a Bundle																	
	1-7			8-19			20-37			38-61			62-91			92-192		
	Temperature Rating			Temperature Rating			Temperature Rating			Temperature Rating			Temperature Rating			Temperature Rating		
AWG	60°C	75°C	90°C	60°C	75°C	90°C	60°C	75°C	90°C	60°C	75°C	90°C	60°C	75°C	90°C	60°C	75°C	90°C
26	1.00	1.23	1.42	0.71	0.87	1.02	0.55	0.68	0.78	0.46	0.57	0.67	0.45	0.55	0.64	N/A	N/A	N/A
24	1.19	1.46	1.69	0.81	1.01	1.17	0.63	0.78	0.91	0.55	0.67	0.78	0.46	0.56	0.65	0.40	0.48	0.55
23	1.24	1.53	1.78	0.89	1.11	1.28	0.77	0.95	1.10	0.66	0.80	0.93	0.58	0.71	0.82	0.45	0.55	0.63
22	1.50	1.86	2.16	1.04	1.28	1.49	0.77	0.95	1.11	0.66	0.82	0.96	0.62	0.77	0.89	0.53	0.63	0.72

Note 1: For bundle sizes over 192 cables, or for conductor sizes smaller than 26 AWG, ampacities shall be permitted to be determined by qualified personnel under engineering supervision.

Note 2: Where only half of the conductors in each cable are carrying current, the values in the table shall be permitted to be increased by a factor of 1.4.

Informational Note No. 1: Elevated cable temperatures can reduce a cable's data transmission performance. For information on practices for 4-pair balanced twisted pair cabling, see TIA-TSB-184-A and 6.4.7, 6.6.3, and Annex G of ANSI/TIA-568-C.2, which provide guidance on adjustments for operating temperatures between 20°C and 60°C.

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

760.121(B) Power Sources for PLFA Circuits *(Fire Alarm Systems)*

- New sentence added to permit the fire alarm branch-circuit disconnecting means for power limited fire alarm (PLFA) circuits to be **secured in the "on" position**
- The fire alarm circuit disconnect for non-power-limited fire alarm (NPLFA) circuits was already permitted to be secured in the "on" position *[see 760.41(A)]*
- Change provides consistency with NPLFA circuits and PLFA circuits
- While this practice was not prohibited by **760.121**, it was not specifically permitted either
- Installing **breaker locks** is already a common industry practice on fire alarm circuits


FIRE
ALARM
CIRCUIT
OFF
15
15A
15A

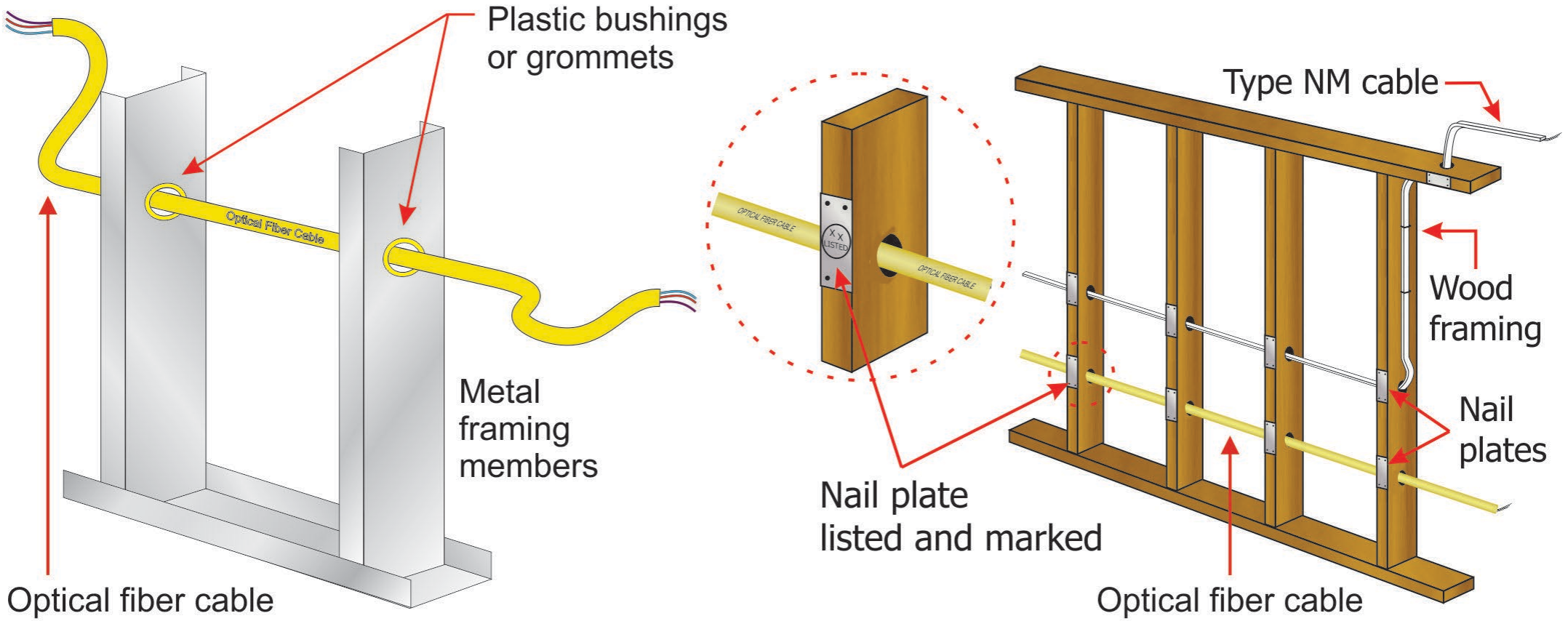
Courtesy of TC Life Safety

770.24 Mechanical Execution of Work (Optical Fiber Cable)

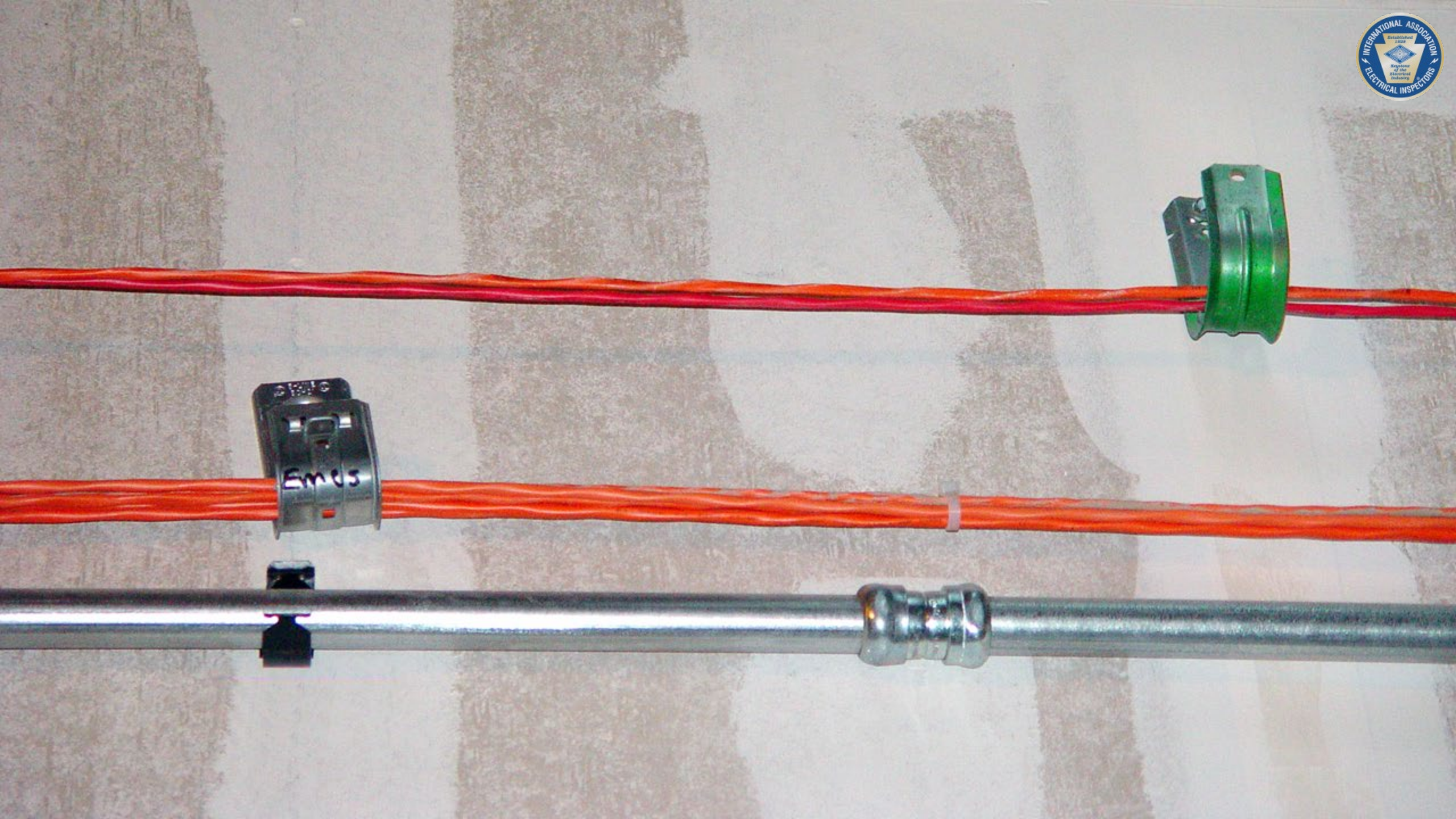
- Revision will require optical fiber cable to conform to **all of 300.4 and 300.11** *[not just 300.4(D) through (G)]*
- Previously, optical fiber cables were to be installed and protected from physical damage in accordance with 300.4(D) through (G) and 300.11
- Optical fiber cables not limited to communications installations and need protection against physical damage regardless if they can be a shock hazard or not
- Even if optical fiber cable is not carrying any current, the equipment being supplied by this cable in several situations are critical to **life and safety**
- The installation of these optical fiber cables should conform to **all of 300.4**

