Continuing Education for Electricians

CETC CONNECTICUT ELECTRICAL Training Center, LLC

2024 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

2024 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.

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.

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

2024 Continuing Education for Electricians

(For All Electrical License Holders)

Part 2 - Safety

PART II – Safety

(1/2 Hour To Review With Class And Inform Attendees Material in Handout)

(Please review with the class the top 10 OSHA Violations for 2022)

The chart below gives OSHA's preliminary data alongside the final data from FY 2021.

See recent results here: 2020 | 2019 | 2018

OSHA Standard	FY 2022 Preliminary Data	Previous Year's Data
1. Fall Protection – General Requirements (1926.501) OSHA Fall Protection Defense Guide Construction Fall Protection Standards	5,260 Violations	5,271 Violations
2. Hazard Communication (1910.1200) OSHA's Revised Hazard Communication Standard	2,424 Violations	1,939 Violations
3. Respiratory Protection (1910.134) Selecting and Using Particulate Respirators Starting a Respiratory Protection Program	2,185 Violations	2,521 Violations
4. Ladders (1926.1053) Are Your Ladders Compliant? Ladder Safety Tips	2,143 Violations	2,018 Violations
5. Scaffolding (1926.451) OSHA Scaffolding Requirements for Construction and General Industry	2,058 Violations	1,943 Violations
6. Lockout/Tagout (1910.147) When Does the Lockout/Tagout Standard Apply?	1,977 Violations	1,670 Violations
7. Powered Industrial Trucks (1910.178) Forklift Safety Training Guide	1,749 Violations	1,404 Violations

8. Fall Protection – Training Requirements (1926.503) ANSI/ASSP Z359: Fall Protection Standards System	1,556 Violations	1,660 Violations
9. Personal Protective and Life Saving Equipment – Eye and Face Protection (1926.102) PPE Requirements: Eye and Face Protection	1,401 Violations	1,451 Violations
10. Machine Guarding (1910.212) OSHA Requirements: Machine Guarding	1,370 Violations	1,105 Violations

2024 Continuing Education for Electricians

(For All Electrical License Holders)

Part 3 – 2020 National Electrical Code

2020 NEC Changes

1

Chapter 2 Wiring and Protection

2

200.3 Connection to Grounded System

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

3

200.10(B) Identification of Terminals

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

4

210.8 Measurements for GFCI Protection

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

5

210.8(A) GFCI Protection for Personnel

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

6

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

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

7

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

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

8

210.8(B) Other Than Dwelling Units

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

9

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

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

10

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

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

11

210.8(D) GFCI Protection for Specific Appliances

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

12

210.8(E) GFCI for Equipment Requiring Servicing

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

13

210.8(F) GFCI for Outdoor Outlets

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

14

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

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

15

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

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

16

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

- AFCI protection has been expanded to patient sleeping rooms in **nursing homes** and **limited-care facilities**
- AFCI protection was expanded to include **guest rooms and guest suites of hotels and motels** during the 2017 *NEC* revision cycle as these areas are similar to dwelling units
- Similar rooms with comparable uses exist at patient sleeping rooms in nursing homes and limited-care facilities

17

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

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

18

210.15 Reconditioned Equipment

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

19

210.52(C) Receptacles at Countertops and Work Surfaces

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

20

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

- At least one receptacle is required to be provided for the **first 0.84 m^2 (9 ft^2)**, **or fraction thereof**, of the countertop or work surface
- An additional receptacle outlet is required for every **additional 1.7 m^2 (18 ft^2)**, **or fraction thereof**, of the countertop or work surface
- At least one receptacle outlet must be located **within 600 mm (2 ft)** of the outer end of a peninsular countertop or work surface

21

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

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

22

210.65 Receptacles for Meeting Rooms

- Meeting room receptacle outlet rules received revisions and a new home at **210.65** rather than its original location at 210.71
- Revisions to 210.65(B)(2) clarifies length versus width concerns while addressing **non-rectangular meeting rooms**, such as those that are round
- Floor outlets now applies to a meeting room "**with any floor dimension**" that is 3.7 m (12 ft) or greater "**in any direction**"

23

210.65 Receptacles for Meeting Rooms *(cont.)*

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

24

215.9 GFCI Protection for Feeders

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

25

215.10, Ex. No. 3 GFP for Feeders

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

26

220.12 Lighting Load for ~~Specified~~ Non-Dwelling Occupancies

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

27

220.14(J) and 220.11 Lighting Loads for Dwelling Units

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

28

220.42 General Lighting

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

29

220.53 Appliance Load - Dwelling Unit(s)

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

30

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

- New text added permitting **more than one feeder** *(up to six feeders)* under very limited circumstances
- Building or other structure served by an outside feeder **previously** permitted to be supplied by **only one feeder** *[unless another feeder (or branch circuit) was permitted by "special conditions" of previous 225.30(A) through (E)]*
- 225.30 "**special conditions**" can include such equipment as fire pumps, emergency systems, legally required standby systems, optional standby systems, parallel power production system
- "**Special conditions**" can also exist where different voltages, frequencies, or phases are involved

31

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

- New text added permitting **more than one feeder** *(up to six feeders)* under very limited circumstances *(cont.)*
- New 225.30(B) will permit **up to six feeders** to supply a building or structure under the following conditions:
  - (1) Each feeder must **originate in the same panelboard, switchboard or other distribution equipment**
  - (2) Each feeder must **terminate in a single disconnecting means**
  - (3) Where more than one feeder is installed, all feeder disconnects supplied are required to be **grouped in the same location**
  - (4) Each disconnect must be **marked to indicate the load served**

32

230.46 Splices and Tapped Conductors

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

33

230.62(C) Barriers

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

34

230.67 Surge Protection

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

35

230.71 Maximum Number of Disconnects

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

36

230.71 Maximum Number of Disconnects *(cont.)*

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

37

230.85 Emergency Disconnects

- New requirement added requiring an **emergency disconnect** at a **readily accessible <u>outdoor</u> location** for dwelling units
- New outdoor emergency disconnecting requirement primarily based upon providing **first responders** an outdoor accessible emergency or service disconnecting means during an **emergency situation** such as a fire, gas leak, structural damage, flooding, etc.
- Access service disconnecting means for first responders is very challenging when the service disconnect is installed in an indoor location of a dwelling unit area such as a basement

38

240.87 Arc Energy Reduction

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

39

240.87 Arc Energy Reduction *(cont.)*

- The **final setting** of the instantaneous trip is what determines whether or not additional arc energy reduction techniques are required
- Not the intention of this requirement that the **minimum setting** of the instantaneous trip *(as is typically shipped from the factory)* be the determining factor on whether or not additional arc energy reduction is necessary
- **Final setting** as determined by the electrical system requirements such as **inrush characteristics** or **selective coordination** is determining factor

40

240.88 Reconditioned Equipment

- New section added dealing with reconditioned equipment to indicate that **molded-case circuit breakers** shall not be permitted to be reconditioned
- Molded-case circuit breakers and low-voltage power circuit breaker electronic trip units cannot be reconditioned
- Low- and medium-voltage power circuit breakers, high-voltage circuit breakers, electromechanical protective relays, and current transformers **can be reconditioned**
- Marking requirement for reconditioned equipment located at **110.21(A)(2)**

41

Article 242 Overvoltage Protection (New)

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

42

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

- **New section** created to cover the requirements for grounding of supply-side disconnects permitted to be connected on the supply-side of a service
- Points user of the Code to **250.24** *(Grounding Service-Supplied Alternating-Current Systems)* for the grounding and bonding requirements for these supply-side disconnects
- **230.82** lists eleven specific items that the *Code* permits to be installed ahead of or on the line side of a service disconnecting means

43

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

- As more and more renewable and interconnected power production sources are connected to the serving utility directly, the need for prescriptive grounding and bonding requirements for these alternative sources is even more critical
- When this equipment is installed in another enclosure and identified as not being "service equipment," requirements need to be provided on how to properly accomplish the grounding and bonding of these installations