770.24 Mechanical Execution of Work for Optical Fiber Cable

Optical fiber cables are now required to be installed and protected from physical damage in accordance with all of 300.4 and 300.11 *[not just 300.4(D) through (G)]*



Where driven nails or screws can penetrate optical fiber cable installed through wood or metal studs, a steel sleeve, steel nail plate or steel clip not less than 1.6 mm (1/16 in.) in thickness is required to be installed *(Thinner steel plates permitted if listed and marked)*



770.110(D) Cable Trays for Optical Fiber Cables

- New section added permitting **optical fiber cables** to be installed in metal or listed nonmetallic **cable tray systems**
- Previously, permission to install optical fiber cable in a cable tray was given in several locations across Article 770
- This revision will make it easier to find this cable tray rule with it located in the same section that permits optical fiber cables to be installed in raceways and cable routing assemblies
- New requirement limits the allowance for optical fiber cables to be installed in a cable tray to **metal and listed nonmetallic cable trays** in order to address flame spread concerns
- Same change occurred for **communications cables and raceways** at **800.110(D)**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770.133 Installation of Optical Fibers and Electrical Conductors

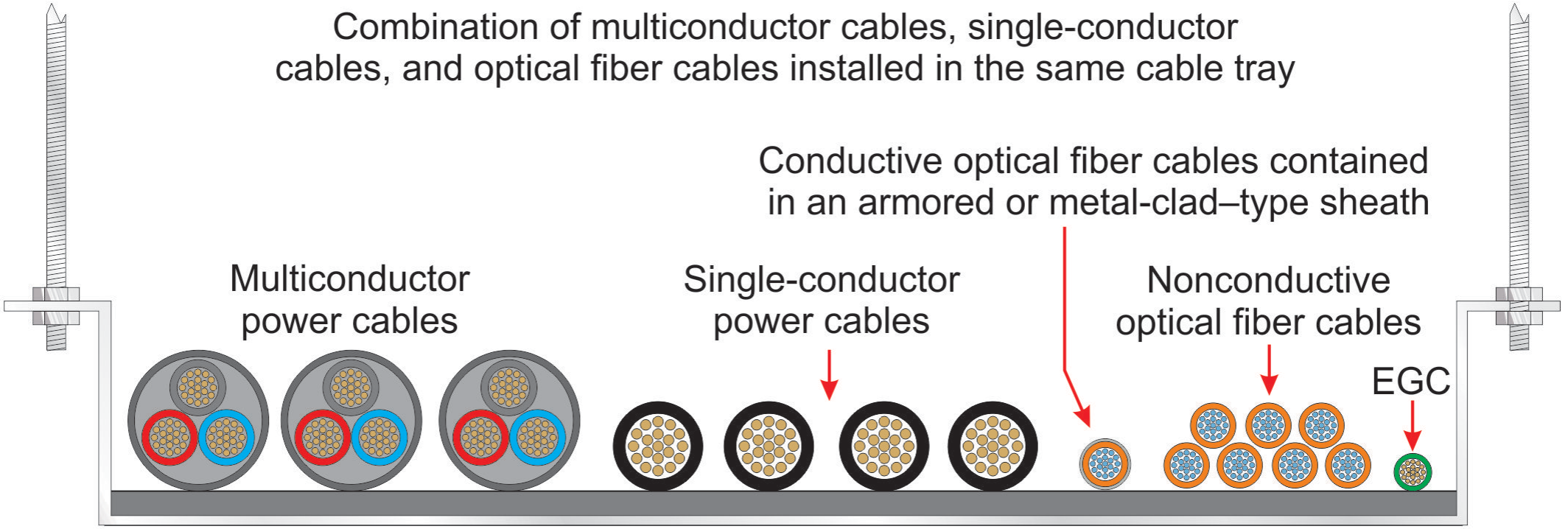
- Previous requirements of **770.133(A)** has been reorganized and relocated throughout **770.133(A)** and new **770.133(B)**
- Previous exceptions rewritten into positive *Code* language
- Previous 770.133(A) permitted optical fiber cables to occupy the same cable tray and raceway as conductors for electric light, power, Class 1, non-power-limited fire alarm, etc. *(with five exceptions)*
- Almost all of the 2017 *NEC* requirements of 770.133 are still there for the 2020 *NEC* but **relocated for a better flow of the information**
- Permission to allow nonconductive optical fiber cables to occupy the same cable tray as conductors for electric light, power, Class 1, non-power-limited fire alarm, etc. operating at 1000 volts or less was moved to the second paragraph of new 770.133(B)

770.133 Installation of Optical Fibers and Electrical Conductors *(cont.)*

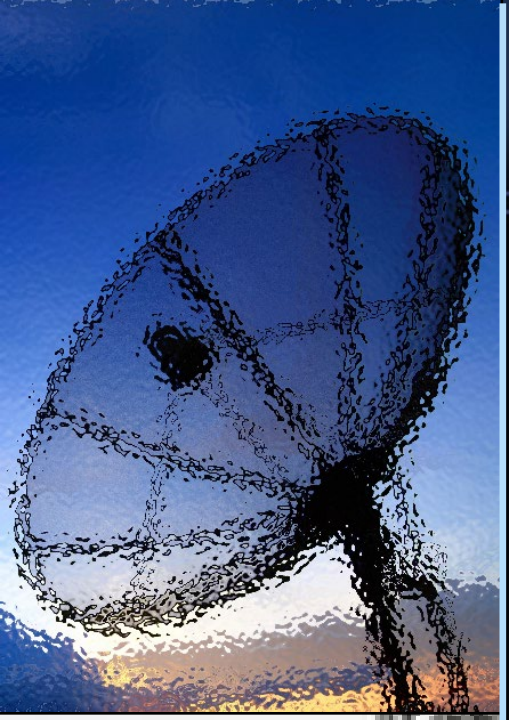
- Previous requirements of **770.133(A)** has been reorganized and relocated throughout **770.133(A)** and new **770.133(B)** *(cont.)*
- First paragraph of **770.133(A)** was updated to permit **conductive optical fiber cables** contained in an armored or metal-clad-type sheath and **nonconductive optical fiber cables** to occupy the same cable tray with conductors for electric light, power, Class 1, non-power-limited fire alarm, etc. operating at 1000 volts or less
- **Conductive optical fiber cables without an armored or metal-clad-type sheath** not permitted to occupy the same cable tray as power conductors, etc. unless separated by a **permanent barrier** or listed divider

770.133 Installation of Optical Fibers and Electrical Conductors

Optical fiber cables permitted to occupy the same cable tray and raceway *(with conditions)* as conductors for electric light, power, Class 1, non-power-limited fire alarm, etc. *(information reorganized for 2020 NEC)*



Conductive optical fiber cables contained in an armored or metal-clad–type sheath and non-conductive optical fiber cables shall be permitted to occupy the same cable tray or raceway with conductors for electric light, power, Class 1, non–power-limited fire alarm, etc.



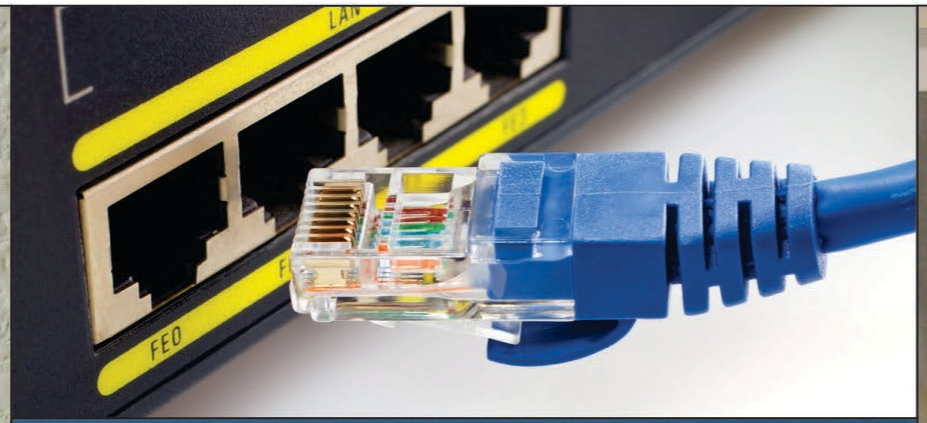
Chapter Eight Communications Systems

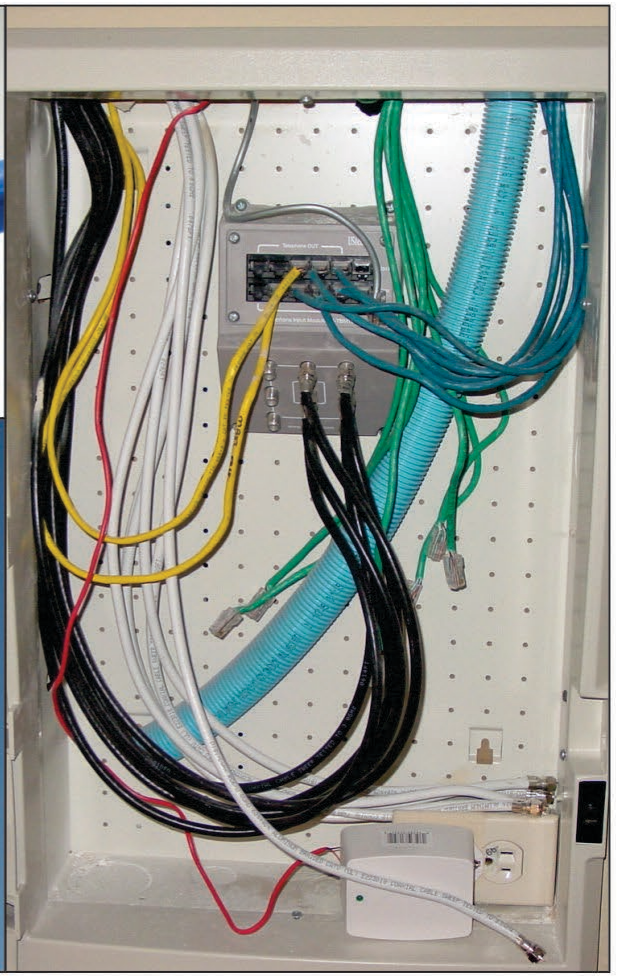
Article 800 General Requirements for Communications Systems

- **New Article 800** *(General Requirements for Communications Systems)* combines **common requirements** previously found in Articles 800, 820, 830 and 840 into a **new "general" article** that applies to all of these articles
- **Previous Article 800** *(Communications Circuits)* was moved to **Article 805** to make room for this new Chapter 8 article
- **Common requirements** would include such things as mechanical execution of work, abandoned cables, spread of fire or products of combustion, and temperature limitations of wires and cables
- In previous editions of the *Code*, if a change in one of the Chapter 8 articles occurred, it was a good bet that the same change would be occurring in the other Chapter 8 articles as well
- New article for communication circuits significantly improves clarity and usability while removing redundant requirements from each of the articles throughout Chapter 8

Article 800 General Requirements for Communications Systems

800.1 Scope. This article covers general requirements for communications systems. These general requirements apply to communication circuits, and equipment community antenna television and radio distribution systems, network-powered broadband communication systems, and premises-powered broadband communication systems unless modified by Articles 805, 820, 830, or 840.





800.2 Definitions: Communications Circuit

- **Communications Circuit.** The circuit that extends service from the communications utility or service provider to and including the customer's communications equipment.
- The definition of a "**Communications Circuit**" was revised to remove the "list" of service types offered by a communications circuit
- List was problematic as it did not allow for new technologies to be included in this definition without a *Code* change, which only happens every three years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800.3 Other Articles for Communications Systems

- New text was added to reinforce the **independence of Article 800 and Chapter 8** which stipulates that only those sections of Chapters 1 through 7 referenced in Article 800 shall apply to communications systems
- Opening sentence of 800.3 now reads, "**Only those sections of Chapters 1 through 7 referenced in Chapter 8 shall apply to Chapter 8**."
- Requirements of **90.3** state that Chapter 8 of the *NEC* is a **"stand-alone" article** and "is not subject to the requirements of Chapters 1 through 7 except where the requirements are specifically referenced in Chapter 8"
- In order for a requirement from Chapters 1 through 7 to apply to Chapter 8, there must be a clear reference or "**road map**" in Chapter 8 to a specific requirement in Chapters 1 through 7

800.3 Other Articles for Communications Systems

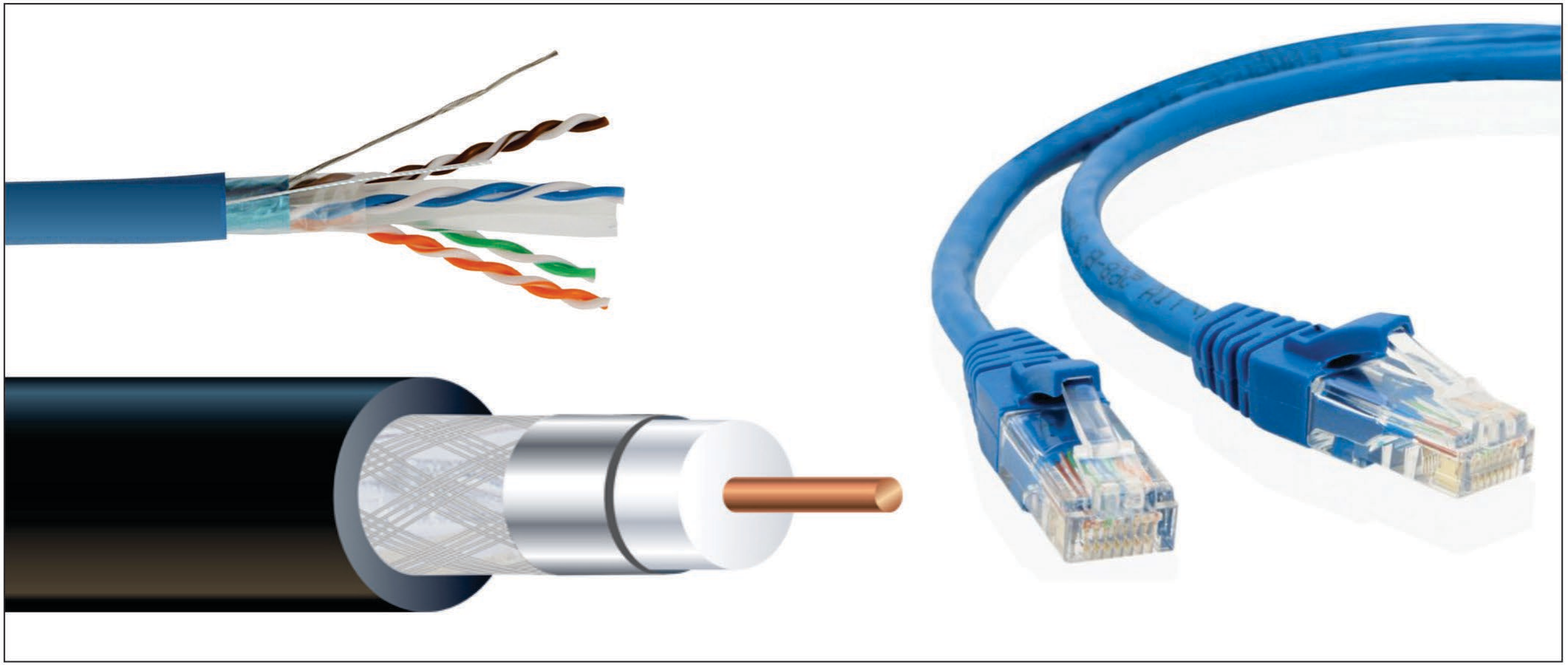
Only those sections of Chapters 1 through 7 referenced in Chapter 8 shall apply to Chapter 8

800.27 Temperature Limitation of Wire and Cables (Communications Systems)

- New section added to specify that no communication wire or cable be used in such a manner that its **operating temperature** exceeds that of its rating
- When the previous requirements of 800.3 were moved to new Article 800, it was felt that this **temperature limitation requirement** deserved its own section in Article 800
- Previous temperature limitations of 800.3(H) were moved to a **new 800.27** and titled "**Temperature Limitation of Wires and Cables**"
- New text at 800.27 makes it clear that this temperature limitations in Chapter 8 **apply to cables** *(not just conductors)*
- New text simplifies the *Code* by including the temperature limitation requirement **directly in Article 800**, rather than have a cross-reference in Article 800 to the temperature limitation requirements of **Article 310**

800.27 Temperature Limitation of Wire and Cables *(Communications Systems)*

No communications wire or cable is permitted to be used in such a manner that its operating temperature exceeds that of its rating