44

250.64(A) Aluminum or Copper-Clad Aluminum GECs

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

45

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

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

46

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

- 250.68(C)(3), which gives the permission to use a rebar extension for connection of GECs and bonding jumpers was reformatted into a **list format**
- **Installation requirements** for the use of a rebar "stub-up" as an extension connected to a concrete-encased electrode was added
- Rebar extension must be continuous with the concrete-encased electrode rebar or it needs to be connected to the concrete-encased electrode rebar by the usual steel tie wires, exothermic welding, welding, or other effective means

47

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

- Additional language **prohibits** the rebar *(both the concrete-encased electrode rebar and the rebar extension)* from being used as a conductor to **interconnect the individual electrodes** of grounding electrode systems
- The rebar extension:
  - Must be **connected to the rebar** in the foundation or footing
  - Shall not be exposed to earth contact without **corrosion protection**
  - Shall not be used to **interconnect electrodes** of the grounding electrode system

48

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

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

49

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

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

50

250.109 Metal Enclosures

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

51

250.109 Metal Enclosures *(cont.)*

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

52

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

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

53

250.122(B) Adjustment of EGC Sizing

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

54

250.148 Continuity of EGCs and Attachment in Boxes

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

55

250.184(C), Exception – Multigrounded Neutral Systems

- **New exception** added to relieve bonding the neutral conductor to a grounding electrode in an **uninterrupted conductor exceeding 400 m (1300 ft)** if the only purpose for removing the cable jacket is for bonding the neutral conductor to a grounding electrode in a multigrounded neutral system
- 250.184(C)(3) requires at least one grounding electrode to be installed and connected to the multigrounded neutral conductor every 400 m (1300 ft)

56

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

- **New exception** added to relieve bonding the neutral conductor to a grounding electrode in an **uninterrupted conductor exceeding 400 m (1300 ft)** if the only purpose for removing the cable jacket is for bonding the neutral conductor to a grounding electrode in a multigrounded neutral system *(cont.)*
- Removing the cable jacket only to create a point for connecting the multigrounded neutral conductor to a grounding electrode creates a **less desirable condition** than allowing further space between these connection points

57

250.187 Impedance Grounded ~~Neutral~~ Systems

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

58

Chapter 3 Wiring Methods and Materials

59

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

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

60

300.7(A) Raceways Exposed to Different Temperatures - Sealing

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

61

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

- Revisions occurred to make it clear **that listed transition fittings** and **listed interconnector devices** are permitted to be installed in **concealed locations** behind drywall and similar locations
- At each conductor splice point, outlet point, switch point, junction point, etc., a fitting **identified for the use** is permitted in lieu of a box or conduit body where conductors are not spliced or terminated within the fitting and the fitting is accessible after installation, **unless the fitting is listed for concealed installation**
- Transition fitting *(Type AC cable to EMT, etc.)* not required to be accessible after installation as they are **designed to be installed concealed**

62

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

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

63

300.25 Exit Enclosures (Stair Towers)

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

64

300.45 ~~Warning~~ Danger Signs

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

65

Article 310 Reorganized

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

66

Article 310 Ampacity Tables

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

67

Article 310 ~~Allowable~~ Ampacity for Conductors

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

68

310.10 and Ampacity Tables – Conductor Types Added

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

69

310.12 Single-Phase Dwelling Services and Feeders

- **New dwelling unit service ampacity table** from Informative Annex D, Example D7 added at **310.12** *[formerly Table 310.15(B)(7)]*
- Text added indicating Table 310.12 permitted to be used if there are **no temperature correction or adjustment factors needed**
- This dwelling unit table and/or information has been a part of the *Code* since the **1956 *NEC*** *(until the 2014 NEC)*
- These higher ampacity allowances permitted primarily due to the **diversity loads** associated with dwelling units

70

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

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

71

Article 311 Medium Voltage Cable (New)

- In order to consolidate the **medium voltage requirements** previously found in **Articles 310** *(Conductors or General Use)* and **Article 328** *(Medium Voltage Cable)*, and to improve the usability of the *Code*, the requirements are combined into a **new Article 311**
- New article will cover the use, installation, construction specifications and ampacities for medium voltage conductors and cable (Type MV)
- Part of the **Article 310** reorganization included moving the Type MV cable requirements into new **Article 311** which also included moving the Type MV cable requirements out of **Article 328** and deleting that article entirely

72

312.8(B) Power Monitoring or Energy Management Equipment

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

73

314.16(B)(5) EGC Box Fill Calculations

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

74

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

- Revision will now generally require **all outlet boxes** mounted in a location acceptable for the installation of a ceiling-suspended (paddle) fan in the ceilings of habitable rooms of dwelling units to be **listed for the sole support of ceiling-suspended (paddle) fan**
- An outlet box complying with the applicable requirements of 314.27 and providing access to structural framing capable of supporting of a ceiling-suspended (paddle) fan bracket or equivalent is permissible as well

75

320.80(A) Type AC Cable Ampacity – Thermal Insulation

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

76

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

- Type MC-HL cable shall be listed and shall have a gas/vapor tight continuous corrugated metallic sheath, an overall jacket of suitable polymeric material, and a separate equipment grounding conductor
- Type MC-HL cable with an interlocked metallic sheath provides a more flexible cable while still providing an overall jacket of suitable polymeric material
- Same change implemented for power and control tray cable (**Type TC cable**) with a designation of "TC-ER-HL" at **336.130**

77

334.2 Nonmetallic-Sheathed Cable – Type NMS Deleted

- All references to **Type NMS** cable has been **deleted** from Article 334 as this cable construction is no longer manufactured
- Type NMS was defined as "insulated power or control conductors with signaling, data, and communications conductors within an overall nonmetallic jacket"
- This cable was intended to be used with "**smart house**" circuits back in the late 1980's and 90's
- Type NMS cable was manufactured specifically to accommodate this type of new technology by combining power conductors with signal conductors all in one cable

78

334.30 Securing and Supporting of Type NM Cable

- Revision will clarify how Type NM cable should be measured from the enclosure to the securing method with the **cable length** between the cable entry and the closest cable support not exceeding **450 mm (18 in.)**
- Other places in the *Code*, such as **314.17(C), Exception** indicate that this measurement should be "**measured along the sheath**" of the cable in question
- The extra length ***[450 mm (18 in.)]*** was provided in consideration of conductor length for repair *(if needed)*

79

Article 337 Type P Cable (New)

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

80

338.2 Definitions - Service-Entrance Cables

- New definition for "**Service-Entrance Conductor Assembly**" added to differentiate between service-entrance cables and assemblies of single-insulated USE conductors
- Existing definition for "**Service-Entrance Cable**" was revised to reflect added definition for "Service-Entrance Conductor Assembly"
- Type SE cables (SER and SEU) and Type USE cables all have an overall polymeric covering of some type

81

338.100 Construction of Service-Entrance Cables

- All conductors of a cabled assemblies of multiple single-conductors of a **Type USE cable** are now required to be **insulated**
- Type SE or USE cable with an **overall covering** containing two or more conductors are permitted to have one conductor uninsulated
- To coincide with the revision to the definition of "Service-Entrance Cable" and the new definition of "Service-Entrance Conductor Assembly," the phrase "**with an overall covering**" was added to **338.100(B)**

82

342.10(E) IMC Subject to Severe Physical Damage

- New sub-section (E) clarifies that intermediate metal conduit (**Type IMC**) is permitted to be installed where **subject to severe physical damage**
- **UL 1242** and **342.10(A)** permit IMC to be used in all atmospheric conditions *(including severe physical damage)*
- Same change occurred for rigid metal conduit (**Type RMC**) at **344.10(E)**