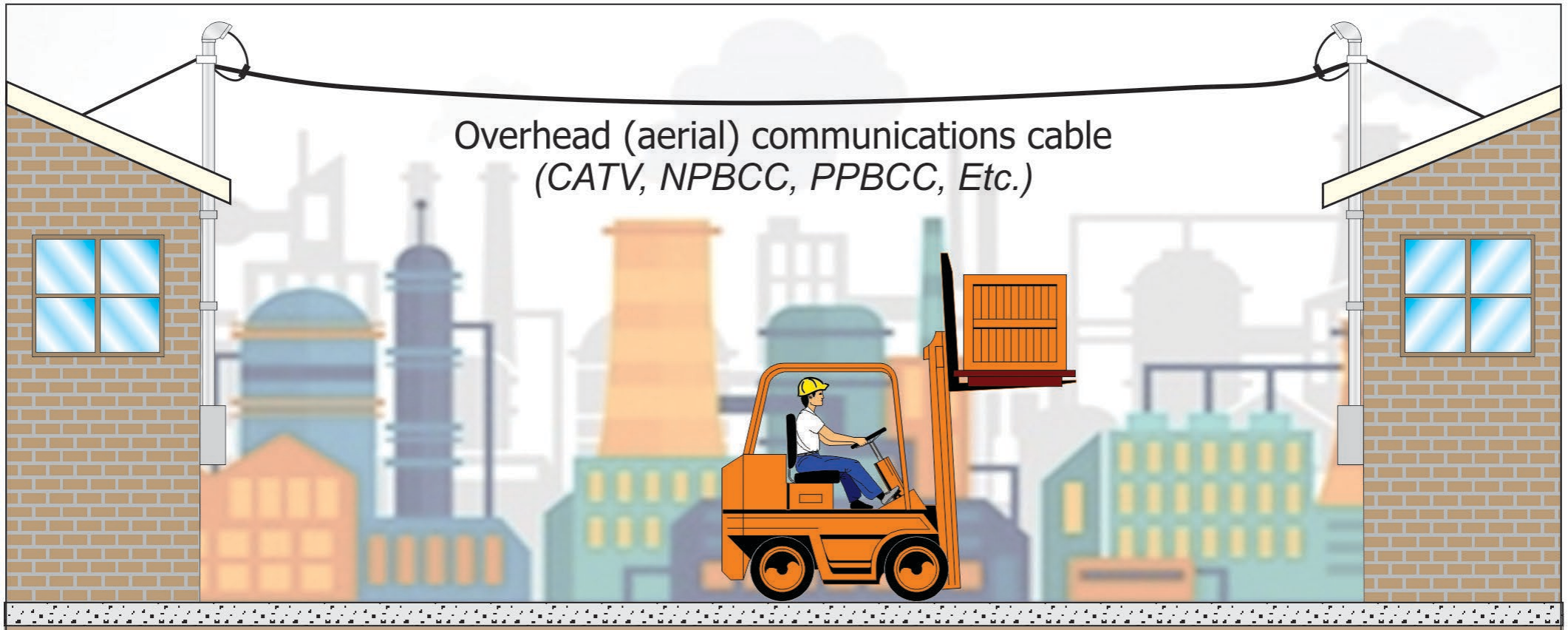
Plenum, riser, general-purpose, and limited-use communications cables required to have a temperature rating of not less than 60°C (140°F) *(see 800.179)*

800.44 Overhead (Aerial) Communications Wires and Cables

- Requirements were added for ***all*** communications circuits pertaining attachment to **above-the-roof raceway mast** and cables extending between buildings or structures
- Previously, **Article 820** contained provisions for attaching coaxial cables to an **above-the-roof raceway mast** that did not enclose or support conductors of electric light or power circuits *(none of the other Chapter 8 article contained this mast rule)*
- Previously, **Articles 820 and 830** contained requirements pertaining to coaxial cables and network-powered broadband communications **cables extending between buildings** or structures *(other Chapter 8 articles did not have such rules)*
- These two rules were perfect candidates to be placed in **new Article 800** to prevent repeating these rules in four different articles *(needed consistency)*

800.44 Overhead (Aerial) Communications Wires and Cables

Overhead (aerial) communications and CATV type coaxial cables permitted to be attached to above-the-roof raceway mast that does not enclose or support conductors of electric light or power circuits



Communications and CATV type coaxial cables extending between buildings or structures *(along with the supports or attachment fixtures)* shall be identified and shall have sufficient strength to withstand the loads to which they might be subjected *(Ex. for supporting messenger cable)*

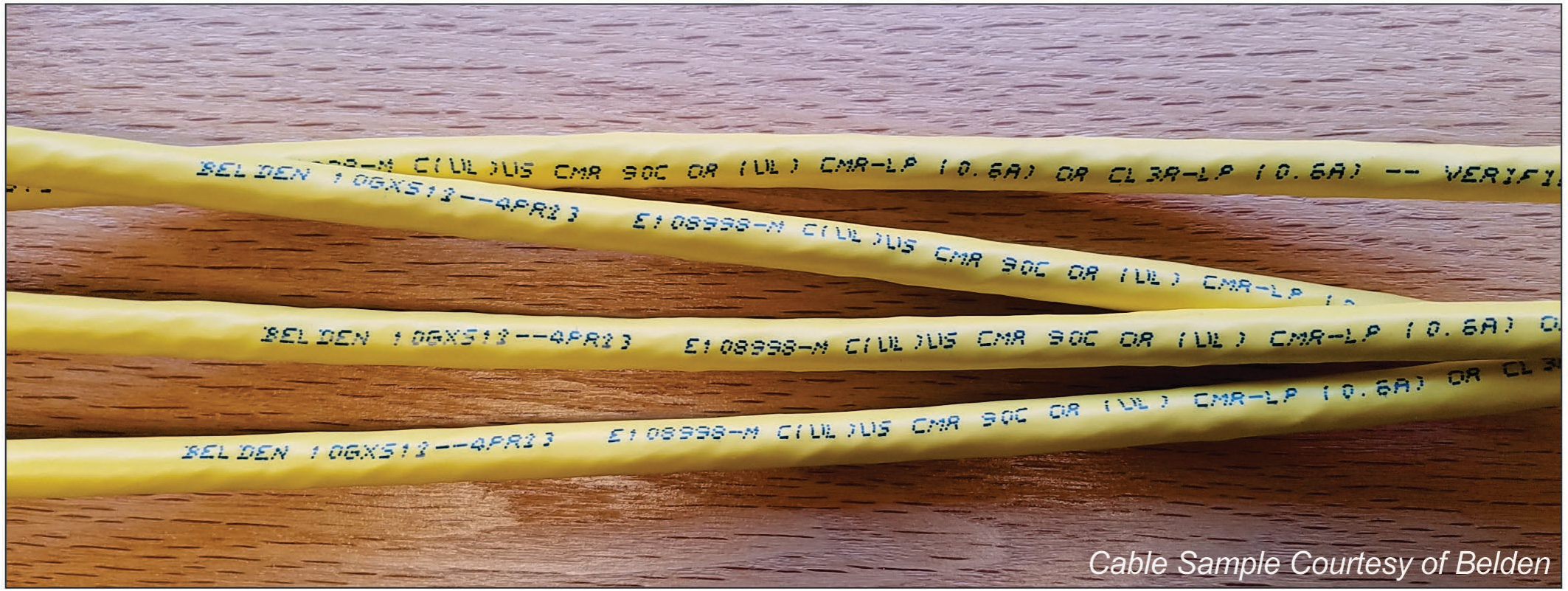
805.179(D) Limited Power (LP) Cables

- Provisions were added to permit **limited power (LP) cables** to act as a **substitute** for Class 2 and Class 3 cables
- Previously, communications cables were permitted as substitutes for Class 2 and Class 3 cables, but the *Code* **did not specifically address** limited power (LP) cables as a substitute for Class 2 and Class 3 cables
- **725.144** and **Table 725.144** gives designers, installers and AHJs the assurance that 4-pair data cables can safely carry power as well as data when bundled together in cable trays or cable routing assemblies
- This revision recognizes the fact that an **LP cable** is a specific type of Class 2, Class 3, and communications cable and explicitly permits these cable types as **substitutes** for Class 2 and Class 3 LP cables *(vast majority of LP cables are listed as communications cables)*
- LP cables are listed under the UL product categories of Communications Cable **(DUZX)** and Power Limited Circuit Cable **(QPTZ)**

805.179(D) Limited Power (LP) Cables

Provisions added at to permit limited power (LP) cables to act as a substitute for Class 2 and Class 3 cables as well as the previous provisions allowing communications cables as substitutes for Class 2 and Class 3 cables

CMR-LP (0.6A) (75C) 23 AWG 4 pair



Cable Sample Courtesy of Belden

840.2 Definitions for Premises-Powered Broadband Communications Systems

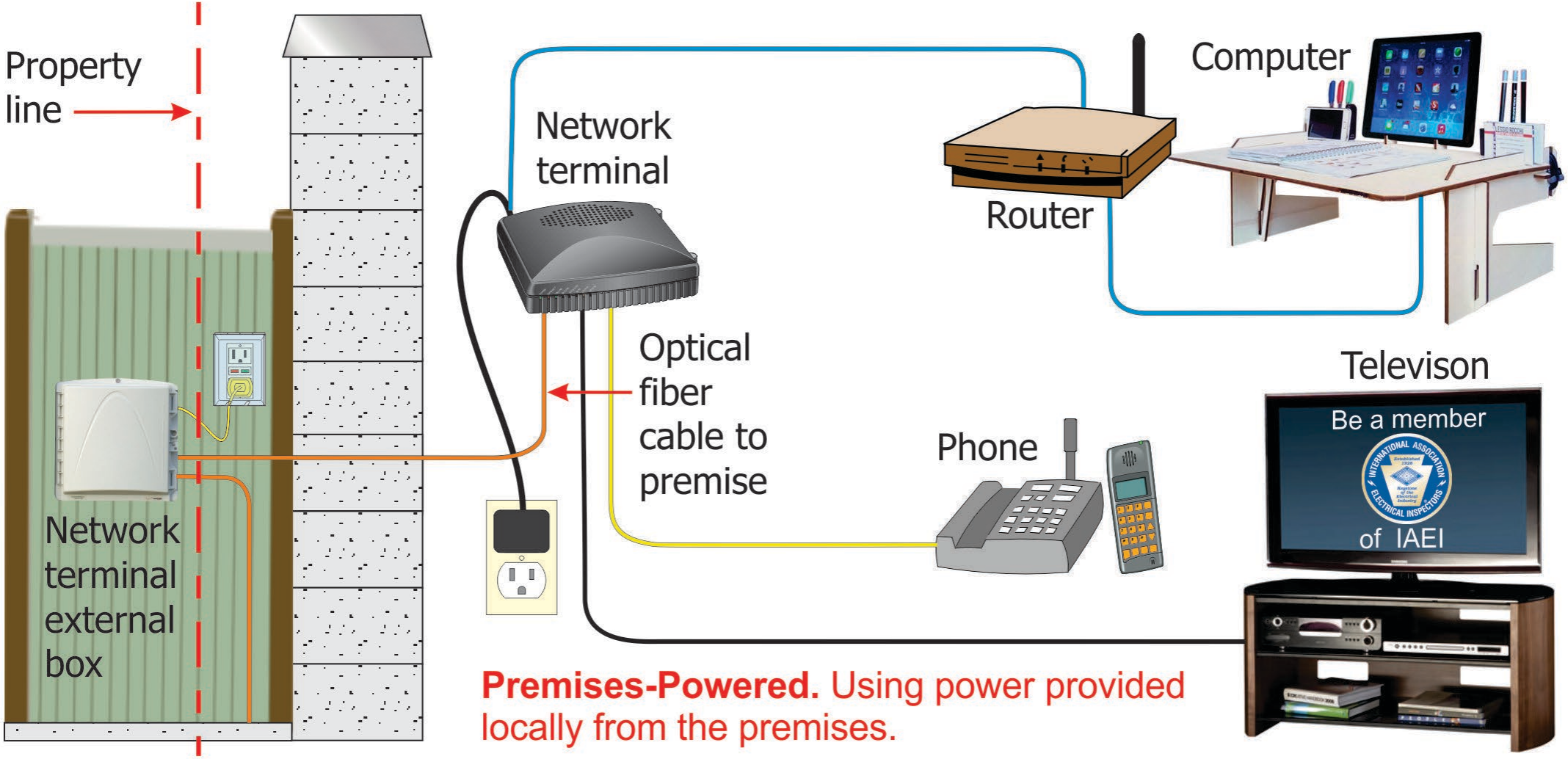
- Two new definitions were added to 840.2 to define the terms "**Broadband**" and "**Premises-Powered**"
- **Broadband.** Wide bandwidth data transmission that transports multiple signals, protocols, and traffic types over various media types.
- **Premises-Powered.** Using power provided locally from the premises.
- Previously, neither "**Broadband**" or "**Premises-Powered**" were defined in Article 840 *(Premises-powered Broadband Communications Systems)* or the *NEC*
- Definition for "**Broadband**" was added to provide an appropriate description of the circuits covered under Article 840
- Term "**Premises-Powered**" had to be defined as it now applies to more than one type of system

840.2 Definitions for Premises-Powered Broadband Communications Systems *(cont.)*

- Two new definitions were added to 840.2 to define the terms "**Broadband**" and "**Premises-Powered**" *(cont.)*
- Premises powered basically means that the power used by the communications system is **derived from the local premises power**, and this power source has **no limits on the power crossing a premises property line** or boundary
- **Example:** Network terminal being powered from a 125-volt, 15- or 20-ampere ac wall receptacle outlet or an uninterruptible power supply (UPS)/battery backup unit where the network terminal is a few feet from a structure
- This location is not necessarily "**on the premises**" based on prescribed property lines, legal boundaries, and/or utility definitions
- New definition of "**Premises-Powered**" would cover such an installation even though the network terminal might not be technically on the premise and keep this type of installation under the scope of Article 840

Article 840 Definitions: Premises-Powered Broadband Communications Systems

Broadband. Wide bandwidth data transmission that transports multiple signals, protocols, and traffic types over various media types.



Premises-Powered. Using power provided locally from the premises.

840.94 and 840.102 Premises Circuits Leaving the Building

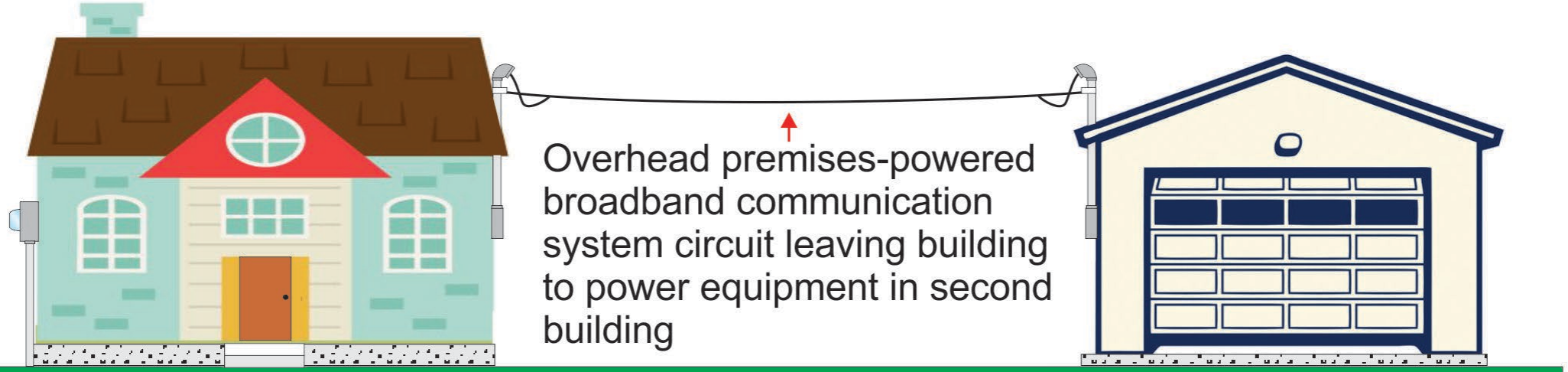
- Two new sections (840.94 and 840.102) added to provide requirements for **premises-powered broadband communication system (PPBCS) circuits** when they **leave the building** to power equipment **remote to that building**
- Previously, 840.101 contained provisions for PPBCS circuits where they **did not leave the building**, but no provisions existed for when PPBCS circuits **did leave the building**
- PPBCS circuits are being installed by utilities or service providers that provide power to exterior equipment such as an asymmetric digital subscriber line (ADSL), which is a type of digital subscriber line (DSL) technology
- The circuits are equipment on the network being powered from the premises which ultimately would power circuits going to **other premises**

840.94 and 840.102 Premises Circuits Leaving the Building *(cont.)*

- Two new sections (840.94 and 840.102) added to provide requirements for **premises-powered broadband communication system (PPBCS) circuits** when they **leave the building** to power equipment **remote to that building**
- These circuits are derived from the premises power to avoid having to run copper cable to the exterior location, avoid establishing a meter point, and/or avoid providing backup batteries *[sometimes referred to as "**reverse powering (RP)**"]*
- These added circuits are potentially exposed to lightning events and/or electric power ground faults
- They deserve and require the same protection and grounding and bonding means as other aerial, buried, or underground communications cables entering a building

840.94 and 840.102 Premises Circuits Leaving the Building

840.94: Requires circuits leaving a building to power equipment remote to that building or outside the exterior zone of protection defined by a 46 m (150 ft) radius rolling sphere, to comply with 805.90 *(Protective Devices)* and 805.93 *(Grounding, Bonding, or Interruption of Non-Current-Carrying Metallic Sheath Members of Communications Cables)*