83

342.14 Dissimilar Metals – Type IMC

- Revision added to make it clear that **stainless steel fittings**, and enclosures can be used with **galvanized steel IMC** but **galvanized fittings** should not be used with **stainless steel IMC**
- Dissimilar metals and alloys have different electrode potentials
- Further revision occurred for the 2020 *NEC* to provide additional clarity on what fittings are acceptable for use with stainless steel IMC, RMC and EMT
- Same revisions occurred at **344.14** for **rigid metal conduit** and at **358.14** for electrical metallic tubing (**EMT**)

84

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

- Revision to clarify that **red brass RMC** is not restricted to just underground or swimming pool applications
- Previous **344.10(A)(2)** stating that red brass RMC is permitted to be installed for direct burial and swimming pool applications has been **deleted** *(not the only application for red brass RMC)*
- Red brass RMC is typically made up of approximately 85% copper, 5% tin, 5% lead, and 5% zinc
- Galvanized steel, stainless steel, and red brass RMC permitted under all atmospheric conditions and occupancies

85

350.10(4) Uses Permitted for Type LFMC

- Conductors or cables with **higher temperature ratings** permitted to be used in LFMC as long as the conductors or cables are **not operated at a higher temperature than the LFMC temperature rating**
- Numerous conductors and multiconductor cables with higher temperature ratings than the LFMC listed temperature rating
- Same change occurred for liquidtight flexible nonmetallic conduit (**LFNC**) at **356.10(8)**

86

370.20 Conductor Size and Termination (Cablebus)

- Two **new informational notes** were added to 370.20 related to conductor sizing and terminations for cablebus
- Two new informational notes point to **110.14(C)** for conductors operating **up to 2000 volts** and **110.40** for medium voltage conductors operating **above 2000 volts to 35,000 volts**
- New I-Notes designed to provide direction regarding termination information for the full range of voltages, which can be encountered with cablebus

87

374.6 Listing Requirements - (Cellular Metal Floor Raceways)

- New provision added to require **cellular metal floor raceways** shall be **listed**
- Cellular metal floor raceways consist of the hollow spaces in cellular metal floors and associated fittings that serve as enclosures for wires and cables
- This requirement follows a pattern in recent *Code* cycles requiring electrical equipment to be listed

88

380.12(7) Uses Not Permitted – Multioutlet Assemblies

- New text added **prohibiting** a **multioutlet assembly** from being **cord and plug connected**
- Multioutlet assemblies intended for **permanent connection only** with a branch circuits *(prohibited from employing a cord and plug connection)*
- A multioutlet assembly is "a type of surface, flush, or freestanding raceway designed to hold conductors and receptacles, assembled in the field or at the factory" *(see Article 100)*

89

382.104(C) Flat Conductor EGC for Nonmetallic Extensions

- Revision replaces "grounding conductor" with appropriate term "**equipment grounding conductor**" for concealable nonmetallic extensions
- For a nonmetallic extension, the "equipment grounding conductor" must consist of two overall sectioned conductors that enclose the grounded conductor and ungrounded conductor(s)
- The "EGC" layers have to be identified by one of four methods

90

392.10 Single Conductor Cables in Cable Trays

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

91

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

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

92

392.44 Expansion Splice Plates for Cable Trays

- New section added for **expansion splice plates** to address thermal expansion and contraction due to temperature variations for cable trays
- Important that cable tray installations incorporate features which provide adequate compensation for their **thermal contraction and expansion**
- The **length of a straight cable tray run** and the temperature differential will play a vital role in determining the number of expansion splice plates required

93

392.46 Bushed Conduit and Tubing at Cable Trays

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

94

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

- New *Code* language added giving permission for individual conductors or multi-conductor cables to enter enclosures through **bushed nonflexible conduits or tubing or opening associated with a flange** that is connecting the cable tray system directly to equipment *(cont.)*
- Limited to "**individual conductors or multiconductor cables with entirely nonmetallic sheaths**" as other wiring methods with metallic sheaths such as Type MC cable requires a listed connector to protect the internal conductors from abrasion where the cable is terminated or transitions to another wiring method

95

Chapter 4 Equipment For General Use

96

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
- 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.)*

97

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**"

98

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

99

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

100

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
- 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"

101

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

102

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

103

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

- Previous Ex. No. 1 to AFCI replacements was **deleted** *(no longer relevant)*
- 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

104

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

105

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 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**

106

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**

107

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

108

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

109

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."

110

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

111

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

112

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
- *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**

113

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

114

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

- 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

115

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

116

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

117

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)*
- 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

118

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

119

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**
- 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

120

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

121

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

122

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)*

123

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

124

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

125

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**

126

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**

127

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

128

422.5(A) GFCI Protection for Appliances *(cont.)*

- **Bottle fill stations** was added to GFCI requirements for drinking water coolers
  - Bottle fill stations are often integral with or installed adjacent to a drinking water cooler and present similar risk of electric shock hazard
- GFCI requirements for **dishwashers** moved from 210.8(D) to 422.5(A)(7)
- This GFCI rule would now encompass **dishwashers** rated at 150 volts or less to ground and 60 amperes or less, single- or 3-phase located at a **non-dwelling unit location**, such as a restaurant, school cafeteria, etc.

129

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)

130

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
- 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)*

131

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*

132

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

133

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**

134

430.2 Electronically Protected Motor

- A new definition for **"Electronically Protected (as applied to motors)"** was added to 430.2
- 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

135

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

136

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

- 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

137

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)*
- 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)**

138

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

139

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

- 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

140

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
- Section was reformatted into a **list format** to help with the clarity

141

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*

142

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

143

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

144

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

145

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
- 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**

146

CALCULATIONS: 2020 NEC AND IRC R314.2.2, AND IRC 315.2.2 SMOKE AND CO DETECTORS.

2024 Connecticut Electrical Training Center

1

LIGHTING LOAD – OFFICE BUILDING

- STEP 1 - Determine the floor area of the building
- 220.11 Floor Area - The floor area for each floor shall be calculated from the outside dimensions of the building, dwelling unit, or other area involved. For dwelling units, the calculated floor area shall not include open porches, garages, or unused or unfinished spaces not adaptable for future use

2

LIGHTING LOAD – OFFICE BUILDING

- STEP 2 - Use 2020 NEC Table 220.12 to calculate lighting loads for office buildings
- Office buildings will be considered continuous loads
- Continuous Load Definition – A load where the maximum current is expected to continue for 3 hours or more

3

LIGHTING LOAD – OFFICE BUILDING

- The 125 percent multiplier for a continuous load as specified in 210.20(A) is included when using the unit loads in Table 220.12 for calculating the minimum lighting load for a specified occupancy

4

LIGHTING LOAD – OFFICE BUILDING

- Calculate the minimum lighting load of an office building with the outside dimensions of 125'x 90'
- STEP 1 – Find the square footage of the building – 125' x 90' = 11,250 sq ft
- STEP 2 – Refer to Table 220.12 and find the unit load for office buildings – 1.3 Volt-amperes/sq ft

5

LIGHTING LOAD – OFFICE BUILDING

- STEP 3 – Calculate the minimum lighting load of the building – 11,250 sq ft x 1.3 VA/sq ft = 14,625 VA
- STEP 4 – Apply the continuous load rule – 14,625 VA x 1.25 = 18,281 VA
- STEP 5 – Calculate the amperage – using 277 Volt lighting – 18,281 VA / 277 Volts = 66 Amps

6

LIGHTING LOAD – WAREHOUSE

- STEP 1 - Determine the floor area of the building
- 220.11 Floor Area - The floor area for each floor shall be calculated from the outside dimensions of the building, dwelling unit, or other area involved. For dwelling units, the calculated floor area shall not include open porches, garages, or unused or unfinished spaces not adaptable for future use.

7

LIGHTING LOAD – WAREHOUSE

- STEP 2 - Use 2020 NEC Table 220.12 to calculate lighting loads for a warehouse
- The minimum lighting load in this warehouse will be considered continuous
- Continuous Load Definition – A load where the maximum current is expected to continue for 3 hours or more

8

LIGHTING LOAD – WAREHOUSE

- The 125 percent multiplier for a continuous load as specified in 210.20(A) is included when using the unit loads in Table 220.12 for calculating the minimum lighting load for a specified occupancy

9

LIGHTING LOAD – WAREHOUSE

- Calculate the minimum lighting load of a warehouse with the outside dimensions of 200'x 150'
- STEP 1 – Find the square footage of the building –200' x 150' = 30,000 sq ft
- STEP 2 – Refer to Table 220.12 and find the unit load for office buildings – 1.2 Volt-amperes/sq ft

10

LIGHTING LOAD – WAREHOUSE

- STEP 3 – Calculate the minimum lighting load of the building – 30,000 sq ft x 1.2 VA/sq ft = 36,000 VA
- STEP 4 – Apply the continuous load rule – 36,000 VA x 1.25 = 45,000 VA
- STEP 5 – Calculate the amperage – using 277 Volt lighting – 45,000 VA / 277 Volts = 162 Amps

11

EQUIPMENT GROUNDING SIZE INCREASE

- 250.122 (B) Increased in Size
- If ungrounded conductors are increased in size for any reason other than as required in 310.15(B) or 310.15(C), wire-type equipment grounding conductors, EGC, if installed, shall be increased in size proportionately to the increase in circular mil area of the ungrounded conductors

12

EQUIPMENT GROUNDING SIZE INCREASE

- A 240-V, single-phase, 250-A load is supplied from a 300-A breaker located in a panelboard 500 ft away. The conductors are 250 kcmil copper, installed in rigid nonmetallic conduit, with a 4 AWG copper EGC
- If the conductors are increased to 350 kcmil, what is the minimum size for the EGC based on the proportional-increase requirement?

13

EQUIPMENT GROUNDING SIZE INCREASE

- STEP 1 - Calculate the size ratio of the new conductors to the existing conductors:

Size ratio = 350,000 circular mils/ 250,000 circular mils = 1.4

- STEP 2– Refer to Chapter 9 Table 8 to find the cross-sectional area of the existing EGC 4 AWG = 41,740 circular mils

14

EQUIPMENT GROUNDING SIZE INCREASE

- STEP 3 – Calculate the cross-sectional area of the new EGC using the size ratio – 41,740 circular mils x 1.4 = 58,436 circular mils
- STEP 4 – Determine the size of the new EGC – refer to Chapter 9 Table 8, we find that 58,436 circular mils is larger than 3 AWG. We must choose the next larger size – 66,360 circular mils which converts to 2 AWG

15

DERATING FOR CONDUCTORS IN LFMC
LIQUIDTIGHT FLEXIBLE METAL CONDUIT

- 350.10 (4) Conductors or cables rated at a temperature higher than the listed temperature rating of LFMC conduit shall be permitted to be installed in LFMC, provided the conductors or cables are not operated at a temperature higher than the listed temperature rating of the LFMC per 110.14(C)

16

DERATING FOR CONDUCTORS IN LFMC LIQUIDTIGHT FLEXIBLE METAL CONDUIT

- A new change in Section 350.10 now allows conductors or cables to be installed in a LFMC raceway even if the conductors have a higher temperature rating than the raceway itself. The catch is the conductors cannot be operated at a temperature higher than the listed temperature rating of the LFMC

17

DERATING FOR CONDUCTORS IN LFMC LIQUIDTIGHT FLEXIBLE METAL CONDUIT

- Calculate the adjusted ampacity of 2 current carrying #8 THHN copper conductors rated at 90˚C that are installed in ¾ inch LFMC that is rated at 60˚C for wet locations
- STEP 1 – Refer to Table 310.16 column for 90˚C – the ampacity of #8 THHN stranded copper conductors is 55 Amps

18

DERATING FOR CONDUCTORS IN LFMC LIQUIDTIGHT FLEXIBLE METAL CONDUIT

- STEP 2 – Since the operating temperature of the conductors cannot exceed the listed temperature rating of the LFMC, the ampacity of the conductors must be derated using Table 310.16 60˚C column – The adjusted ampacity of the #8 THHN stranded copper conductors is 40 Amps

19

ARTICLE 310 2017 TO 2020 COMPARISON CHART

- Article 310 has been reorganized in 2020 NEC to increase usability
- The ampacity tables in Article 310 are simply titled Table 310.16 through Table 310.21
- The scope of Article 310 is limited to not more than 2000 Volts

20

ARTICLE 310 2017 TO 2020 COMPARISON CHART

- The table for Ampacities of Insulated Conductors with Not More Than Three Current-Carrying Conductors in Raceway, Cable, or Earth (Directly Buried) was labeled Table 310.15(B)(16) in the 2017 NEC
- The labeling was changed to Table 310.16 in the 2020 NEC

21

ARTICLE 310 2017 TO 2020 COMPARISON CHART

- The table for Ambient Temperature Correction Factors Based on 30˚C (86˚F) was labeled Table 310.15(B)(2)(a)
- The labeling was changed to Table 310.15(B)(1) in the 2020 NEC

22

ARTICLE 310 2017 TO 2020 COMPARISON CHART

- When a size 3 AWG copper conductor, with THW insulation, is installed in an area where the ambient temperature is 114 deg F, the wire has an allowable ampacity of _____.

23

ARTICLE 310 2017 TO 2020 COMPARISON CHART

- Solve this problem using the 2017 NEC and the 2020 NEC

2017 NEC

- STEP 1 – Find the ampacity of size 3 AWG THW copper conductors in Table 310.15(B)(16) 75˚C column = 100 Amps
- STEP 2 – Find the ambient temperature correction factor 114˚F in Table 310.15(B)(2)(a) = .75

24

ARTICLE 310 2017 TO 2020 COMPARISON CHART

- STEP 3 – Apply the correction factor

100 Amps x .75 = 75 Amps

2020 NEC

- STEP 1 – Find the ampacity of size 3 AWG THW copper conductors in Table 310.16 75˚C column = 100 Amps
- STEP 2 – Find the ambient temperature correction factor 114˚F in Table 310.15(B)(1) = .75

25

ARTICLE 310 2017 TO 2020 COMPARISON CHART CALCULATIONS

- STEP 3 – Apply the correction factor

100 Amps x .75 = 75 Amps

26

ARTICLE 310 2017 TO 2020 COMPARISON CHART

- The table for Adjustment Factors for More Than Three Current-Carrying Conductors was labeled Table 310.15(B)(3)(a)in the 2017 NEC
- The labeling was changed to Table 310.15(C)(1) in the 2020 NEC

27

ARTICLE 310 2017 TO 2020 COMPARISON CHART CALCULATIONS

- Determine the allowable ampacity of six current-carrying 12 AWG THW conductors and a 12 AWG THW Equipment Grounding Conductor in ¾ inch EMT

28

ARTICLE 310 2017 TO 2020 COMPARISON CHART

2017 NEC

- STEP 1 - Refer to Informative Annex C Table C.1 to verify if seven 12 AWG THW conductors would be allowed in ¾ inch EMT = Maximum number of 12 AWG THW conductors is 15
- STEP 2 - Find the ampacity of size 12 AWG THW copper conductors in Table 310.15(B)(16) 75°C column = 25 Amps

29

ARTICLE 310 2017 TO 2020 COMPARISON CHART

- STEP 3 – Find the correction factor for 5 current carrying conductors in Table 310.15(B)(3)(a) = 80%
- STEP 4 – Apply the correction factor

25 Amps x .8 = 20 Amps

30

ARTICLE 310 2017 TO 2020 COMPARISON CHART

2020 NEC

- STEP 1 - Refer to Informative Annex C Table C.1 to verify if seven 12 AWG THW conductors would be allowed in ¾ inch EMT = Maximum number of 12 AWG THW conductors is 15
- STEP 2 - Find the ampacity of size 12 AWG THW copper conductors in Table 310.16 75˚C column = 25 Amps

31

ARTICLE 310 2017 TO 2020 COMPARISON CHART

- STEP 3 – Find the correction factor for 5 current carrying conductors in Table 310.15(C)(1) = 80%
- STEP 4 – Apply the correction factor

25 Amps x .8 = 20 Amps

32

SINGLE PHASE DWELLING SERVICES TABLE 310.12

- The main service or feeder to a dwelling unit is permitted to be sized at 83 percent of the disconnect rating
- The minimum disconnect rating for a dwelling unit is 100 amperes
- This calculation applies only to conductors carrying 100 percent of the dwelling unit's load.