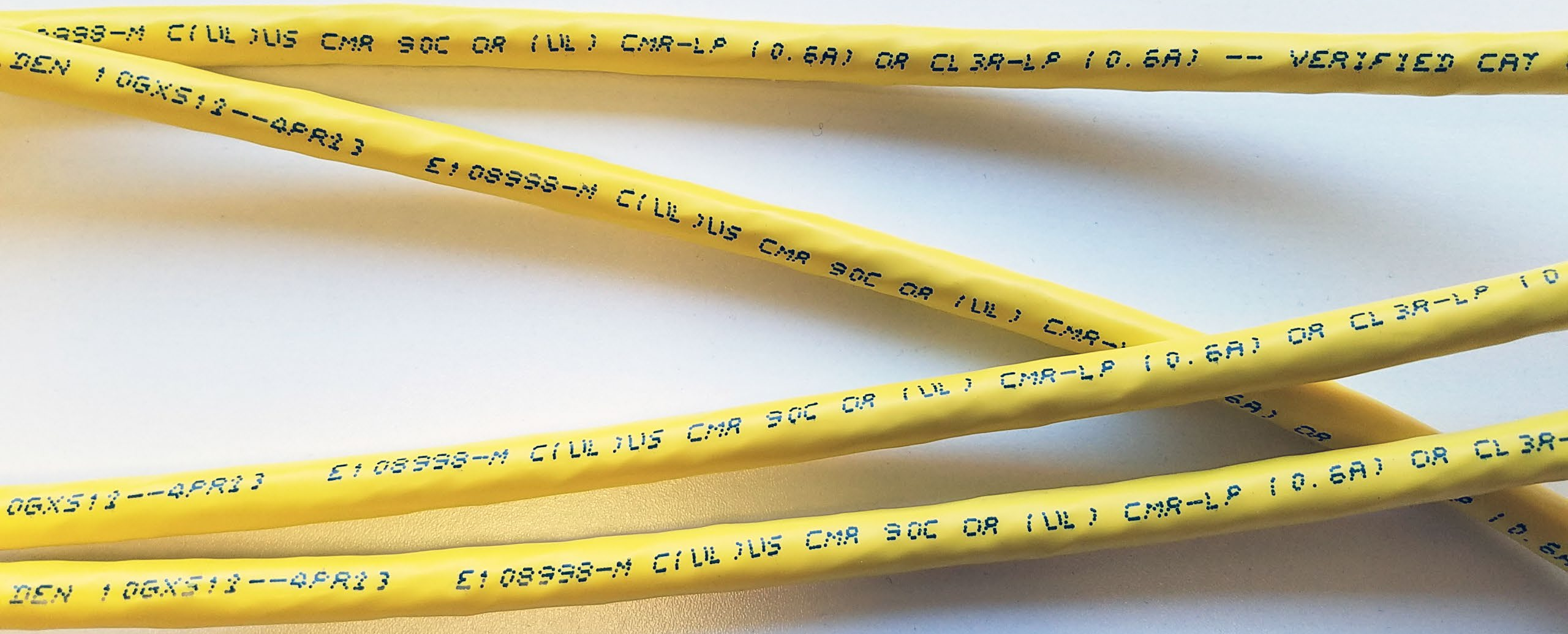
If coaxial cables are present, required to comply with 820.100 *(Cable Bonding and Grounding) (which references 800.100)* and 800.106

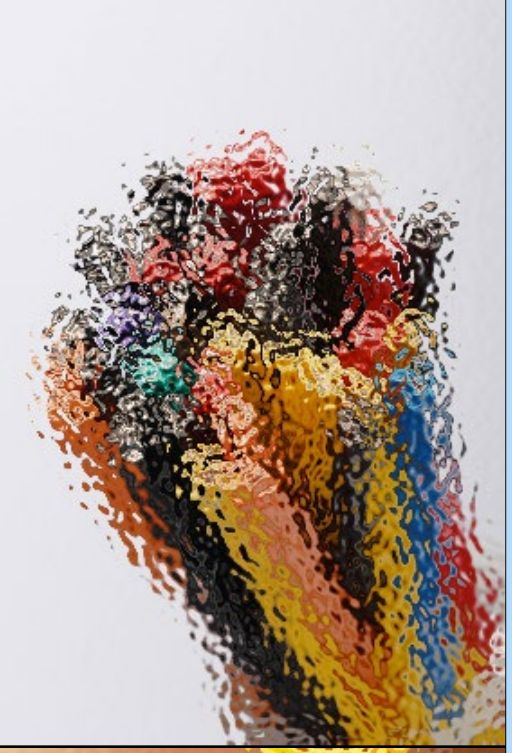
840.102: Requires communications wires and cables circuits leaving the building to power equipment remote to the building or outside the exterior zone of protection defined by a 46 m (150 ft) radius rolling sphere to comply with 800.100 *(Cable and Primary Protector Bonding and Grounding)* and 800.106 *(Primary Protector Grounding and Bonding at Mobile Homes)*

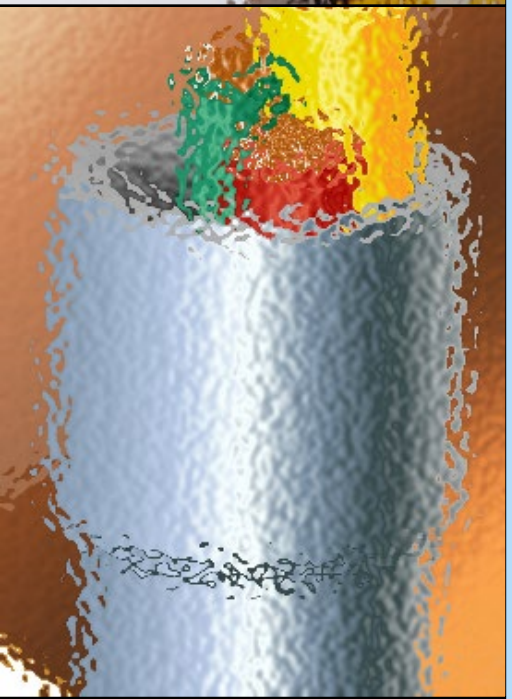
840.160 Powering Circuits (Premises-Powered Broadband Communication Systems)

- Revised text identifies **listing provisions** for communications cables, powered communications equipment, and the power source
- Communications cables that are listed in accordance with **805.179** are permitted to carry circuits for powering communications equipment *(in addition to carrying the communications circuit)*
- Communications equipment has to be listed in accordance with **805.170**
- Power source required to be listed in accordance with **840.170(G)**
- Installation of listed 4-pair communications cables for a communications circuit or installation where 4-pair communications cables are substituted for Class 2 and Class 3 cables in accordance with **725.154(A)** is required to comply with **725.144** with an exception *where the rated current of the power source does not exceed 0.3 amperes in any conductor 24 AWG or larger*

Communications cables listed in accordance with 805.179







Chapter Nine
Tables

Chapter 9, Notes to Tables, Note (2)

- Revision to Note (2) now indicates that **Table 1** does not apply to exposed wiring ***and cable*** when used in incomplete sections of conduit or tubing to protect from physical damage
- Previously, Note (2) to the Chapter 9 tables only referenced "**exposed wiring**" *(and not cable)*
- Revision to make it clear that protection from physical damage is for "**exposed wiring**" **includes cables** as well
- Should have been fairly evident with the title of Table 1 of Chapter 9 being "Percent of Cross Section of Conduit and Tubing for Conductors ***and Cables***" with a subheading of "Number of Conductors and/***or Cables***"
- Proper conductor fill will avoid conductor overheating and possible insulation damage due to excessive heat

Chapter 9, Notes to Tables, Note (2)

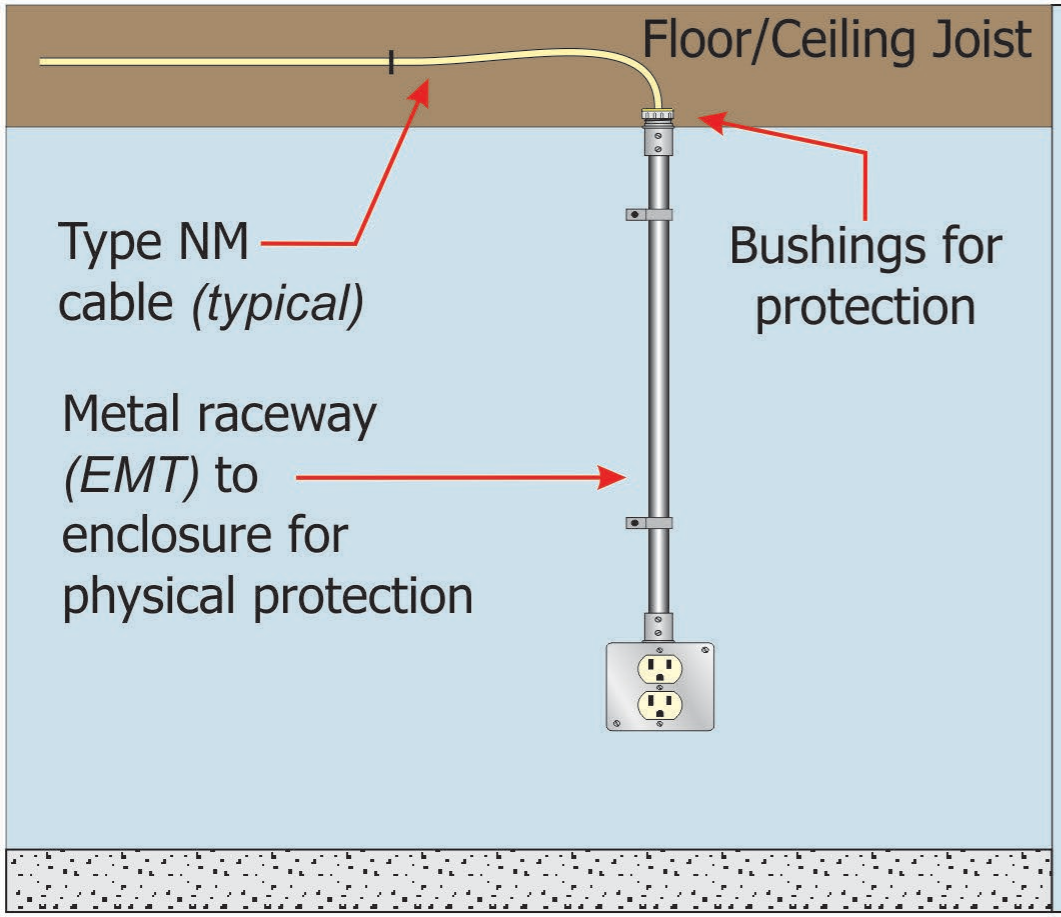
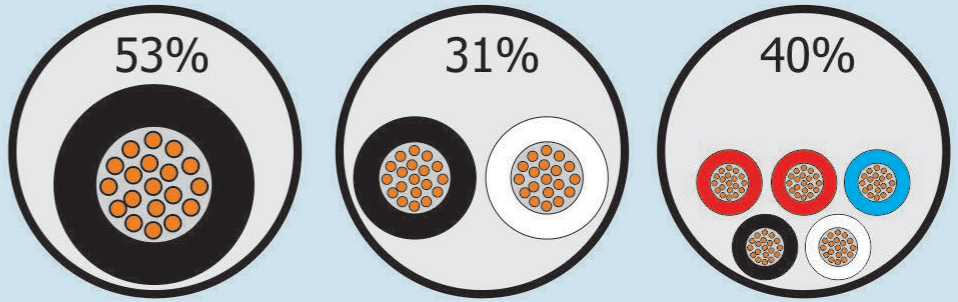
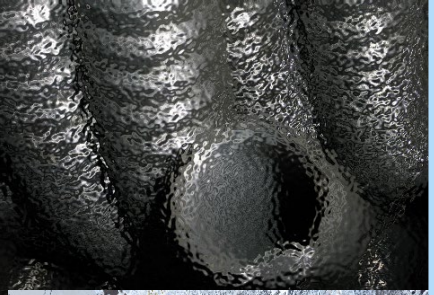