33

SINGLE PHASE DWELLING SERVICES TABLE 310.12

- If a 120/240-volt single-phase service supplies a one-family dwelling or an individual unit of a two-family or multifamily dwelling, the reduced conductor size is applicable to the service-entrance conductors or feeder conductors that supply the dwelling unit

34

SINGLE PHASE DWELLING SERVICES TABLE 310.12

- The following exhibit shows that the reduced conductor size permitted applies only to the service-entrance conductors run to each apartment and the feeder conductors run to apartment 3, because that feeder carries the entire load
- Table 310.12 shall be permitted to be applied if no adjustment or correction factors are required

35

SINGLE PHASE DWELLING SERVICES TABLE 310.12

36

SINGLE PHASE DWELLING SERVICES TABLE 310.12

- Determine the size copper THWN service-entrance conductors required for apartment 1
- STEP 1 – A 100 Amp electrical service will be used to supply the load for apartment 1
- STEP 2 – Apply the 83% rule – 100 Amps x 83% = 83 Amps

37

SINGLE PHASE DWELLING SERVICES TABLE 310.12

- STEP 3 – Refer to Table 310.16 75˚C column and find that 4 AWG THWN copper conductors have an ampacity of 85 Amps
- STEP 4 – Refer to Table 310.12 and find that 4 AWG copper conductors are suitable for a 100 Amp dwelling service

38

DERATING FOR AC CABLE IN THERMAL INSULATION

- Armored cable installed in thermal insulation shall have conductors rated at 90°C (194°F). The ampacity of cable installed in these applications shall not exceed that of a 60°C (140°F) rated conductor

39

DERATING FOR AC CABLE IN THERMAL INSULATION

- The 90°C (194°F) rating shall be permitted to be used for ampacity adjustment and correction calculations; however, the ampacity shall not exceed that of a 60°C (140°F) rated conductor

40

DERATING FOR AC CABLE IN THERMAL INSULATION

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

41

DERATING FOR AC CABLE IN THERMAL INSULATION

- Determine the ampacity of three 10 AWG Type AC cables containing two current-carrying copper conductors each installed in thermal insulation
- STEP 1 – Find the ampacity of size 10 AWG copper conductors in Table 310.16 90˚C column = 40 Amps

42

DERATING FOR AC CABLE IN THERMAL INSULATION

- STEP 3 – Find the correction factor for 6 current carrying conductors in Table 310.15(C)(1) = 80%
- STEP 4 – Apply the correction factor

40 Amps x .8 = 32 Amps

- STEP 5 – Find the maximum allowable ampacity in Table 310.16 60˚C column = 30 Amps

43

RACEWAY FILL INFORMATIVE ANNEX C

- Determine the maximum number of 4/0 THHN conductors in 4" Rigid Metal Conduit (RMC)
- STEP 1 – Find the maximum allowable number of 4/0 THHN conductors in Informative Annex C Table C.9 = 16

44

BOX FILL EQUIPMENT GROUNDING CONDUCTOR 314.16(B)(5)

- Where up to four equipment grounding conductors or equipment bonding jumpers enter a box, a single volume allowance in accordance with Table 314.16(B) shall be made based on the largest equipment grounding conductor or equipment bonding jumper entering the box

45

BOX FILL EQUIPMENT GROUNDING CONDUCTOR 314.16(B)(5)

- A ¼ volume allowance shall be made for each additional equipment grounding conductor or equipment bonding jumper that enters the box, based on the largest equipment grounding conductor or equipment bonding conductor

46

BOX FILL EQUIPMENT GROUNDING CONDUCTOR 314.16(B)(5)

- Using the standard method, determine the adequacy of the device box in which two standard sized 3 in. × 2 in. × 3½ in. device boxes are ganged to form a single box

47

BOX FILL EQUIPMENT GROUNDING CONDUCTOR 314.16(B)(5)

Items Contained Within Box	Volume Allowance	Unit Volume Table 314.16(B) (in^3)	Total Box Fill (in^3)
6 conductors	2 volume allowances for 14 AWG	2.00	4.00
	4 volume allowances for 12 AWG	2.25	9.00
2 clamps	1 volume allowance based on 12 AWG	2.25	2.25
2 devices	2 volume allowances based on 14 AWG	2.00	4.00
	2 volume allowances based on 12 AWG	2.25	4.50
3 EGCs	1 volume allowance based on 12 AWG	2.25	2.25
Total			**26.00**

48

BOX FILL EQUIPMENT GROUNDING CONDUCTOR 314.16(B)(5)

- STEP 1 – Refer to Table 314.16(A) the minimum volume of a single box = 18 in^3. The total box volume for the ganged box = 36 in^3
- STEP 2 – The total box fill, based on Table 314.16(A) and shown on the previous slide = 26 in^3. With only 26 in^3 of the 36 in^3 filled, the box is adequately sized

49

BOX FILL METAL AND NONMETALLIC BARRIERS 314.16 (A)

- Where a box is provided with one or more securely installed barriers, the volume shall be apportioned to each of the resulting spaces. Each barrier, if not marked with its volume, shall be considered to take up 8.2 cm^3 (½ $in.^3$) if metal, and 16.4 cm^3 (1.0 $in.^3$) if nonmetallic.
- Each space within a box installed with a barrier shall be calculated separately

50

BOX FILL METAL AND NONMETALLIC BARRIERS 314.16(A)

- Using the standard method, determine the adequacy of the device box in which two standard sized 3 in. × 2 in. × 3½ in. device boxes are ganged to form a single box
- Add a metal barrier – Now each side must be considered a separate box.

51

BOX FILL METAL AND NONMETALLIC BARRIERS 314.16(A)

Items Contained Within Box	Volume Allowance	Unit Volume T314.16(B)(in³)	Total Box Fill (in³)
LEFT SIDE			
2 conductors	2 volume allowances for 14 AWG	2.00	4.00
1 clamp	1 volume allowance based on 14 AWG	2.00	2.00
1 device	2 volume allowances based on 14 AWG	2.00	4.00
1 EGC	1 volume allowance based on 14 AWG	2.00	2.00
1 metal barrier (unmarked)	1 volume allowance based on metal barrier	0.50	0.50
Total			**12.50**

52

BOX FILL METAL AND NONMETALLIC BARRIERS 314.16(A)

LEFT SIDE

- STEP 1 – Refer to Table 314.16(A) the minimum volume of a single box = 18 in³.
- STEP 2 – The total box fill, based on Table 314.16(A) and shown on the previous slide = 12.5 in³. With only 12.5 in³ of the 18 in³ filled, the box is adequately sized

53

BOX FILL METAL AND NONMETALLIC BARRIERS 314.16(A)

Items Contained Within Box	Volume Allowance	Unit Volume T314.16(B)(in³)	Total Box Fill (in³)
RIGHT SIDE			
4 conductors	4 volume allowances based on 12 AWG	2.25	9.00
1 clamp	1 volume allowance based on 12 AWG	2.25	2.25
1 device	2 volume allowances based on 12 AWG	2.25	4.50
1 EGC	1 volume allowance based on 12 AWG	2.25	2.25
Total			**18.00**

54

BOX FILL METAL AND NONMETALLIC BARRIERS 314.16(A)

RIGHT SIDE

- STEP 1 – Refer to Table 314.16(A) the minimum volume of a single box = 18 in^3.
- STEP 2 – The total box fill, based on Table 314.16(A) and shown on the previous slide = 18 in^3. With 18 in^3 of the 18 in^3 filled, the box is adequately sized

55

BOX FILL METAL AND NONMETALLIC BARRIERS 314.16(A)

- Using the standard method, determine the adequacy of the device box in which two standard sized 3 in. × 2 in. × 3½ in. device boxes are ganged to form a single box
- Replace the metal barrier with a nonmetallic barrier - Now each side must be considered a separate box

56

BOX FILL METAL AND NONMETALLIC BARRIERS 314.16(A)

Items Contained Within Box	Volume Allowance	Unit Volume T314.16(B)(in^3)	Total Box Fill (in^3)
LEFT SIDE			
2 conductors	2 volume allowances for 14 AWG	2.00	4.00
1 clamp	1 volume allowance based on 14 AWG	2.00	2.00
1 device	2 volume allowances based on 14 AWG	2.00	4.00
1 EGC	1 volume allowance based on 14 AWG	2.00	2.00
1 nonmetallic barrier	1 volume allowance based on metal barrier	1.00	1.00
Total			**13.00**

57

BOX FILL METAL AND NONMETALLIC BARRIERS 314.16(A)

LEFT SIDE

- STEP 1 – Refer to Table 314.16(A) the minimum volume of a single box = 18 in^3.
- STEP 2 – The total box fill, based on Table 314.16(A) and shown on the previous slide = 13 in^3. With only 13 in^3 of the 18 in^3 filled, the box is adequately sized

58

BOX FILL METAL AND NONMETALLIC BARRIERS 314.16(A)

Items Contained Within Box	Volume Allowance	Unit Volume T314.16(B)(in^3)	Total Box Fill (in^3)
RIGHT SIDE			
4 conductors	4 volume allowances based on 12 AWG	2.25	9.00
1 clamp	1 volume allowance based on 12 AWG	2.25	2.25
1 device	2 volume allowances based on 12 AWG	2.25	4.50
1 EGC	1 volume allowance based on 12 AWG	2.25	2.25
Total			**18.00**

59

BOX FILL METAL AND NONMETALLIC BARRIERS 314.16(A)

RIGHT SIDE

- STEP 1 – Refer to Table 314.16(A) the minimum volume of a single box = 18 in^3.
- STEP 2 – The total box fill, based on Table 314.16(A) and shown on the previous slide = 18 in^3. With 18 in^3 of the 18 in^3 filled, the box is adequately sized

60

IRC R314.2.2 ALTERATIONS, REPAIRS, AND ADDITIONS

- Where alterations, repairs, or additions requiring a permit occur, the individual dwelling unit shall be equipped with smoke alarms located as required for new dwellings
- Exceptions:

1). Work involving the exterior surfaces

2.) Installation, alteration, or repairs of plumbing or mechanical systems

61

IRC R314.2.2 ALTERATIONS, REPAIRS, AND ADDITIONS

- R314.3 Location
- Smoke alarms shall be installed

1.) In each sleeping room

2.) Outside each separate sleeping room

3.) On each additional story of the dwelling, including basements and habitable attics

62

IRC R314.2.2 ALTERATIONS, REPAIRS, AND ADDITIONS

4.) Not less than 3 feet horizontally from the door or opening of a bathroom that contains a bathtub or shower unless this would prevent placement of a smoke alarm required by this section

63

IRC R314.2.2 ALTERATIONS, REPAIRS, AND ADDITIONS

5.) In the hallway and in the room open to the hallway in dwelling units where the ceiling height of a room open to a hallway serving bedrooms exceeds that of the hallway by 24 inches

64

IRC R314.2.2 ALTERATIONS, REPAIRS, AND ADDITIONS

65

IRC R314.2.2 ALTERATIONS, REPAIRS, AND ADDITIONS

- Determine the smoke alarm locations in the cottage illustrated on the previous slide that underwent a permit required alteration

66

IRC R314.2.2 ALTERATIONS, REPAIRS, AND ADDITIONS

67

IRC R315.2.2 ALTERATIONS, REPAIRS, AND ADDITIONS

- R315.2.1 For new construction, carbon monoxide alarms shall be provided in dwelling units where either or both of the following conditions exist

1.) The dwelling unit contains a fuel-fired appliance

68

IRC R315.2.2 ALTERATIONS, REPAIRS, AND ADDITIONS

2.) The dwelling unit has an attached garage with an opening that communicates with the dwelling unit

69

IRC R315.2.2 ALTERATIONS, REPAIRS, AND ADDITIONS

- Where alterations, repairs, or additions requiring a permit occur, the individual dwelling unit shall be equipped with carbon monoxide alarms located as required for new dwellings
- Exceptions:

1). Work involving the exterior surfaces

2.) Installation, alteration, or repairs of plumbing

70

IRC R315.2.2 ALTERATIONS, REPAIRS, AND ADDITIONS

3.) Installation, alteration, or repairs of mechanical systems that are not fuel-fired

71

IRC R315.2.2 ALTERATIONS, REPAIRS, AND ADDITIONS

- R315.3 Location
- Carbon monoxide alarms in dwelling units shall be installed outside of each sleeping area in the immediate vicinity of the bedrooms. Where a fuel-burning appliance is located within a bedroom or its attached bathroom, a carbon monoxide alarm shall be installed within the bedroom

72

IRC R315.2.2 ALTERATIONS, REPAIRS, AND ADDITIONS

73

IRC R315.2.2 ALTERATIONS, REPAIRS, AND ADDITIONS

- Determine the carbon monoxide alarm locations in the cottage illustrated on the previous slide that underwent a permit required alteration and has a boiler fueled by natural gas

74

IRC R315.2.2 ALTERATIONS, REPAIRS, AND ADDITIONS

75

ARTICLE 90 – INTRODUCTION

(Amd) **90.2 Scope.**

(A) Covered. This code covers the installation of electrical conductors, equipment and raceways; signaling and communications conductors, equipment and raceways; and optical fiber cables and raceways for the following:

(1) Public and private premises, including:
a. *buildings* and structures;
b. utility connections, *additions* and alterations to mobile homes;
c. utility connections to recreational vehicles; and
d. floating *buildings*.

(2) Yards, lots, parking lots, carnivals and industrial substations.

(3) Installations of conductors and equipment that connect to the supply of electricity.

(4) Installations used by the electric utility, such as office *buildings*, warehouses, garages, machine shops and recreational *buildings* that are not an integral part of a generating plant, substation or control center.

(5) Installations supplying shore power to ships and watercraft in marinas and boatyards, including monitoring of leakage current.

(6) Installations used to export electric power from vehicles to premises wiring or for bidirectional current flow.

(B) Not covered. This code does not cover the following:

(1) Installations in ships, watercraft other than floating *buildings*, railway rolling stock, aircraft or automotive vehicles other than mobile homes and recreational vehicles.

(2) Installations underground in mines and self-propelled mobile surface mining machinery and its attendant electrical trailing cable.

(3) Installations of railways for generation, transformation, transmission or distribution of power used exclusively for operation of rolling stock or installations used exclusively for signaling and communications purposes.

(4) Installations of communications equipment under the exclusive control of communications utilities located outdoors or in *building* spaces used exclusively for such installations.

(5) Installations under the exclusive control of an electric utility where such installations:
a. Consist of service drops or service laterals, and associated metering; or
b. Are located in legally established easements, rights-of-way or by other agreements either designated by or recognized by public service commissions, utility commissions or other regulatory agencies having *jurisdiction* for such installations; or

c. Are on property owned or leased by the electric utility for the purpose of communications, metering, generation, control, transformation, transmission or distribution of electric energy; or
d. Are located by other written agreements either designated by or recognized by public service commissions, utility commissions, or other regulatory agencies having ***jurisdiction*** for such installations. These written agreements shall be limited to installations for the purpose of communications, metering, generation, control, transformation, transmission, or distribution of electric energy where legally established easements or rights-of-way cannot be obtained. These installations shall be limited to federal lands, Native American reservations through the U.S. Department of the Interior Bureau of Indian Affairs, military bases, lands controlled by port authorities and state agencies and departments, and lands owned by railroads.