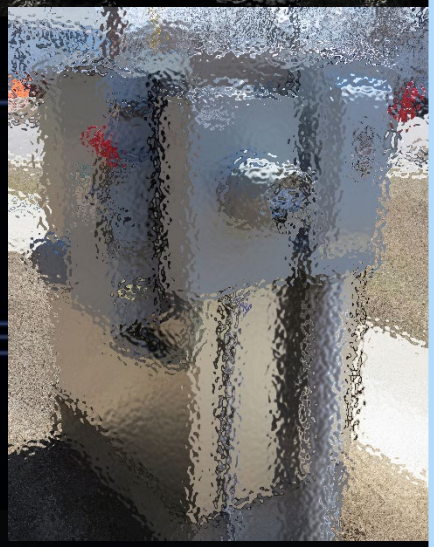
Table 1: Percent of Cross Section of Conduit and Tubing for Conductors and Cables

Number of Conductors and/or Cables	Cross Sectional Area (%)
1	53%
2	31%
Over 2	40%



Note (2): Table 1 applies only to complete conduit or tubing systems and is not intended to apply to sections of conduit or tubing used to protect exposed wiring and cable from physical damage.





Informative Annexes

Informative Annex A- Product Safety Standards

- Informative Annex A was reformatted to provide and add ***NEC* article numbers** and **appropriate product standards were added and updated**
- Previously, Informative Annex A had **two columns** of information; **(1)** the name of the product standard and **(2)** the product standard number
- Informative Annex A now has **three columns** of information; **(1)** the *NEC* article number where the referenced product standard can be found, **(2)** the product standard number, and **(3)** the name of the product standard
- **2017 *NEC*:** Informative Annex A referenced **236 product standards**
- **2020 *NEC*:** Informative Annex A references **352 product standards**
- Previous tabular format of Informative Annex A did not provide **correlation with various *Code* Articles** (*where can these product standard references be found throughout the NEC?)*

Informative Annex A - Product Safety Standards

Informative Annex A was reformatted to provide *NEC* article numbers and appropriate product standards were added

2017 *NEC* Informative Annex A *(in part)*

Product Standard Name	Product Standard Number
Antenna-Discharge Units	UL 452
Arc-Fault Circuit-Interrupters	UL 1699
Armored Cable	UL 4
Attachment Plugs and Receptacles	UL 498
Audio, Video and Similar Electronic Apparatus — Safety Requirements	UL 60065
Audio/Video, Information and Communication Technology Equipment — Part 1: Safety Requirements	UL 62368-1
Automatic Electrical Controls	UL 60730-1

2020 *NEC* Informative Annex A *(in part)*

Article	Standard Number	Standard Title
110	UL 943	Ground-Fault Circuit-Interrupters
210	UL 1699	Arc-Fault Circuit-Interrupters
230	UL 1053	Ground-Fault Sensing and Relaying Equipment
240	UL 2735	Electric Utility Meters
	UL 198M	Mine-Duty Fuses
	UL 248-1	Low-Voltage Fuses — Part 1: General Requirements
	UL 248-2	Low-Voltage Fuses — Part 2: Class C Fuses
250	UL 467	Grounding and Bonding Equipment

Informative Annex C - Conduit, Tubing, and Cable Tray Fill Tables for Conductors and Fixture Wires of the Same Size

- Informative Annex C revised to include conductor fill tables for **cable trays** as well and for conduits and tubing
- Previous Informative Annex C contained **26 tables** for determining the maximum number of conductors or fixture wires permitted in various conduits and tubings
- New Informative Annex C is now contains **33 tables** for determining the maximum number of conductors or fixture wires permitted in various conduits, tubings **and cable trays**
- Rules and tables provided in Article 392 *(Cable Trays)* for determining the sizing of various cable tray types and sizes can be intimidating and complicated to some users of the *Code*
- **New tables** in Informative Annex C allows for **simplified determination** of the maximum number of cables or conductors allowed in a particular cable tray width and serve to **enhance safety** due to reductions of errors pertaining to incorrect cable selection and erroneous cable tray sizing calculations

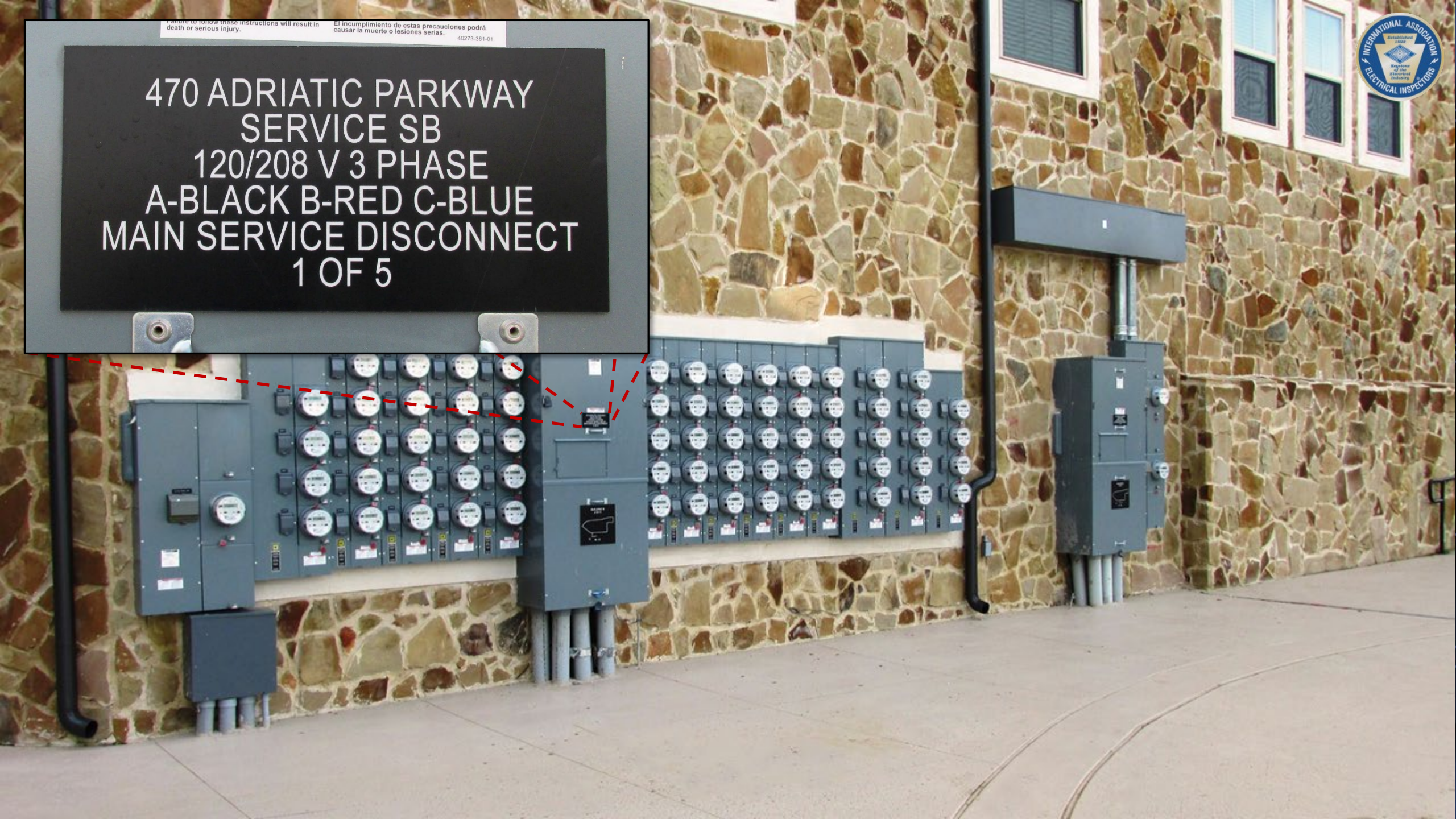
Informative Annex C - Conduit, Tubing, and Cable Tray Fill Tables for Conductors and Fixture Wires of the Same Size