(C) Special permission. The State Building Inspector may grant an exception for the installation of conductors and equipment that are not under the exclusive control of the electric utilities and are used to connect the electric utility supply system to the service-entrance conductors of the premises served, provided such installations are outside a ***building*** or terminate immediately inside a ***building*** wall.

(Amd) **90.4 Enforcement.** Administration of this code shall be in accordance with the provisions of Chapter 1 of the 2021 *International Building Code* portion of the 2022 Connecticut State Building Code. For the purposes of this code, the authority having ***jurisdiction*** for interpreting the rules and for granting the special permission contemplated in a number of rules is the State Building Inspector. Interpretations shall be requested verbally or in writing from the Office of the State Building Inspector. Special permission shall be requested in writing using the Request for Modification of the State Building Code form available from local building departments or from the Office of the State Building Inspector, 450 Columbus Boulevard, Suite 1303, Hartford CT 06103. www.portal.ct.gov/DAS.

Where this Code contains requirements for a new product, construction, or material that has an effective date after the adoption date of the 2022 Connecticut State Building Code, those requirements are not part of this Code.

CHAPTER 1 – GENERAL

ARTICLE 100 – Definitions.

(Amd) **Authority having jurisdiction.** The organization, office or individual responsible for approving equipment, material, an installation, or a procedure. The local ***building official*** has the responsibility for approving ***construction documents***, issuing ***permits***, approving materials and procedures and for making inspections from time to time as the construction process requires. The State Building Inspector has the responsibility for administering the Connecticut State Building Code, interpreting the Connecticut State Building Code and for granting exceptions from specific rules of the Connecticut State Building Code. See the definition of "Special Permission," and Article 90.4.

(Amd) **Special Permission.** For the purposes of this code, the authority having ***jurisdiction*** for granting the special permission contemplated in a number of rules is the State Building Inspector. Special permission shall be requested in writing using the Request for Modification of the State Building Code form available from local building departments or from the Office of the State Building Inspector, 450 Columbus Boulevard, Suite 1303, Hartford CT 06103. www.portal.ct.gov/DAS.

CHAPTER 2 – WIRING AND PROTECTION

(Amd) **210.8 Ground-Fault Circuit-Interrupter Protection for Personnel. (F) as follows:**

(Amd) **(F) Outdoor Outlets.** All outdoor outlets for dwellings, other than those covered in 210.8 (A)(3), Exception to (3), that are supplied by single-phase branch circuits rated 150 volts to ground or less, 50 amperes or less, shall have ground-fault circuit-interrupter protection for personnel.

Exception No. 1: Ground-fault circuit-interrupter protection shall not be required on lighting outlets other than those covered in 210.8(C).

Exception No. 2: Ground-fault circuit-interrupter protection shall not be required for mini-split-type heating/ventilating/air-conditioning (HVAC) equipment and other HVAC units employing power conversion equipment as a means to control compressor speed.

(Amd) **230.46 Spliced and Tapped Conductors.** Service-entrance conductors shall be permitted to be spliced or tapped in accordance with 110.14, 300.5(E), 300.13, and 300.15. Power distribution blocks, pressure connectors, and devices for splices and taps shall be listed.

(Amd) **230.85 Emergency Disconnects.** For new one- and two-family dwelling units, all service conductors shall terminate in disconnecting means having a short-circuit current rating equal to or greater than the available fault current, installed in a readily accessible outdoor location. If more than one disconnect is provided, they shall be grouped. Each disconnect shall be one of the following:

(1) Service disconnects marked as follows:
EMERGENCY DISCONNECT,
SERVICE DISCONNECT

(2) Meter disconnects installed per 230.82(3) and marked as follows:
EMERGENCY DISCONNECT,
METER DISCONNECT,
NOT SERVICE EQUIPMENT

(3) Other listed disconnect switches or circuit breakers on the supply side of each service disconnect that are suitable for use as service equipment and marked as follows:
EMERGENCY DISCONNECT,
NOT SERVICE EQUIPMENT

Markings shall comply with 110.21(B).

(Amd) **250.50 Grounding Electrode System**. All grounding electrodes as described in 250.52(A)(1) through (A)(7) that are available at each building or structure served shall be bonded together to form the grounding electrode system. Where none of these grounding electrodes exist, one or more of the grounding electrodes specified in 250.52(A)(4) through (A)(8) shall be installed and used.
Exception: Concrete-encased electrodes of existing buildings or structures shall not be required to be part of the grounding electrode system where the steel reinforcing bars or rods are not accessible for use without disturbing the concrete.

(Amd) **250.68(C) Grounding Electrode Conductor Connections.** Grounding electrode conductors and bonding jumpers shall be permitted to be connected at the following locations and used to extend the connection to an electrode(s):

(1) Interior metal water piping that is electrically continuous with a metal underground water pipe electrode and is located not more than 1.52 m (5 ft) from the point of entrance to the building shall be permitted to extend the connection to an electrode(s). Interior metal water piping located more than 1.52 m (5 ft) from the point of entrance to the building shall not be used as a conductor to interconnect electrodes of the grounding electrode system.
Exception: In industrial, commercial, and institutional buildings or structures, if conditions of maintenance and supervision ensure that only qualified persons service the installation, interior metal water piping located more than 1.52 m (5 ft) from the point of entrance to the building shall be permitted as a bonding conductor to interconnect electrodes that are part of the grounding electrode system, or as a grounding electrode conductor, if the entire length, other than short sections passing perpendicularly through walls, floors, or ceilings, of the interior metal water pipe that is being used for the conductor is exposed.

(2) The metal structural frame of a building shall be permitted to be used as a conductor to interconnect electrodes that are part of the grounding electrode system, or as a grounding electrode conductor. Hold-down bolts securing the structural steel column that are connected to a concrete-encased electrode complying with 250.52(A)(3) and located in the support footing shall be permitted to connect the metal structural frame of a building or structure to the concrete encased grounding electrode. The hold-down bolts shall be connected to the concrete-encased electrode by welding, exothermic welding, the usual steel tie wires, or other approved means.

(3) A rebar-type concrete-encased electrode installed in accordance with 250.52(A)(3) with an additional rebar section extended from its location within the concrete footing to an accessible location that is not subject to corrosion shall be permitted for connection of grounding electrode conductors and bonding jumpers in accordance with the following:
a. The additional rebar section shall be continuous with the grounding electrode rebar or shall be connected to the grounding electrode rebar and connected together by the usual steel tie wires, exothermic welding, welding, or other effective means.
b. The rebar extension shall not be exposed to contact with the earth without corrosion protection.
c. Rebar shall not be used as a conductor to interconnect the electrodes of grounding electrode systems.

CHAPTER 3 – WIRING METHODS AND MATERIALS

(Add) **300.4.1 Drilling and notching.**

(A) Structural floor, wall, ceiling and roof members.

(1) Solid sawn lumber. Notches in solid lumber joists, rafters and beams shall not exceed one-sixth of the depth of the member, shall not be longer than one-third of the depth of the member and shall not be located in the middle one-third of the span. Notches at the ends of the member shall not exceed one-fourth the depth of the member. The tension side of members 4 inches (102 mm) or greater in nominal thickness shall not be notched except at the ends of the members. The diameter of holes bored or cut into members shall not exceed one-third the depth of the member. Holes shall not be closer than 2 inches (51 mm) to the top or bottom of the member, or to any other hole located in the member. Where the member is also notched, the hole shall not be closer than 2 inches (51 mm) to the notch.
Exception: Notches on cantilevered portions of rafters are permitted provided the dimension of the remaining portion of the rafter is not less than 4-inch (102 mm) nominal and the length of the cantilever does not exceed 24 inches (610 mm).