C.1 - Electrical Metallic Tubing (EMT)
C.1(A)* - Electrical Metallic Tubing (EMT)
C.2 - Electrical Nonmetallic Tubing (ENT)
C.2(A)* - Electrical Nonmetallic Tubing (ENT)
C.3 - Flexible Metal Conduit (FMC)
C.3(A)* - Flexible Metal Conduit (FMC)
C.4 - Intermediate Metal Conduit (IMC)
C.4(A)* - Intermediate Metal Conduit (IMC)
C.5 - Liquidtight Flexible Nonmetallic Conduit (Type LFNC-A)
C.5(A)* - Liquidtight Flexible Nonmetallic Conduit (Type LFNC-A)
C.6 - Liquidtight Flexible Nonmetallic Conduit (Type LFNC-B)
C.6(A)* - Liquidtight Flexible Nonmetallic Conduit (Type LFNC-B)
C.7 - Liquidtight Flexible Nonmetallic Conduit (Type LFNC-C)
C.7(A) - Liquidtight Flexible Nonmetallic Conduit (Type LFNC-C)
C.8 - Liquidtight Flexible Metal Conduit (LFMC)
C.8(A)* - Liquidtight Flexible Metal Conduit (LFMC)
C.9 - Rigid Metal Conduit (RMC)
C.9(A)* - Rigid Metal Conduit (RMC)
C.10 - Rigid PVC Conduit, Schedule 80
C.10(A)* - Rigid PVC Conduit, Schedule 80
C.11 - Rigid PVC Conduit, Schedule 40 and HDPE Conduit
C.11(A)* - Rigid PVC Conduit, Schedule 40 and HDPE Conduit
C.12 - Type A, Rigid PVC Conduit
C.12(A)* - Type A, Rigid PVC Conduit
C.13 - Type EB, PVC Conduit
C.13(A)* - Type EB, PVC Conduit
C.14- Type MC Cables Allowed in Cable Tray
C.15- Type MC Cables *(4C Multiconductor)*
C.16- Type TC Cables *(3C Multiconductor)*
C.17- Type TC Cables *(4C Multiconductor)*
C.18- Single Conductor Cables Allowed in Cable Tray
C.19- Single Conductor Cables Allowed in Cable Tray
C.20- Single Conductor Cables Allowed in Cable Tray


6 of 6
legrand
CABLOFIL
PW Cable Tray
Catalog Number: LD-6A2O-2024-24
Production Number:
Mark Number:
Purchase Order: 4300269400
MIN. X-SEC. Area: 1.5 SQ. IN.
Tray Type: VENTILATED
NEMA Load Class: 20C
Material Type: ALUMINIUM
CSA Load Class: E6M
MFG. Location: Pico Ladder
P033532
0690154683 / 000030
WARNING:
DO NOT USE AS A
WALKWAY, LADDER
OR SUPPORT FOR
PERSONNEL.
USE ONLY AS A
MECHANICAL SUPPORT
FOR CABLES, TUBING

Informative Annex D Example D5(b) Optional Calculation for Multifamily Dwelling Served at 208Y/120 Volts, Three Phase

- Example D5(b) has been revised to accurately reflect the **neutral load calculation** for a three-phase system
- Previously, the **neutral load calculation** was based on a **single-phase system**
- The neutral load used in Example D5(b) was extracted from Example D4(a)
- The problem is that **Example D4(b)** is a **single-phase example** and calculations and **Example D5(b)** is a **three-phase example**


death or serious injury.
El incumplimiento de estas precauciones podrá causar la muerte o lesiones serias.
40273-381-01
470 ADRIATIC PARKWAY
SERVICE SB
120/208 V 3 PHASE
A-BLACK B-RED C-BLUE
MAIN SERVICE DISCONNECT
1 OF 5

Informative Annex D Example D8 Motor Circuit Conductors, Overload Protection, and Short-Circuit and Ground Fault Protection

- Example D8 was revised to include the **30 hp motor as the largest motor** and the **example was expanded**
- Previous example was based on a 25 hp motor, which was not the largest motor in the circuit
- This mishap has been corrected and the calculations are now based on one of the 30 hp motors for the largest motor
- Text was also added to distinguish between the type motors considered in the calculations *(squirrel-cage vs. wound-rotor)*
- There is a difference in calculations between squirrel cage and wound rotor motors


VFD3
DANGER
DANGER

Informative Annex H – Administration and Enforcement

- Revision to the opening paragraph of **Article 80** informs users of the Code that **Informative Annex H** is intended to provide a **template and sample language** for local jurisdictions adopting the *NEC*
- The opening paragraph of Article 80 now states that "Informative Annex H is not a part of the requirements of this NFPA document and is included for informational purposes only. **Informative Annex H is intended to provide a template and sample language for local jurisdictions adopting the *National Electrical Code®*.**"
- This revision provides **additional clarity** and **removes redundant language** and is intended to help in the process of local jurisdictions adopting the latest edition of the *NEC* in a timely manner

Informative Annex H - Administration and Enforcement

Informative Annex H is not a part of the requirements of the *NEC* (informational purposes only) and is intended to provide a template and sample language for local jurisdictions adopting the *NEC*

Analysis of Changes – 2020 *NEC*

End of Part 2 – NEC Chapters 5 through 9

Training Presentation By:
International Association of Electrical Inspectors

How to Find 2020 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

Informative Annex C — Conduit, Tubing, and Cable Tray Fill Tables for Conductors and Fixture Wires of the Same Size

Raceway Fill Practice Calculations

Maximum Number of Conductors or Fixture Wires in Electrical Metallic Tubing (EMT)

What is the maximum number of #2/0 THW conductors in 4” EMT?

Maximum Number of Conductors or Fixture Wires in Electrical Metallic Tubing (EMT)

Solution:

- Step 1 – refer to Informative Annex Table C.1 – Maximum number of Fixture Wires or Conductors in Electrical Metallic Tubing (EMT) (Based on Chapter 9: Table 1, Table 4, and Table 5)

- Step 2 – locate 2/0 THW in the Conductor Size column of Table C.1

- Step 3 – follow the 2/0 THW row to the Trade Size 4 column

Answer = 17 - 2/0 THW conductors

Maximum Conductors or Fixture Wires in Electrical Nonmetallic Tubing (ENT)

What is the maximum number of #18 PFF fixture wires in ¾” ENT?

Maximum Conductors or Fixture Wires in Electrical Nonmetallic Tubing (ENT)

Solution:

- Step 1 – refer to Informative Annex Table C.2 – Maximum number of Fixture Wires or Conductors in Electrical Nonmetallic Tubing (ENT) (Based on Chapter 9: Table 1, Table 4, and Table 5)

- Step 2 – locate #18 PFF in the Conductor Size column of Table C.2

- Step 3 – follow the #18 PFF row to the Trade Size ¾ column

Answer = 35 - #18 PFF fixture wires

Maximum Conductors or Fixture Wires in Liquidtight Flexible Metal Conduit (LFMC)

What is the maximum number of #4/0 XHHW conductors in 3” LFMC?

Maximum Conductors or Fixture Wires in Liquidtight Flexible Metal Conduit (LFMC)

Solution:

- Step 1 – refer to Informative Annex Table C.8 – Maximum number of Fixture Wires or Conductors in Liquidtight Flexible Metal Conduit (LFMC) (Based on Chapter 9: Table 1, Table 4, and Table 5)

- Step 2 – locate #4/0 XHHW in the Conductor Size column of Table C.8

- Step 3 – follow the #4/0 XHHW row to the Trade Size 3 column

Answer = 9 - #4/0 XHHW conductors

Maximum Number of Conductors or Fixture Wires in Rigid Metal Conduit (RMC)

What is the maximum Number of #4 THHN conductors in 2” RMC?

Maximum Number of Conductors or Fixture Wires in Rigid Metal Conduit (RMC)

Solution:

- Step 1 – refer to Informative Annex Table C.9 – Maximum number of Fixture Wires or Conductors in Rigid Metal Conduit (RMC) (Based on Chapter 9: Table 1, Table 4, and Table 5)

- Step 2 – locate #4 THHN in the Conductor Size column of Table C.9

- Step 3 – follow the #4 THHN row to the Trade Size 2 column

Answer = - 16 #4 THHN conductors

Maximum Number of Conductors or Fixture Wires in Rigid PVC Conduit, Schedule 80

What is the maximum Number of #12 RHW conductors in 1½” Rigid PVC Conduit, Schedule 80?

Maximum Number of Conductors or Fixture Wires in Rigid PVC Conduit, Schedule 80

Solution:

- Step 1 – refer to Informative Annex Table C.10 – Maximum number of Fixture Wires or Conductors in Rigid PVC Conduit, Schedule 80 (Based on Chapter 9: Table 1, Table 4, and Table 5)

- Step 2 – locate #12 RHW in the Conductor Size column of Table C.10

- Step 3 – follow the #12 RHW row to the Trade Size 1½ column

Answer = 19 - #12 RHW conductors