(2) Engineered wood products. Cuts, notches and holes bored in trusses, structural composite lumber, structural glue-laminated members or I-joists are prohibited except where permitted by the manufacturer's recommendations or where the effects of such alterations are specifically considered in the design of the member by a *registered design professional*.

(3) Studs. Any stud in an *exterior wall* or interior bearing partition may be cut or notched to a depth not exceeding 25 percent of its width. Studs in nonbearing interior partitions may be notched to a depth not to exceed 40 percent of a single stud width. Any stud may be bored or drilled, provided that the diameter of the resulting hole is no greater than 40 percent of the stud width, the edge of the hole is no closer than 5/8 inch to the edge of the stud and the hole is not located in the same section as a cut or notch.

Exception No. 1: A stud may be bored or drilled to a diameter not exceeding 60 per cent of its width, provided that such studs located in exterior walls or interior bearing partitions are doubled and not more than two successive studs are bored.
Exception No. 2: Approved stud shoes may be used when installed in accordance with the manufacturer's recommendations.

(4) Top plates. When wiring, conduit, piping or ductwork is placed in or partly in an *exterior wall* or interior bearing wall, necessitating cutting, drilling or notching of the top plate by more than 50 per cent of its width, a galvanized metal tie of not less than 0.054 inch thick (1.37 mm) (16 ga) and 1 ½ inches (38 mm) wide shall be fastened across and to the plate at each side of the opening with not less than eight 10d (0.148 inch diameter) nails at each side or equivalent. The metal tie must extend a minimum of 6 inches (152 mm) past the opening.
Exception: When the entire side of the wall with the notch or cut is covered by wood structural panel sheathing.

CHAPTER 4 – EQUIPMENT FOR GENERAL USE

(Amd) **440.14 Location –** Add exception No. 3.

(Add) Exception No. 3: Where the interior section of a factory packaged split system is fed solely from the exterior section of the system and the disconnecting means for the exterior section is capable of being locked in the open position, a separate disconnecting means for the interior section shall not be required within sight from that section. The provisions for locking or adding a lock to the disconnecting means shall remain in place with or without the lock installed.

CHAPTER 5 - SPECIAL OCCUPANCIES

(Amd) **517.13 Equipment Grounding Conductor for Receptacles and Fixed Electrical Equipment in Patient Care Spaces**. Wiring in patient care spaces shall comply with 517.13(A) and (B).

Exception No. 1: Luminaires more than 2.3 m (71/ 2 ft) above the floor and switches located outside of the patient care vicinity shall be permitted to be connected to an equipment grounding return path complying with 517.13(A) or (B).

(A) Wiring Methods. All branch circuits serving patient care spaces shall be provided with an effective ground-fault current path by installation in a metal raceway system or a cable having a metallic armor or sheath assembly. The metal raceway system, metallic cable armor, or sheath assembly shall itself qualify as an equipment grounding conductor in accordance with 250.118.

(B) Insulated Equipment Grounding Conductors and Insulated Equipment Bonding Jumpers.

(1) General. The following shall be directly connected to an insulated copper equipment grounding conductor that is clearly identified along its entire length by green insulation and installed with the branch circuit conductors in the wiring methods as provided in 517.13(A):

(1) The grounding terminals of all receptacles other than isolated ground receptacles

(2) Metal outlet boxes, metal device boxes, or metal enclosures

(3) All non–current-carrying conductive surfaces of fixed electrical equipment likely to become energized that are subject to personal contact, operating at over 100 volts

(4) Metal faceplates, by means of a metal mounting screw(s) securing the faceplate to a metal yoke or strap of a receptacle or to a metal outlet box

Exception No. 1: For other than isolated ground receptacles, an insulated equipment bonding jumper that directly connects to the equipment grounding conductor is permitted to connect the box and receptacle(s) to the equipment grounding conductor. Isolated ground receptacles shall be connected in accordance with 517.16.

(2) Sizing. Equipment grounding conductors and equipment bonding jumpers shall be sized in accordance with 250.122.

(Amd) **525.5 Overhead Conductor Clearances.** Add the following exception to (B)(2):

(Add) Exception: Tents erected and dismantled under the supervision of a licensed electrician or other person approved by the authority having jurisdiction may be placed within the 15 feet (4.5 m) space provided the finished height of the tent is a minimum of 10 feet (3.0 m) below the conductors.

CHAPTER 6 – SPECIAL EQUIPMENT

(Del) **680.4 Inspections After Installation.** Delete in its entirety without substitution.

CHAPTER 7 - SPECIAL CONDITIONS

700.3 Tests and Maintenance

(Del) **(F) Temporary Source of Power for Maintenance or Repair of the Alternate Source of Power.** Delete in its entirety without substitution.

(Amd) **700.7 Signs.** Amend (A) as follows:

(Amd) **(A) Emergency sources.** A sign shall be placed at the service-entrance equipment, at the meter location, and on any equipment up to the service entrance-equipment, indicating type and location of on-site emergency power sources.
Exception: A sign shall not be required for individual unit equipment as specified in 700.12(I).

(Amd) **701.7 Signs.** Amend (A) as follows:

(Amd) **(A) Mandated standby.** A sign shall be placed at the service entrance, at the meter location, and on any equipment up to the service entrance-equipment, indicating type and location of on-site legally required standby power sources.
Exception: A sign shall not be required for individual unit equipment as specified in 701.12(J).

(Amd) **702.7 Signs.** Amend (A) as follows:

(Amd) **(A) Standby**. A sign shall be placed at the service-entrance equipment, at the meter location, and on any equipment up to the service-entrance equipment for all installations that indicates the type and location of on-site optional standby power sources. For one- and two-family dwelling units, a sign shall be placed at the disconnecting means required in 230.85 that indicates the location of each permanently installed on-site optional standby power source disconnect or means to shut down the prime mover as required in 445.18(D).

(Amd) **725.121 Power Sources for Class 2 and Class 3 Circuits.** Amend (C) as follows:

(Amd) **725.121 (C) Marking**. The power sources for limited power circuits in 725.121(A)(3), limited power circuits for listed audio/video equipment, listed information technology equipment, listed communications equipment, and listed industrial equipment in 725.121(A)(4) shall have a label indicating the maximum voltage and rated current output per conductor for each connection point on the power source. Where multiple connection points have the same rating, a single label shall be permitted to be used. The labeling requirement shall apply to equipment with a rated current per conductor 0.3 amperes or greater.

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

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 fromtime 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

Pop Quiz

1.) What is the number one OSHA violation for 2022?
   A.) Machine guarding
   B.) Ladders
   C.) Fall protection-general requirements
   D.) Lockout/tagout

2.) What is the continuous load multiplier?
   A.) 75%
   B.) 200%
   C.) 50%
   D.) 125%

3.) Where in the 2020 NEC can ampacities of insulated conductors with not more than three current-carrying conductors in raceway, cable, or earth (directly buried) be found?
   A.) Table 310.16
   B.) Table 220.12
   C.) Table 310.15(B)(1)
   D.) Table 400.4

4.) What is the volume allowance of up to four equipment grounding conductors entering a box?
   A.) 4
   B.) 1
   C.) 3
   D.) 2

5.) Based on Informative Annex C Table C1 how many 12 AWG THHN conductors can be installed in 1 in. EMT?
   A.) 22
   B.) 9
   C.) 16
   D.) 4

Pop Quiz Answers

1.) What is the number one OSHA violation for 2022?
   A.) Machine guarding
   B.) Ladders
   C.) Fall protection-general requirements
   D.) Lockout/tagout

2.) What is the continuous load multiplier?
   A.) 75%
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   C.) Table 310.15(B)(1)
   D.) Table 400.4

4.) What is the volume allowance of up to four equipment grounding conductors entering a box?
   A.) 4
   B.) 1
   C.) 3
   D.) 2

5.) Based on Informative Annex C Table C1 how many 12 AWG THHN conductors can be installed in 1 in. EMT?
   A.) 22
   B.) 9
   C.) 16
   D.) 4